Running Head: ERPs and Hot Cognition

The Automatic Activation of Political Attitudes: A Psychophysiological Examination of the Hot Cognition Hypothesis.

James P. Morris[1]

Nancy K. Squires[1]

Charles S. Taber[2]

Milton Lodge[2]

State University of New York at Stony Brook

Address correspondence to: James P. Morris, Department of Psychology, State University of New York at Stony Brook, Stony Brook, NY 11794-2500 (email: jmorris@ic.sunysb.edu)

[1] Department of Psychology

[2] Department of Political Science

Abstract

The recording of Event-Related Brain Potentials (ERPs) has allowed for a better understanding of human sensory and cognitive processing. This technique may also prove useful in studying implicit social attitudes, and their effects on information processing. In this paper we report the results of an ERP study that looks at "hot cognition" in the context of political terms and concepts. Hot cognition, as applied to the political domain, posits that all socio-political concepts that have been evaluated in the past are affectively charged, and that this affective charge is automatically activated from long-term memory within milliseconds of presentation of the political stimulus. We begin by reviewing the literature on empirical tests of the hot cognition hypothesis, and then report a study using ERP recording during an evaluative priming task. Affectively incongruent prime/target pairs elicited an enhanced negativity with a peak latency around 400 ms, when compared to affectively congruent prime/target pairs. These differences suggest that automatic, implicit evaluations were made to strongly positive and negative political stimuli, and that these evaluations affected the subsequent processing of a high valence adjective. Therefore, it appears that the emotional valence of a political prime is stored along with the concept itself, and that an affective response becomes active upon mere exposure to the political stimulus.

With the advent of the political behavior movement in political science in the 1950s, in particular with publication of The American Voter in 1960, beliefs, feelings, and behavioral dispositions were brought center stage in the prediction and explanation of political behavior. In line with an implicit assumption of human rationality, the social sciences commonly assumed that behavioral goals, intentions, and ultimately action reflected a deliberative process in which the thoughts and feelings that came consciously to mind mediate behavior. In accord with the assumption that conscious considerations mediated the expression of goals, intentions, and action, we commonly ask survey or experimental respondent's to voice their beliefs, report their likes and dislikes, recount feelings and past behaviors, and foretell their intended actions. As a consequence of this reliance on introspection, much of what we as political scientists claim to know about public opinion and electoral behavior and how we model the expression of political beliefs, attitudes, and behavioral dispositions is based almost exclusively on what considerations come to mind consciously when respondents are asked who, what, why questions.

Conventionally, political scientists like their fellow social scientists have viewed the "holy trinity" of cognition, affect, and behavior as conceptually distinct and analytically separable, and treated any disassociation of belief from feeling from behavior as measurement error or irrationality (Eagly & Chaiken, 1993; Kinder, 1998; Taber, forthcoming), but it has proven impossible to reliably tease them apart in practice. Twenty years into the cognitive revolution (Lindsay & Norman, 1977; Lachman, Lachman & Battlefield, 1979; Eysenck & Keane, 1995), we see that thinking of thinking as a deliberative process in which beliefs and attitudes are consciously linked to action is at best only half of the story and may often lead to the misidentification of what is causing what.

Current theorizing in the cognitive sciences backed up by hundreds of well crafted behavioral studies in social and cognitive psychology posits a dual process model that distinguishes between automatic and deliberative processing in the formation and expression of beliefs, attitudes, and behavior (Brewer, 1988). Dual processing models contrast automatic processes, in which thoughts, feelings, and intentions come to mind spontaneously on a time scale of milliseconds, with the deliberative, cognitively demanding processes people engage in when they have the time, cognitive resources, and motivation to construct a response. Dual-process models contrasting conscious and unconscious processes in thinking, reasoning, and action are now preeminent in social psychology (Bargh, 1997; Kunda, 1999).

Moreover, everyday thinking about social and political objects will tend to unitize our beliefs, feelings, and behavioral intentions in long term memory (LTM). When they are "contiguously activated" (Hebb, 1948), as they frequently will be, beliefs, feelings, and intentions become linked in memory, perhaps so strongly that the mere exposure to a "triggering event" will bring them automatically to mind. From this perspective William James (1890) was right in believing that "thinking is for doing" and Antonio Damasio (2002) right in claiming, "the brain is a feeling machine for thinking." In real life, thinking, feeling and acting are only untied in pathological cases (Damasio, 1994). What is critical is that these automatically triggered beliefs, feelings, and behavioral intentions can and routinely do impact the conscious appraisal of judgments, evaluations, intentions and actions (Bargh, 1997; Greenwald et al., 2002).

Labeling one mode of processing "deliberate" emphasizes the reflective, consciously controlled character of one's responses to an object – whether person, place, event, thing, or idea – which generally (but not necessarily) involves verbal reasoning. Other descriptors of the poles on what is surely a continuum (Fiske & Neuberg, 1990) are: controlled vs. automatic (Bargh, 1997; Fazio, 1986); central vs. peripheral (Petty & Cacioppo, 1986); systematic vs. heuristic (Eagly & Chaiken, 1993); conscious vs. unconscious (James, 1890); explicit vs. implicit (Greenwald & Banaji, 1995). Deliberative processes are cognitively effortful, time consuming, demanding of attention, and often premised on a memory search for relevant facts and considerations (Neely, 1976; 1977). Conversely, automatic processes – whether the immediate activation of cognitive associations (e.g., George W. Bush is President), or the spontaneous activation of affect (terrorists are evil), or the habitual actions that operate "mindlessly" (Langer, 1989; Bargh, 1994) - are involuntary, fast, immediate, top of the head, and can be evoked even when the individual's attention is focused elsewhere. Under some situational conditions or environmental triggers automatic responses will directly impact subsequent evaluations, judgments, goals, decisions, and actions with little or no pre or post conscious appraisal. Automaticity has been demonstrated in:

- judgment (Greenwald & Banaji, 1995);
- attitude formation (Betsch et al., 2001);
- the expression of attitudes (Bargh, 1994; Fazio, Sanbonmatsu, Powell, & Kardes, 1986);
- stereotyping (Devine, 1989; Davidio, Evans, and Tyler, 1986);
- self-esteem (Greenwald & Pratkanis, 1984);
- evaluations of political candidates, issues, groups, and symbols (Lodge & Taber, 2000, 2001); and
- many other aspects of social cognition (see Bargh, 1997; Greenwald & Banaji, 1995).

