
The Influence of Motor Processes on Attitudes Toward Novel Versus Familiar Semantic Stimuli

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Recent research has suggested that the motor processes elicited by upper arm isometric flexion and extension can subtly influence attitudes. Specifically, ideographs evaluatively categorized while performing isometric upper arm flexion were subsequently preferred to ideographs evaluatively categorized while performing isometric upper arm extension. The present research sought to replicate this attitudinal effect with semantic stimuli and to examine a theoretical boundary condition posited by the elaboration likelihood model (ELM). Subjects categorized either neutral words or pronounceable nonwords while adopting the isometric positions. Results indicated that motor processes influenced subsequent attitudes toward stimuli with few associations (i.e., nonwords) more than toward stimuli with many associations in memory (i.e., familiar words). These results are consistent with a growing literature on the possible influence of nondeclarative (e.g., procedural) knowledge on attitudes.

Research has demonstrated that motor processes can subtly influence attitude formation and change (Riskind, 1984; Strack, Martin, & Stepper, 1988; Wells & Petty, 1980). One novel motor process identified in recent research (Cacioppo, Priester, & Berntson, 1993) is the isometric flexion and extension associated with approach or withdrawal. Cacioppo et al. (1993) found that ideographs viewed during upper arm flexion were subsequently preferred to ideographs viewed during upper arm extension. Flexion or extension per se was insufficient for the attitudinal effects, however. Rather, it was only when these motor processes occurred in conjunction with evaluative processing of the target stimuli that arm flexion and extension had attitudinal effects. Furthermore, subjects were unable to articulate the relation-

ship between these motor processes and attitudes, suggesting that the effect could not be explained in terms of on-line inferences (e.g., self-perception processes) or memory-based heuristics (e.g., "I like things toward which I smile"). This feature distinguishes the attitudinal effects of arm flexion and extension from those of other motor processes (e.g., facial expressions, posture; Laird & Bresler, 1992) and mood-based processes (e.g., moods instigated by the weather; Schwartz & Clore, 1983).

One explanation for the attitudinal effects of arm flexion and extension is in terms of higher order Pavlovian conditioning (Rescorla & Wagner, 1972; Wagner & Brandon, 1989). For instance, in the flexor-withdrawal reflex to nociceptive stimuli, arm extension tends to be temporarily coupled with the onset of the unconditioned aversive stimulus, and arm flexion tends to be associated with its offset—conditioning contingencies that foster aversive conditioning (onset of pain) to arm extension and positive conditioning (relief of pain) with flexion. In retrieving a desirable stimulus, arm flexion rather than extension is again more closely coupled temporally to the acquisition or consumption of a desired object or positive goal. Of course, arm flexion and extension are associated with a wide variety of other stimuli and actions as well. Evaluative contexts, therefore, may serve as a discriminative stimulus for the operation of these contingencies. Given the frequency

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of these associations and the potential for classical conditioning to influence knowledge representations without much cognitive mediation, Cacioppo et al. (1993) speculated that these contingencies may have the properties of nondeclarative (e.g., procedural) memory.

The aims of the present study were twofold. First, we sought to replicate conceptually the attitudinal effects of arm flexion and extension using semantic rather than pictorial stimuli (nonwords rather than ideographs). Proponents of hemispheric specialization, who note the preferential role of the left ("verbal") hemisphere in language processing and the right ("nonverbal") hemisphere in spatial processing (Doyle, Ornstein, & Galin, 1974; Galin & Ornstein, 1972), might question whether these contingencies would operate only when evaluating pictorial or spatial stimuli (e.g., ideographs) and not when evaluating semantic but comparably nonassociative letter groupings (e.g., pronounceable nonwords). One counterargument to this is that other motor processes (e.g., smiling) have been found to influence attitudes toward semantic stimuli. As noted earlier, however, the attitudinal effects of these motor processes are more verbalizable.

Second, we sought to test a boundary condition for the effect posited, for instance, by the elaboration likelihood model (ELM; Petty & Cacioppo, 1981, 1986). According to the ELM, conditioning processes are more potent determinants of attitudes under conditions of low than high elaboration likelihood. This prediction is in accord with classical conditioning research and theory in animal learning, which shows that the efficacy of conditioning is diminished by preexposure to conditioned stimuli (Rescorla & Wagner, 1972). In a test of this prediction in the area of human attitudes, Cacioppo, Marshall-Goodell, Tassinary, and Petty (1992) paired words or nonwords with mild electric shock. Results confirmed that these pairings were a more powerful determinant of attitudes toward nonwords (nonassociative stimuli) than neutral words (associative stimuli; see also, Stuart, Shimp, & Engle, 1987). In the present study, neutral words and pronounceable nonwords served as the attitudinal stimuli, and isometric arm flexion and extension served as the primary independent variable. The words and nonwords were modeled after the set used by Cacioppo et al. (1992). The words and nonwords were matched in terms of their valence and structural features but differed in terms of the semantic information individuals were likely to have acquired about each. If classical conditioning is underlying the attitudinal effects of arm flexion and extension, then these effects should be more evident when nonwords rather than words served as the experimental stimuli.