If – as we claim – those beliefs, feelings, intentions, and actions that have been repeatedly linked together in past experience come to mind automatically on mere exposure to a situational cue or on merely ruminating about the object (Martin & Tesser, 1996), then much of our thinking and action is necessarily infused with associated thoughts, feelings, and behavioral dispositions that run independent of conscious guidance. The claim of dual process models is that those beliefs, feelings, and behavioral intentions that were contiguously associated in the past will – like the Three Musketeers – be bundled together spontaneously in LTM and come to mind automatically, only sometimes being available to conscious, thoughtful appraisal. To the extent that some (Fazio, 1992) or all (Bargh, Chaiken, Govender & Pratto, 1992) political thoughts, feelings, intentions, and actions have an automatic component that can influence subsequent evaluations, judgments, and choices, then our discipline's focus on conscious, introspectively-available considerations as mediators of behavior fails to model correctly how most citizens most of the time think, reason and act.

In this paper we report the results of an experimental study testing the hot cognition hypothesis (Abelson, 1963; Lodge & Taber, 2000, 2001; Taber & Lodge, 2001), which claims that political leaders, groups, issues, and ideas thought about and evaluated in the past become affectively charged – positively or negatively – and this

affective tag is stored directly with the concept in long-term memory where it can be automatically evoked on mere exposure to the construct (Bargh, 1994; 1997; Fazio, et al., 1986; Fazio & Williams, 1986; Zajonc, 1980).

THE UNDERLYING MODEL OF HOT COGNITION

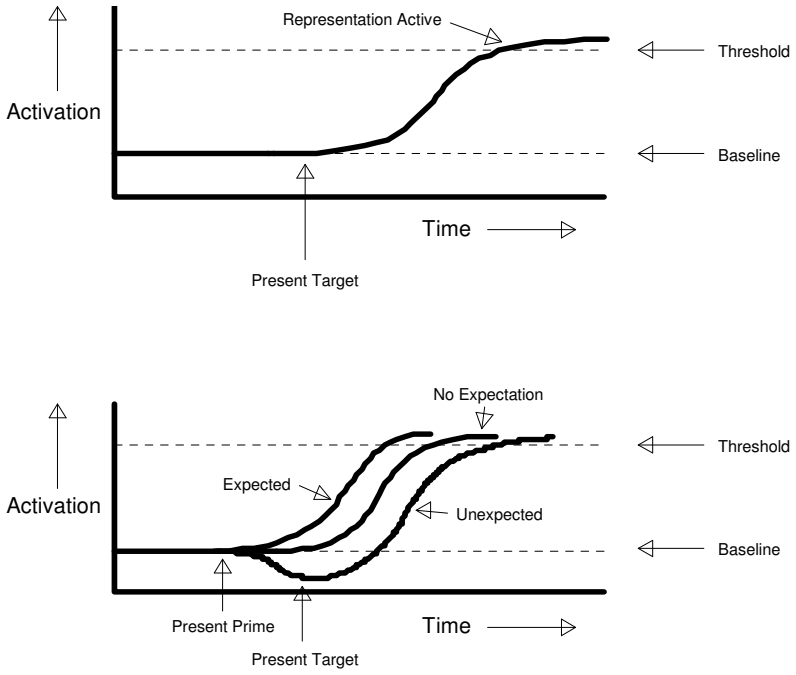
To set the hot cognition hypothesis in perspective, let us briefly review the cognitive architecture underlying these information-processing mechanisms (Lodge & Stroh, 1993; Lodge & Taber, 2000; Taber, forthcoming). A cornerstone of any model of political reasoning is the citizen's preexisting knowledge and predilections. These long-term factors, functionally speaking, require a vast long-term memory (LTM) for storing facts, beliefs, and predispositions, and a mechanism for "moving" one's knowledge about leaders, parties, and issues from LTM into working memory (WM) where it can be attended to (Rumelhart & Norman, 1977; Sanford, 1986). Attention is very limited, perhaps to the magic number 7±2 bits or chunks of information, hence the need for heuristics and other simplifying mechanisms for thinking and reasoning.

LTM is organized associatively, and it is useful to think of knowledge structures metaphorically in LTM as a configuration of nodes linked to one another in a network of associations (or if you prefer as neurons "bundled" together by weighted connections (Read & Miller, 1998; Smith, 1996)). Were we able to tap a citizen's complete political knowledge structure, there might be tens of thousands of nodes (among them one for George W. Bush) with a complex network of associations. (For Bush, these may include his demographics, his stands on issues, perceived traits, and maybe an inferential abstraction or two – e.g., that he is conservative). Many links represent beliefs, or what Judd and Krosnick (1989) call "implicational relations," the strength of which will vary. Moreover, memory objects vary in accessibility – the ease with which a stored concept lying dormant in LTM can be retrieved into WM.

A serious problem with this classic model of cognitive information processing is its inability to account for the role of affect. Taking a lead from Fazio and his colleagues (1986a; 1986b; 1995; see also Fiske, 1981; 1982; Sears, Huddy & Schaffer, 1986), we view all objects in LTM which represent sociopolitical concepts as affect laden, with this affect varying along two dimensions: valence and strength. That is, sociopolitical objects in LTM are directly linked to evaluative tags, or summary judgments of the objects, based on past evaluative processing. Our "hot cognition" hypothesis, following Abelson's (1963) lead, building directly on this architecture and on the theoretical and empirical work described above, asserts that the affect associated with sociopolitical objects in LTM will come automatically to mind (i.e., enter WM) along with the object itself.

But how is information moved from LTM into WM? Spreading activation provides the mechanism. A node in LTM switches from being dormant to a state of readiness with the potential to be moved into WM when it receives activation, either because it is a direct object of thought processes or because it is closely linked to an object of thought. The top panel of Figure 1 (adapted from Barsalou, 1992, p.46) depicts the activation process, with the Y-axis representing the level of activation of a given node in LTM and the X-axis representing time in milliseconds. The rise time from dormant-state to activation threshold is almost instantaneous (100-200 milliseconds). Though Figure 1 does not show this, activation also decays quite rapidly so that a given node will drop back to baseline in about a second if there is no further source of activation.

Figure 1: Activation of a Node in LTM



Imagine a person reading about President Bush in a newspaper headline. Without perceptible effort, the concept BUSH becomes activated and pops into consciousness; even more important for our purposes, activation spreads along the network of links to related concepts, thereby "priming" strong semantic associations of BUSH (he is a REPUBLICAN) as well as beliefs (he opposes TAXES). For a few hundred milliseconds, these associated concepts remain in a heightened state of arousal; any additional activation will likely push them over threshold and into WM.

It may be useful to think of priming through spreading activation as producing preconscious expectations. The bottom panel of Figure 1 shows the activation of associations under different priming conditions. Consider again the activation of the concept BUSH from a newspaper headline. As noted, concepts associated with BUSH in LTM also receive activation, thereby raising them near threshold so that any subsequent processing which passes activation to these energized concepts will likely drive them over threshold. In a sense, primed associations (perhaps Bush's Republican label or his stand on gun control) are "expected" so that it takes substantially less processing to activate them. In short, they have a better chance of getting into WM, of being processed faster, and thereby of "framing" the perception, recognition, and interpretation of subsequent information.

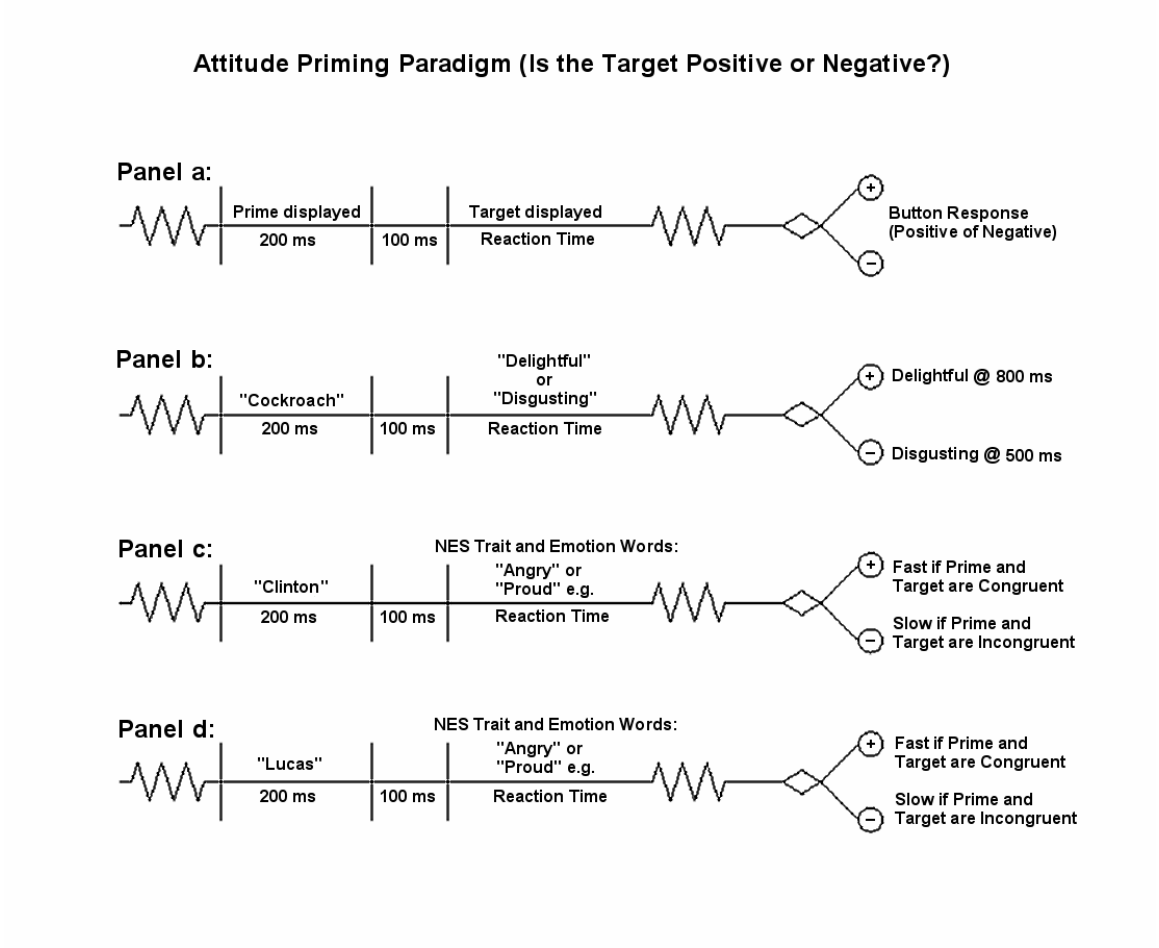
Conversely, spreading activation can inhibit the processing of unexpected categories (the bottom course in Figure 1). When a concept is encountered unexpectedly, more bottom-up processing is necessary before it may pass threshold and enter WM. If the word "walnut" was processed initially, this would inhibit the recognition of semantically unrelated concepts (such as REPUBLICAN), which would take more time and effort to process.

Finally, the middle course in Figure 1 is a control or "baseline" condition in which no "expectations" are created by a prime. The non-word BBB, for example, which conveys no semantic expectations, would neither facilitate nor inhibit the recognition and categorization of subsequent concepts.

To turn the notion of hot cognition from postulate to hypothesis, we adapted the experimental paradigm developed by Fazio and his colleagues (1986) for empirically testing the premise that affect is directly tagged to its conceptual node and "travels" with it into WM automatically on mere exposure of the concept. Fazio's attitude priming paradigm is a spin off of the classic lexical decision paradigm where, for example, an experimental subject (S) sees a "prime" word ("BIRD") flashed on a computer screen for 200 milliseconds, followed 100 milliseconds later – when the prime word's activation is at its peak – by a second word, a "target" stimulus (say "robin" or "rose" or "binor") which remains onscreen until the S makes a response, typically by pressing one button "as fast as possible without making too many errors" if the target is a legal English word, another button if it is not. Note that the subject is not asked directly whether the target is associated with the prime. (Indeed, though this is not a subliminal task, the prime is onscreen so briefly that the S may be only dimly aware of it.) Rather, an inference about whether the target and prime are linked in the person's LTM is made on the basis of their reaction times in performing the unrelated (word/not-a-word) task. These and similar cognitive priming paradigms produce robust effects (Collins & Quillian, 1972; Collins & Loftus, 1975). What is more, these cognitive associations are automatic – they are generated spontaneously and cannot be easily suppressed (Neely, 1976; 1977).

But what about affect? Is one's affect also primed when the concept it is attached to is primed? To test the hot cognition hypothesis we adapted the attitude-priming paradigm developed by Fazio (1986) and Bargh (1997) to the political domain. Here in Figure 2 – as in the cognitive priming paradigm – we expose Ss to a prime and then present a target word, but in this variant of the paradigm the Ss' task is to press a button labeled "plus" or "minus" to indicate "as fast as possible without making too many errors" whether the target word has a positive or negative connotation. On each trial the name of an attitude object (e.g., COCKROACH) is presented for 200 ms on a computer screen, followed by a 100 ms blank-screen interval (the elapsed time from the onset of the prime to the onset of the target, in this case 300 ms – when the priming effect is at it's peak – is called the stimulus onset asynchrony or SOA and is often varied as an experimental manipulation to distinguish automatic from conscious processing. Then a target word – chosen for its unambiguous positive or negative connotation – is presented. The subject's task is to indicate by a button press whether the target word is "good" or "bad" in meaning. The latency time from onset of target word to the S's response is recorded.