METHOD

Subjects and Design

A total of 22 students enrolled in introductory psychology participated for partial course credit. Subjects were assigned to the cells of a 2 (somatic activation: isometric arm flexion versus isometric arm extension) \times 2 (attitude stimulus: nonwords versus words) \times 2 (activation order: flexion versus extension first) factorial design in which the first factor was manipulated within subjects.

Experimental Stimuli

The experimental stimuli were 24 six-letter words and 24 six-letter structurally similar, highly regular, and pronounceable nonwords constructed from these words (i.e., anagrams). The construction of the nonwords (one nonword per word) was constrained such that the letters in each anagram were consistent with single-letter, bigram, and trigram frequencies established by Kucera and Francis (1967) for familiar English words. The nonwords/words used in the present experiment were *ceglan/glance*, *primet/permit*, *fering/finger*, *inmear/remain*, *tasmer/stream*, *begrid/bridge*, *sarone/reason*, *sartil/trails*, *werans/answer*, *raques/square*, *triven/winter*, *surtel/result*, *thaber/breath*, *nagred/garden*, *rapley/player*, *tapent/patent*, *namout/amount*, *plemis/simple*, *praeds/spread*, *vetal/travel*, *tommen/moment*, *trubet/butter*, *geenin/engine*, and *plicen/pencil*. Pilot testing was conducted on these nonwords and words, and it confirmed that they were rated comparably and neutrally; mean ratings for each stimulus fell between 5 and 7 on an 11-point bipolar attitude rating scale (anchored by *Very unpleasant* and *Very pleasant*). Because the words were familiar and the nonwords were unfamiliar, the latter stimuli may evoke more competing responses (e.g., pronunciations). Competing responses toward the stimuli, however, should make it more difficult to remember or change attitudes toward the stimuli and thus should work against the experimental hypothesis.

Each subject was exposed to either words or nonwords. The experimenter randomly selected, ordered, and presented 12 stimuli during isometric arm flexion, and the remaining 12 stimuli were randomly ordered and presented during isometric arm extension. These randomization procedures were performed for each subject.

Procedure

Subjects were tested individually. Each subject was seated in a chair approximately 41 cm in height in front of a stationary bar approximately 55 cm in height. The experimenter sat next to the subject. In the flexion condition, subjects were instructed to place their palms facing upward on the bottom of the bar, to lift lightly so

that they felt a moderate tension in their arms, and to maintain this tension until instructed to stop. In the extension condition, subjects were instructed to place their palms facing downward on the bar, to press lightly so that they felt a moderate tension in their arms, and to maintain this tension until instructed to stop. In both conditions, subjects were seated such that their upper arms were perpendicular to the floor, their forearms were parallel to the floor, and only their palms touched the bar. Subjects were further instructed that they would be viewing English (i.e., word) or foreign (i.e., nonword) words. Subjects were additionally informed that they did not have to pronounce the words but, rather, that

I will show you a series of English [foreign] words. I want you to look at each word and simply tell me whether you like or dislike the word. Obviously, there are no right or wrong answers. However you feel about the word is fine. At no point in this experiment will you be asked to justify any of your answers.

Each stimulus was held in front of the subjects until it was categorized as liked or disliked.¹ A 5-min rest period separated arm flexion and extension.

After completion of the flexion and extension task, the preferences that developed toward the stimuli were assessed. Subjects were taken to a table on which were six trays arranged in a row. The trays were labeled, from left to right, as follows: *extremely unpleasant*, *very unpleasant*, *unpleasant*, *pleasant*, *very pleasant*, *extremely pleasant*. The subjects were given a deck of 24 cards identical in size and appearance to the cards used during the isometric portion of the experiment. The cards were ordered randomly within this deck. Subjects were instructed to sort the cards into the appropriate trays based on how they felt about each word. The experimenter additionally stipulated that each tray should contain exactly 4 cards when the subject had finished. Subjects were allowed to spread the cards across the table in front of the trays while performing this task. The experimenter was not present while the subjects completed this preference assessment.