Figure 2 – Attitude Priming Paradigm



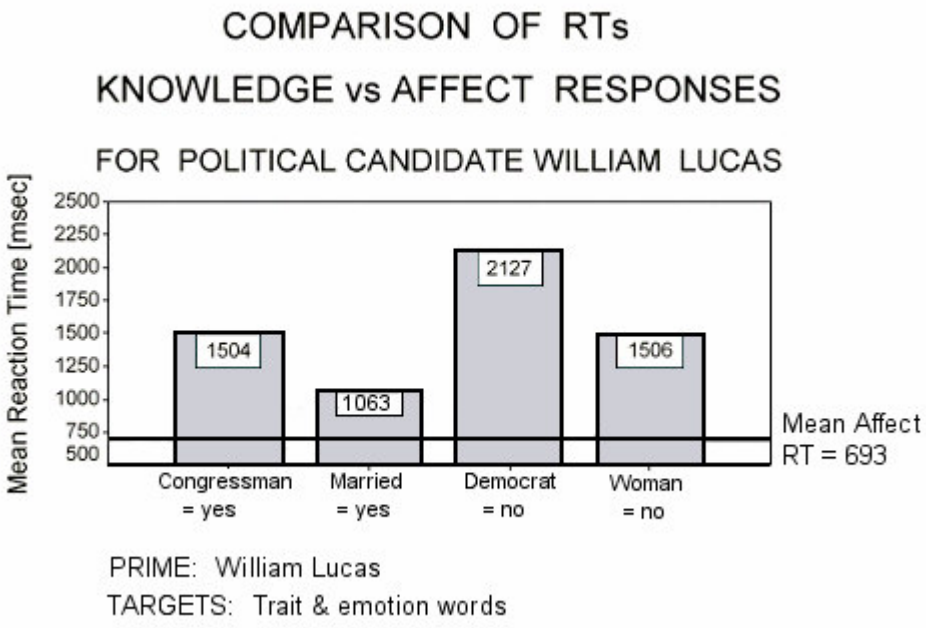
> "The logic of the design was that to the extent that presentation of the attitude object name activated the evaluation associated with the attitude object, this evaluation (good or bad) would then influence how quickly subjects could correctly classify the target adjective as positive or negative in meaning. If the adjective was of the same valence as the attitude object prime, responses should have been faster (i.e., facilitated) relative to a baseline response…. Conversely, if the adjective and prime were of opposite valence, responses should be slower. The time from the onset of the prime word to the onset of the target word (300 ms) is a critical feature of this priming paradigm as it is too brief an interval for Ss to develop an active expectancy or response strategy regarding the target adjective that follows; such conscious and flexible expectancies require at least 500 ms to develop, and to influence responses in priming tasks (Neely, 1977; Posner & Snyder, 1975). Given an SOA (interval from prime to target) of 300 ms, then, if presentation of an attitude object prime influences response time to a target adjective, it can only be attributed to an automatic, unintended activation of the corresponding attitude." (Bargh, Chaiken, Govender, and Pratto, 1992, p. 894).

By way of example, if COCKROACH was the prime and the target word was "disgusting" we would expect facilitation – a fast RT (predictably, on the order of 500 – 600 milliseconds) to say "Disgusting" is a negative word – a relatively fast response time

because the prime and target are affectively congruent. Conversely, if the target word was "delightful," we would expect inhibition – a slower latency time to respond (on average around 800 ms) to say "delightful" is a positive word – because the association is affectively incongruent. Note again that this is a non-reactive measure: the S's task is to not to say whether the target word describes the prime word but rather to simply indicate whether the target word is positive or negative, not whether the word is or is not semantically associated. This is a strong test for discerning whether affect is automatically activated along with the concept itself.

In series of experiments Lodge & Taber (2000) had Ss read a campaign brochure of a hypothetical Congressman William Lucas. In addition to the Congressman's picture was information detailing his background and experience as well as his strong position on the death penalty (pro for half the Ss, con for the others). After reading the brochure, Ss were engaged in a classical sentence verification task in which they indicated by a True/False button response whether LUCAS was, for example, a Republican [Yes], a woman [No], pro [Yes]or anti [No] death penalty. The Ss were also engaged in the attitude-priming task where LUCAS preceded such target adjectives as "delightful," "disgusting," "angry" and "sad". In the Figure 3 we report the reaction times for the cognitive True/False responses to the single-word targets "Congressman," "Democrat," "Married," and "Woman," as well as the mean reaction time to the single-word affective targets in the attitude-priming task. On average it took Ss less than 700ms to make an affective response, about twice as fast as the time to verify a cognitive association. The authors interpret this finding as supporting the "hot cognition" hypothesis and, what is more, it perhaps reflects what Zajonc's calls "the primacy of affect" (Murphy & Zajonc, 1993) – affect comes to mind faster than the cognitive associations thought to cause the affective response.

Figure 3 – Response Times for Knowledge and Affective Responses



THE ERP PARADIGM

While these and other behavioral measures (for instance, the IAT developed by Greenwald and Banaji, 1995) have proven valuable in validating the hot cognition hypothesis, in this paper we turn to a more direct, neurological test of the hot cognition hypothesis. Event Related Potentials (ERPs) are patterned voltage changes in the ongoing electroencephalogram that are time-locked to specific processing events. By averaging the brain's electrical response to a particular class of events, conclusions can be drawn about the populations and timing of neurons being recruited for sensory and cognitive processes associated with these events.

Prior research employing cognitive ERP analyses have led many investigators to understand the promise these paradigms hold for studying implicit evaluative processes. Early ERP research in the cognitive domain focused on the technique's ability to reflect the temporal sequence of information-processing operations. One of the first successful applications of ERP research was the development of the "odd ball" paradigm, which produces a particular component, called the "P300," that is thought to reflect memory-updating processes (Donchin, 1981). In a simple oddball experiment, there are two distinct types of stimuli, for example, two distinct auditory tones, one with a high probability of occurrence (the "frequent stimulus"), the second type a very low probability of occurrence (the "rare" stimulus). On averaging the ERPs to rare events, the result is an enhanced positive component occurring between 200-500 ms after stimulus presentation, and most pronounced over the centroparietal region of the scalp.

The amplitude of the P300 component elicited by rare events has been demonstrated to vary as a function of probability and event saliency. Thus, the amplitude of the P300 component is enhanced for rare stimuli that are remarkably different from the frequent stimuli, and also for rare stimuli that have a very low frequency of occurrence (Squires, Squires, and Hillyard, 1975). Furthermore, the elicitation of a P300 component does not require an explicit categorization process, as P300 components may be elicited even when subjects are unwilling to explicitly report information (Farwell and Donchin, 1991). One theory argues that the enhanced P300 for rare events represents a biological marker of context-updating. Therefore, the processing of categorically inconsistent stimuli is thought to exert greater processing demands in order to allow for an updating of the current representation of the environment (Donchin and Coles, 1988).

Cacioppo, Crites, Bernstson, and Coles (1993) demonstrated the utility of the classic P300 component for attitude research, by using the component as an index of attitude registration. Cacioppo et al. (1993) speculated that since implicit attitudes are suspected to play a major role in information processing, it might therefore be possible to use the P300 component to elucidate the role that implicit attitudes play in the processing of information. Cacioppo and his colleagues employed a modified oddball paradigm in which positive and negative words were presented sequentially in a series of six. In addition, the experiment was balanced, so that half of the series contained positive words as the frequent event with negative words being rare, and the other half of the sequences used negative rare events as the frequent event and positive words as the rare. This is a "modified oddball paradigm" in that the traditional oddball paradigm does not break up the presentations into short sequences of events.

Another modification to the oddball paradigm that was introduced by Cacioppo et al. (1993) was the position of the rare event. In each series of six stimuli, a rare stimulus never occurred within the first three stimuli. This was to encourage subjects to first

generate a positive or negative context and thereby ensure that rare events were perceived as categorically different from the frequent events. The subjects in this experiment were asked to count how many positive or negative events occurred in each sequence and to report the count at the end of the sequence. The results indicate that the rare events did elicit an enhanced positivity, between 500 and 700 ms after event presentation. Therefore, the results of this initial study, with the modified oddball approach, are consistent with a wealth of research investigating the utility of the P300 component as a tool for understanding information processing procedures.

Cacioppo, Crites, Gardner, and Bernston (1994) followed the initial development of the evaluative oddball paradigm with a study that showed the P300 component to vary as a function of trait extremity. Specifically, highly and moderately evaluatively inconsistent traits evoked a larger P300-like component, as compared to mildly inconsistent or evaluatively consistent traits. This finding suggests that the P300 amplitude in this paradigm is an index of the evaluative consistency of each trait with the valence of the context in which it is presented.

Furthermore, Crites, Cacioppo, Gardner, and Berntson (1995) provided evidence that the evoked P300-like component varies as a function of attitude registration as opposed to attitude report. In this study, participants were asked in various conditions to misreport their attitudes toward target incongruent adjectives. Even when participants misreported the information, Crites et al. (1995) found enhanced P300-like components to evaluatively incongruent trait words. The results suggest that the enhanced amplitude of the component elicited by evaluatively incongruent trait adjectives reflects a categorization process, independent of the subsequent response.

Another widely studied ERP component that might have potential application to the study of implicit social attitudes is the N400 component. The N400 component was first described by Kutas and Hillyard (1980), after observing a negative deflection that peaks around 400 ms to words that are semantically incongruent with the context of a sentence (e.g., "I like my coffee with cream and *dog*"*)*. The N400 is believed to reflect the relative ease with which word meaning can be placed within the context of a sentence. Therefore, while every word in a sentence (presumably) elicits an N400 component, words that are semantically incongruent with the sentence context elicit a much larger N400 component.

The N400 component has also received some treatment in semantic priming research. The seminal works with the semantic priming paradigm focused on latency differences in lexical decision tasks. Neely (1977), you will recall, used a priming procedure in which word/non-word judgments were to be made to the target word preceded by a prime. The results indicated that concepts associated with the prime are automatically activated from memory upon presentation, and subsequently may facilitate the responses to semantically related words. For example, using a category label "bird" as a prime facilitates the response to "robin" as a word. The results from Neely's experiment and many others seemed to fit the model of spreading activation processes in semantic processing.

The semantic priming paradigm has also been used occasionally in ERP research. Bentin, McCarthy, and Wood (1985) observed a pronounced N400 component to target words that were either semantically unrelated or only moderately related to the prime. Furthermore, the unrelated words elicited a more pronounced N400 component that those

that were moderately related. Some debate still remains about the processes that this enhanced N400 component reflects. One prevailing theory is that in the semantic priming paradigm the N400 occurs when semantic facilitation is not possible, rather than as a result of semantic inhibition (Holcomb, 1988). Whatever the underlying mechanism, the N400 component has been demonstrated to be a reliable component, elicited by targets that were unrelated to their primes. Thus the ERP results with semantic priming support the behavioral results with the classic cognitive priming paradigm, and they open the way to address questions such as whether facilitation occurs when the connotation of the primed attitude object matches the connotation of the target, or inhibition when the connotations of the prime and target are not congruent.

Central to our efforts here, the behavioral attitude priming paradigm has shown a reliable significant interaction between the valence of the prime and the valence of the target (Bargh, Chaiken, Govender, and Pratto, 1992; Fazio, et al, 1987; Greenwald, Klinger, and Liu, 1989; Hermans, de Houwer and Eelen, 1994; Giner-Sorolla, Garcia, and Bargh, 1999). Since the behavioral effects observed in the affective priming paradigm are similar to those found in the original semantic priming paradigms, we reason that the affective priming paradigm should elicit a N400 component when the target valence differs from the prime valence. If an N400 component is elicited by a target stimulus that is affectively incongruent with that of the prime, we hypothesize that the passive reception of the prime is sufficient to activate a learned positive or negative judgment, which subsequently will effect the processing of the target stimulus. If so, the enhanced N400 component would provide physiological evidence that (a) an implicit attitude is activated by mere presentation of an attitude object, even when the task does not demand such an evaluation, and (b) this evoked attitude will affect the subsequent evaluative processing of the target stimulus.

The purpose of the current project was to test the notion that attitudes towards political leaders, groups, issues, and ideas are automatically activated by the presentation of a political stimulus. To test this notion, event-related brain potentials were recorded while participants were engaged in a political attitude-priming paradigm. In this study, participants first took part in a reaction-time pretest to determine their attitude toward political leaders, groups and issues. The fastest latencies were used to select the strongest positive and negative responses served as primes in the subsequent priming procedure. The target words for the priming procedure were high valence positive and negative personality characteristics that were chosen based on normative data (Anderson, 1955). Our major hypothesis in this particular experiment is that incongruent prime/target pairs will elicit a larger N400 component than congruent prime and target pairs. If, in fact, the N400 component is enhanced for incongruent prime/target pairs, it can be assumed that evaluations regarding the political primes were activated automatically, even though the experimental task did not call on Ss to make an evaluation of the prime or the target concepts. Such a finding would offer physiological evidence for the hot cognition hypothesis.

METHODS

Participants

Fourteen (8 female) graduate students from the State University of New York at Stony Brook volunteered for participation in the experiment. Three participants were excluded from the final analysis, due to excessive eye-blinks during the ERP recordings.

Stimuli and Procedure

Two days before the experimental session, participants took part in a computerized prime-selection phase. In this pretest, participants viewed 37 political attitude objects (see appendix), and indicated as fast as possible whether they felt positively or negatively about the political stimulus. The participants indicated their attitudes by pressing one of two keys on a standard keyboard, one labeled "positive" and the other labeled "negative." The order in which the words appeared on the screen was randomized. The latency of response was recorded by a commercially available stimulus presentation program. Each participant took the pretest twice, with the stimuli in different orders. When participants responded differently to a particular political attitude object in the two runs, that object was discarded. Finally, the response latencies from the two runs were added together for each of the remaining political attitude objects, forming a composite latency score for each object. Similar to Fazio et al. (1986), the five strongest positive and five strongest negative political attitude objects were selected based on the lowest latency of response composite scores, and subsequently served as the primes in the experimental task.