In prior research, subjects completed measures designed to assess the difficulty, enjoyment, and effort associated with each of the isometric manipulations at this time during the experiment (Cacioppo et al., 1993). Because no differences emerged in these measures (or in an experiment contrasting muscular contraction with relaxation) that could account for the attitude data, the measures were not included in the present experiment. Instead, subjects completed a memory task in which they were asked to match each attitude stimulus with the isometric condition during which they were shown the stimulus. Subjects were given a single sheet of paper on which the 24 stimuli were listed one to a row on the left side of the page. To the right of the stimuli appeared two

columns marked first and second exercise. Subjects were instructed to mark during which exercise they were first exposed to each of the 24 words. Afterward, subjects were debriefed and excused.

Data Reduction

As in previous research, the subjects' responses to the preference ranking (i.e., attitude assessment) task served as the major dependent variable. The six categories into which the subjects sorted the stimuli were assigned numeric values ranging from -3 (*Extremely unpleasant*) to 3 (*Extremely pleasant*). The preference measure was then calculated on a subject-by-subject basis to reflect the difference between the mean rating of 12 stimuli associated with isometric arm flexion and the mean rating of the 12 stimuli associated with isometric arm extension. Due to the nature of the preference ranking task, the mean ratings within subjects of stimuli associated with isometric arm flexion and extension were equal in extremity but opposite in sign. The difference score, calculated for each subject, represents the relative preference of stimuli associated with the activation of arm flexors (i.e., mean flexor rating minus mean extensor rating). Thus, if a subject categorized the 24 stimuli randomly across the six preference ratings, the difference score would be zero; if a subject categorized all 12 of the stimuli associated with isometric flexion in the bottom three preference rankings (i.e., unpleasant) and hence all 12 of the stimuli associated with isometric extension in the top three preference rankings, the difference score would be -4 ; and if a subject categorized all 12 of the stimuli associated with isometric extension in the bottom three preference rankings (and, consequently, all 12 of the stimuli associated with isometric flexion in the top three preference rankings), the difference score would be 4 . Consequently, (a) a *t* test to determine whether the difference score is larger for nonwords than words tests the hypothesis that motor processes influence attitude formation toward nonassociative more than associative stimuli, (b) a *t* test to determine whether the difference score for the nonwords differs significantly from zero represents a conceptual replication of the motor processes effect on attitude formation, and (c) a *t* test to determine whether the difference score for words departs significantly from zero tests whether motor processes influence associative stimuli.²

Finally, the memory task was scored in terms of the percentage of stimuli correctly matched to the activity during which the stimuli were presented.

RESULTS³

Our primary hypothesis was that the attitudinal preferences developed as a function of upper arm flexion and extension would be greater for nonwords than

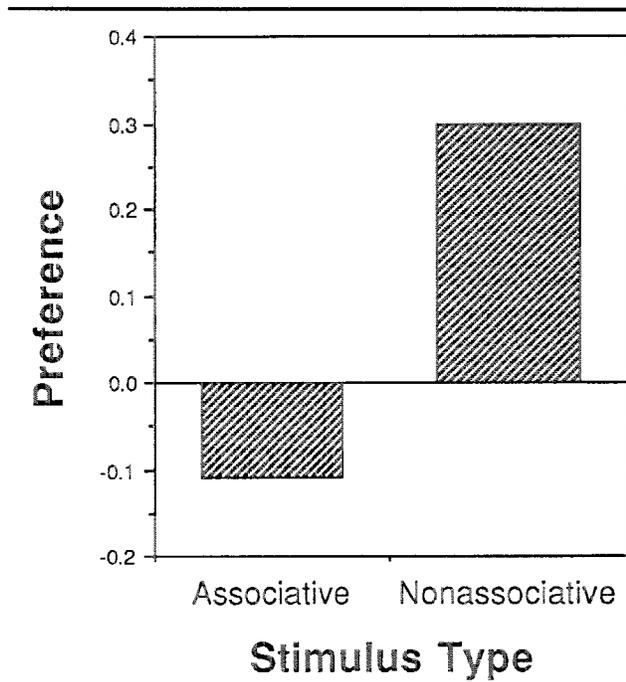


Figure 1 Attitude preference as a function of stimulus type.

words. As expected, analyses revealed that the mean difference score for the nonwords ($M = +.30$) was greater than the mean difference score for the words ($M = -.11$), $t(21) = 2.57, p < .02$.

The second hypothesis was that the mean difference score associated with the nonwords would differ from zero, thus replicating previous findings that used Chinese ideographs as the target stimuli. Analysis of the difference scores for the nonword conditions revealed that, as predicted, the difference score was significantly greater than zero, $t(10) = 2.97, p < .01$. Also as expected, analysis of the difference scores for the word conditions revealed no statistically significant deviation from zero, $t(10) > -1, ns$ (see Figure 1).