For the experimental phase of the experiment, a list was constructed of 15 adjectives that were clearly positive (e.g., "honest," "attractive") and 15 adjectives that were clearly negative (e.g., "cruel," "vulgar"). These served as the targets in the priming task. Participants were instructed that the experimental task would involve having them make a valence (positive or negative) judgment for each target word. Furthermore, they were told that immediately prior to each of the target words, there would be a "memory" word presented quickly on the screen. These memory words were the five positive and five negative political attitude objects that had been selected based on the results of each participant's pretest. To ensure that participants attended to the prime words, they were told they would be tested on the memory words after the experimental session. The design was balanced so that each prime appeared six times (paired with a negative target three times, and a positive target three times), and each target appeared twice, once preceded by a positive prime and once preceded by a negative prime. The primes were randomized before creating the unique sequence file for each participant, so that the strongest primes wouldn't always occur with the same target adjectives.

On any given trial, the prime was presented for 150 ms, followed by a 100 ms interval before the onset of the target. Therefore, the stimulus onset asynchrony (SOA) was 250 ms. The target word remained on the screen for 1000 ms, and was followed by an upper-case "R," which signaled the participant to make a valence judgment for the target word. The one-second delay before responding was included to minimize muscle artifact and motor potentials in the ERP.

EEG and EOG recording

The EEG was recorded from three midline scalp locations: F_Z, C_Z, and P_Z (according to the International 10-20 system). The EEG from all active electrodes was referenced to the right mastoid. The ground electrode was placed on the left mastoid. The vertical electro-oculogram (EOG) was recorded from an electrode above the right

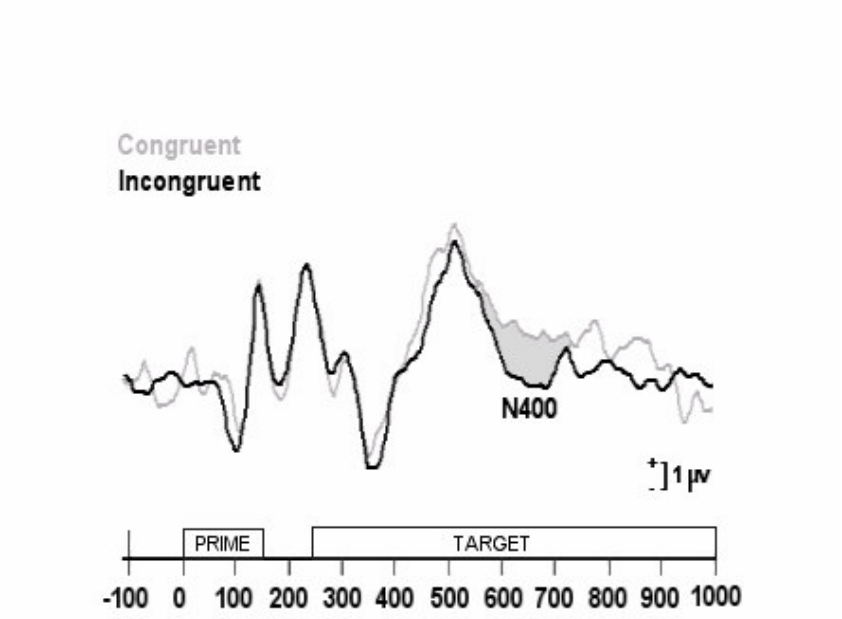
eye. All impedances were held under 10 ohms. The EEG was recorded with a bandpass of .1 to 30 Hz and a gain of 1000.

The evoked potentials were analyzed off line, with a time base from 100 ms before the presentation of the prime until 800 ms after the target, for a total epoch of 1100 ms. Epochs with ocular artifact were excluded from further analyses. Separate averages were then constructed for congruent prime/target pairs and incongruent prime/target pairs.

RESULTS

Figure 4 compares the ERPs to congruent and incongruent prime/target pairs. (These ERPs are the grand averages of the ERPs of all individual subjects.) Until about 200 ms after the onset of the target stimulus, the ERPs are highly similar. At 200 ms the ERPs diverge. The ERP to the targets that are affectively incongruent with their primes show a negative component not seen in the ERP to the congruent targets. This is labeled "N400" in the figure, consistent with the label applied to a similar component in semantic-incongruity paradigms. (Note that the actual latency of the component varies, depending on the specific circumstances.)

Figure 4 – ERPs to congruent and incongruent prime/target pairs



Prior research indicates that the N400 component shows the greatest amplitude at centroparietal electrodes, and has a peak latency of approximately 400 ms after onset of an incongruous word. Since the *a priori* hypotheses was that targets that are incongruent with the prime will evoke an N400, the amplitude of the largest negative potential at P_Z between 570 and 710 ms following the onset of the prime served as the dependent

measure in the analysis. Amplitudes for the ERPs at all electrodes were measured at the same latency. A 4 (electrode) X 2 (condition) within subjects analysis of variance was employed, with the amplitude of the N400 component serving as the dependent measure in the analysis. Greenhouse-Geisser epsilons were used to adjustment the degrees of freedom, due to the possibility of violating the sphericity assumption. There was a significant main effect for condition, $F(1,10) = 8.55$, $P<.05$. This main effect revealed a larger negative amplitude for incongruent prime/target pairs (M= -2.36 μV) than for congruent prime/target pairs (M= -.633 μV). There was also a main effect for electrode site, $F(3,13) = 6.66$ $p<.05$. The amplitude of N400 was significantly larger at electrode sites C_Z (M = -3.47μV) and P_Z (M= -3.22 μV) than it was at F_Z (M= -1.037 μV) and the eye channel (M=1.74 μV). Finally, there was a significant interaction between electrode and condition, $F(3,12) = 8.56$, $P<.01$. The amplitude differences between conditions were greatest for the ERPs from C_Z and P_Z, consistent with prior N400 research.

DISCUSSION

There is a large literature on semantic priming showing that behavioral responses to a target word are faster when that word is primed by related, congruent concepts. Recently the priming paradigm has been extended to the study of the affective impact of words. These studies (e.g., Fazio et al., 1986; Bargh, 1997) suggest that words automatically activate affective associations as well as semantic associations. Lodge & Taber (2002) extended the affective and semantic priming research into the political domain. In this paper, we demonstrate the utility of the ERP technique in exploring the neural bases of automatic activation. The results strongly support the concept of "hot cognition" and open the way for more detailed studies of the semantic and affective characteristics of political concepts.

Incongruent prime/target pairings were shown to elicit a negative ERP component peaking around 400 ms after the onset of the target stimulus (see Figure 4). This component closely resembles the N400 component that has been extensively studied in the semantic domain, where it is thought to reflect the brain's reaction to semantic incongruity (Kutas & Hillyard, 1980). The first important implication of the current results is that affective, as well as semantic incongruity can produce an N400. It remains to be seen whether the semantic and affective N400's are identical in their neural substrates and functional properties.

The current study didn't show any evidence for differences in the P300 component of the waveform for congruent or incongruent prime/target pairs. The lack of a difference in P300 amplitude between experimental conditions can be attributed to the methodological design of the current experiment. As previously mentioned, the amplitude of the P300 component has been demonstrated to vary as a function of event probability and event saliency (Squires, et al., 1975). The current experiment did not include a probability manipulation, as there were equal numbers of congruent and incongruent pairs, and equal numbers of positive and negative targets. Furthermore, since each target was a high valence word, it would not be expected that any one particular target would be more salient than the others. Cacioppo, et al. (1993) found significant differences in P300 amplitude for target words that were incongruent in valence to those words in the rest of the series. In this case, the valence of the target word was a rare event, and perhaps very salient because of its differences with regard to

the rest of the stimulus set. Therefore, the differences in P300 amplitude in the Cacioppo et al. (1993) study are not surprising, given the necessary conditions for finding amplitude differences between different types of stimuli. The current study did not contain probability or saliency manipulations, and therefore it is not surprising that P300 amplitude differences were not observed.

Thus, the N400 emerges as an important tool for measuring implicit evaluative processing. ERP recordings provide several major advantages for the study of cognition and affect. First, the ERP directly reflects the activation of populations of neurons involved in the processing of information. Thus, it is possible to ask whether automatic affective and semantic activations involve the same brain areas. Second, the ERP consists of a temporal series of components whose timing reflects the timing of the underlying processes. ERPs should prove useful in testing Zajonc's hypothesis on the primacy of affect – determining whether semantic or affective activation occurs first. The technique also can be used to address questions about how semantic and affective processing interact with each other. Third, ERP recordings allow for an unobtrusive, non-invasive glimpse into ongoing information processing. For example, if an affect-laden political term were embedded into a sentence that the subject is asked to read and comprehend in normal fashion, and we require a behavioral response to that term (e.g., a button press) to assess the affective response, this would disrupt the normal processing of the sentence. With ERP recordings, by contrast, we can index the subject's evaluative reaction to the term without requiring a behavioral response and without the subject's awareness.

On a less methodological level, the results support the concept of "hot cognition." It has been speculated that affective evaluations are stored in memory for all political concepts that have been repeatedly evaluated in the past and that these affective responses are automatically elicited when the concept is activated in memory. Here we demonstrated that automatic, implicit evaluations were made to strongly positive and negative political stimuli, and that these evaluations affected the brain's response to the high valence adjective that followed. This suggests that the emotional evaluation is stored with the concept – i.e., that political terms are indeed "hot."

It is, perhaps, less surprising that political terms are hot than that they can affect the processing of subsequent semantically unrelated political and non-political words. Whereas semantic activation is thought to spread in a network of semantically associatived concepts, we find – as others have recently found (see the March, 2001 issue of Cognition and Emotion) - an automatic affective incongruence effect for semantically unrelated concepts. For every positively or negatively valenced word in one's vocabulary, the set of similarly valenced words must be enormous. While the neural mechanisms by which the processing of all of these words could be automatically facilitated are completely unknown, the social-psychological-neurological implications are great in implying the interdependence of thought and feeling, or, this too an implication of this study, the primacy of affect.

References

Anderson, N.H. (1968). Likableness ratings of 555 personality trait words. Journal of Personality and Social Psychology, 9 (3), 272-279.

Bargh, J.A., Chaiken, S., Govender, R., & Pratto, F. (1992). The generality of the automatic attitude activation effect. Journal of Personality and Social Psychology, 62 (6), 893-912.

Bentin S., McCarthy G., & Wood, C.C. (1984). Event-related potentials, lexical decision and semantic priming. Electroencephalography and Clinical Neurophysiology, 60 (4), 343-355.

Betsch, T., Plessner, H., Schwieren, C., & Gutig, R. (2001). I like it bit I don't know why: A value-account approach to implicit attitude formation. Personality and Social Psychology Bulletin, 27 (2). 242-253.

Boynton, G.R. (1995). Computational Modeling: A Computational Model of a Survey Respondent. In Milton Lodge & Kathleen McGraw (ED.) Political Judgment: Structure and Process. Ann Arbor, Michigan.

Brewer, Marilynn (1988). A Dual Process Model of Impression Formation. In Thomas Srull and Robert Wyer {Eds.). *Advances in Social Cognition*, Vol. 1. Hillsdale, NJ, Erlbaum & Associates.

Cacioppo, J.T., Crites, S.L., Berntson, G.G., & Coles, M.G.H. (1993). If attitudes affect how stimuli are processed should they not affect the event-related brain potential? Psychological Science, 4 (2), 108-112.

Cacioppo, J.T., Crites, S.L., Gardner, W.L., & Berntson, G.G. (1994). Bioelectrical echoes from evaluative categorizations: I. A late positive brain potential that varies as a function of trait negativity and extremity. Journal of Personality and Social Psychology, 67 (1), 115-125.

Crites, S.L., Cacioppo, J.T., Gardner, W.L., & Bernston, G.G. (1995). Bioelectrical echoes from evaluative categorization: II. A late positive brain potential that varies as a function of attitude registration rather than attitude report. Journal of Personality and Social Psychology, 68 (6), 997-1013.

Collins, A.M. & Loftus, E.F. (1975). A spreading activation theory of semantic processing. Psychological Review, 82 (6), 407-428.

Damasio, Antonio (2002). Public Television Documentary On the Brain.

Donchin, E. (1981). Surprise!…Surprise? Psychophysiology, 18, 493-513.

Donchin, E., & Coles, M.G.H. (1988). Is the P300 component a manifestation of context updating? Behavioral and Brain Sciences, 11, 354-356.

Dovidio, J.F., Evans, N., & Tyler (1986). Racial stereotypes: The contents of their cognitive representations. Journal of Experimental Social Psychology, 22, 22-37

Eagly, Alice and Shelly Chaiken. (1993). The Psychology of Attitudes. Fort Worth, TX: Harcourt Brace Jovanovich.

Eysenck, Michael and Mark Keane (1995). Cognitive Psychology: A Student's Handbook. Psychology Press.

Farwell, L. A., & Donchin, E. (1991). The truth will out: Interrogative polygraphy ("lie detection") with event-related brain potentials. Psychophysiology, 28(5), 531-547.

Fazio, Russell and Williams, C. (1986). Attitude Accessibility as a Moderator of the Attitude-Perception andAttitude-behavior relations: an Investigation of the 1984 Presidential Election. Journal of Personality and Social Psychology 51: 505-514.

Fazio, R.H., Sanbonmatsu, D.M., Powell, M.C., & Kardes, F.R. (1986). On the automatic activation of attitudes. Journal of Personality and Social Psychology, 50 (2), 229-238.

Fiske, Susan, and S.L. Neuberg (1990). A Continuum of Impression Formation, From Category-based to Individuating Processes: Influences of Information and Motivation on Attention and Interpretation. *Advances in Experimental Social Psychology*. San Diego, CA: Academic Press, Vol. 23: 1-74.

Giner-Sorolla, R., Garcia, M.T., & Bargh, J.A. (1999). The automatic evaluation of pictures. Social Cognition, 17, 76-96.

Greenwald, A.G., & Banaji, M.R., (1995). Implicit social cognition: Attitudes, self-esteem, and stereotypes. Psychological Review, 102 (1), 4-27.

Greenwald, A.G., Klingler, M.R., & Liu, T.J. (1989). Unconscious processing of dichoptically masked words. Memory & Cognition, 17, 35-47.

Greenwald, A. G., & Pratkanis, A. R. (1984). The self. In R. S. Wyer & T. K. Srull (Eds.), Handbook of social cognition (pp. 129-178). Hillsdale, NJ: Erlbaum.

Greenwald, A. G., Banaji, M. R., Rudman, L. A., Farnham, S. D., Nosek, B. A., & Mellott, D. S. (2002). A unified theory of implicit attitudes, stereotypes, self-esteem, and self-concept. Psychological Review, 109 (1), 3-25.

Hebb, D. (1948). The organization of behavior. New-York: Wiley.

Hermans, D., De Hower, J.D., & Eelen, P. (2001). A time course analysis of the affective priming effect. Cognition and Emotion, 15 (2), 143-165.

Holcomb, P.J. (1988). Automatic and attentional processing: an event-related brain potential analysis of semantic priming. Brain and Language, 35 (1), 66-85.

James W (1890) The Principles of Psychology. New York: Dover Publications.

Kinder, Donald. (1998). Opinion and Action in the Realm of Politics. In Daniel Gilbert, Susan Fiske, and Gardner Lindzey [Eds.] The Handbook of Social Psychology, Vol 2. (4th Edition). Oxford University Press, New York.

Kunda, Ziva. (1999). Social Cognition: Making Sense of People. Cambridge, MA, MIT Press

Kutas, M. & Hillyard, S.A. (1980). Reading senseless sentences: Brain potentials reflect semantic incongruity. Science, 207, 203-205.

Lachman, Roy, Janet Lachman, and Earl Butterfield (1979). Cognitive Psychology and Information Processing: An Introduction. Hillsdale, NJ, Erlbaum and Associates Publishers

Lau, Richard (1989). Construct Accessibility and Electoral Choice, Political Behavior.1: 5-32.

Langer, E. J. (1989). Mindfulness. Reading, MA: Addison-Wesley Publishing Co

Lindsay, Peter, and Donald Norman (Eds.) Human Information Processing: An Introduction to Psychology, (2nd Edition). New York, Academic Press.

Lodge, Milton, and Charles Taber (2000). Three Steps Toward a Theory of Motivated Political Reasoning. In Arthur Lupia, Mathew McCubbins, and Samuel Popkin, (Eds.) Elements of Reason: Cognition, Choice and the Bounds of Rationality. Cambridge, MA. Cambridge University Press.

Martin, Leonard, and Abraham Tesser (1996). Some Ruminative Thoughts. In Robert Wyer (Ed.), Advances in Social Cognition, Vol. IX. Mahwah, NJ, Lawrence Erlbaum Associates.

Murphy and Robert Zajonc (1993). Affect, Cognition, and Awareness: Affective Priming with Optimal and Suboptimal Stimulus Exposures. Journal of Personality and Social Psychology, 64: 723-739

Neely, J.H. (1976). Semantic Priming and Retrieval from Lexical Memory: Evidence for Facilitatory and Inhibitory Processes. Memory and Cognition, 4 (5), 648-654

Neely, J.H. (1977). Semantic priming and retrieval from lexical memory: Roles of inhibitionless spreading activation and limited-capacity attention. Journal of Experimental Psychology: General, 106 (3), 226-254.

Petty, Richard, & John Cacioppo (1986). The Elaboration Likelihood Model of Persuasion. In L. Berkowitz (Ed.), Advances in Experimental Social Psychology (Vol. 19, Pp. 123-205). New York: Academic Press.

Read, Stephan, and Lynn Miller (1998). (Eds.). Connectionist Models of Social Reasoning and Social Behavior. Mahwah, NJ, Lawrence Erlbaum Associates

Rumelhart, David, and Donald Norman (1997). Representation in Memory. In In R. Atkinson, R. Herrnstein, G. Lindzey, and R. Luce {Eds.). Handbook of Experimental Psychology. New York, Wiley.

Sanford, Anthony. (1986). The Mind of Man: Models of Human Understanding. New Haven: Yale.

Sears, David, Leonie Huddy, and Lynitta Schaffer (1986). A Schematic Variant of Symbolic Politics Theory, as Applied to Racial and Gender Equality. In Richard Lau & David Sears (Eds.). Political Cognition. Hillsdale: Lawrence Erlbaum Associates, 159-202.

Tabor, C.S. and Milton Lodge (2001). Motivated Skepticism in Political Information Processing. Paper presented at Midwest Political Science Convention, 2000 Annual Meeting of the American Political Science Association.

Smith, Eliot (1996). What do Connectionism and Social Psychology Offer Each Other. Journal of Personality and Social Psychology, 70: 893-912.

Squires, N.K., Squires, K.C., and Hillyard, S.A. (1975). Two varieties of long-latency positive waves evoked by unpredictable auditory stimuli in man. Electroencephalography and Clinical Neurophysiology, 38, 387-401.

Taber, C.S. (In Press). Information processing and public opinion. In D.O. Sears, L. Huddy, and R.L. Jervis, eds., The Handbook of Political Psychology. London: Cambridge University Press.

Zajonc, Robert (1984). On the Primacy of Affect. American Psychologist 39, 117-23.

Appendix

Political Primes

Clinton
Gore
Guiliani
George W. Bush
Hillary
Hitler
Lincoln
Kennedy
Pataki
Bloomberg
Mark Green
Osama Bin Laden
Colin Powell
George Washington
Democrat
Republican
Politician
Pro-Life
Pro-Choice
NRA
NAACP
African-Americans
Arabs
Jews
Americans
Taxes
Free-Speech
Death Penalty
Peace
Flag
Parade
Swastika
Terrorists
Affirmative-Action
Welfare
Gun-Control
Counter-Terrorism