Finally, analyses of the memory task revealed that the mean percentage of correctly identified stimuli for the nonwords ($M = .53$) did not differ statistically from the mean percentage of correctly identified stimuli for the words ($M = .55$), $t(19) < 1$. Thus the attitudinal effects of motor processes were more evident for nonwords than words despite the fact that subjects were equally unlikely to be able to recall the conditions under which they were exposed to each type of stimuli.

DISCUSSION

Veridical evaluations of objects and events in the world are so central to survival that all species have biological mechanisms for approaching, acquiring, or ingesting certain classes of stimuli; for withdrawing from, avoiding, or rejecting others; and for constructing gen-

eral and enduring response dispositions toward classes of stimuli (Cacioppo, Petty, & Berntson, 1991; Martin & Levey, 1978). Indeed, these mechanisms are represented at all levels of the central nervous system, including the most primitive (Berntson, Boysen, & Cacioppo, 1993). Attitudes and evaluative predispositions free individuals from the burdens of considering the details of all relevant information each time a stimulus is encountered or a choice is required (e.g., Blascovich et al., 1993; Fazio, Blascovich, & Driscoll, 1992). Although it has been suggested previously that attitudes and the knowledge on which these attitudes are based are stored separately in memory (e.g., Lingle & Ostrom, 1981), a newer perspective is the notion that the knowledge on which attitudes are based may be nondeclarative and may involve motor processes whose links to attitudes cannot be verbalized by subjects (see Cacioppo et al., 1992, 1993). By demonstrating that the attitudinal effects of arm flexion and extension are not limited to pictorial stimuli (or spatial processing), the results from the present study provide further evidence for the possible influence of nondeclarative knowledge on attitudes.

The ELM posits that individuals in a complex world do not have the motivation or the ability to think exhaustively about each stimulus they encounter, nor do they have the luxury or the inclination to ignore them all. Thus the model posits that people are neither universally thoughtful nor invariantly mindless when forming or modifying an attitude. Initially, the emphasis in research on the ELM was on identifying the conditions that led to attitude change through the central route (e.g., Cacioppo & Petty, 1979, 1989; Cacioppo, Petty, & Morris, 1983; Petty & Cacioppo, 1977, 1979; Petty, Wells, & Brock, 1976) and the situational and dispositional factors that moderated the central versus the peripheral route (e.g., Cacioppo, Petty, Kao, & Rodriguez, 1986; Petty & Cacioppo, 1984; Petty, Cacioppo, & Goldman, 1981; Petty, Cacioppo, & Schumann, 1983). The next set of studies sought to examine the differential consequences of attitudes that were marked by similar verbal expressions but, nevertheless, resulted from different routes to persuasion. Thus studies showed that attitudes derived through the central route were more enduring, more resistant to counterpersuasion, and more predictive of behavior than attitudes derived through the peripheral route (e.g., Cacioppo et al., 1986, Experiment 2; Haugtvedt & Petty, 1992; Leippe & Elkin, 1987; Petty et al., 1983; Sivacek & Crano, 1982; for a review, see Petty & Cacioppo, 1986).

The peripheral route is interesting in its own right, however, because many attitudes develop or change without the benefits of the individual carefully scrutinizing all the information bearing on the merits of the innumerable attitude stimuli to which they are exposed each

day. Rudimentary attitude influences such as mere exposure can occur even in situations in which people are not aware of being exposed to the stimulus (Kunst-Wilson & Zajonc, 1980; Wilson, 1979) and operate more strongly on nonassociative than associative stimuli (Harrison, 1977), as well as when the ability to process the target stimulus is low (Bornstein & D'Agostino, 1992). Similarly, classical conditioning can be a powerful determinant of attitudes, particularly when subjects are unwilling or unable to engage in issue-relevant thinking (Cacioppo et al., 1992; Stuart et al., 1987). Thus Cacioppo et al. (1992) demonstrated that aversive classical conditioning was a more powerful determinant of attitudes toward nonwords than neutral words; Fiske, Kinder, and Larter (1983) found that people who had low knowledge about politics were more likely to use simple cues in rendering judgments about an obscure country than people who had high political knowledge; and Srull (1983) reported that the credibility of statements about a product increased more with familiarity (repetition) for subjects who were not knowledgeable about a product than for subjects who were knowledgeable about the product. And as hypothesized, the effect of motor processes on attitude formation was greater for nonassociative than associative stimuli.

The attitudinal effects of arm flexion and extension appear to be small. However, if motion affects attitudes, as this research suggests, the effect in real life may be small, but the point is not. It would mean that there is a connection between biology and social thinking that has not been recognized and that is empowered when individuals know little about a stimulus. It would intimate that there is more underlying the formation of attitudes than declarative knowledge. And because subjects appear to be unaware of the actual attitudinal effects of arm flexion or extension (see Cacioppo et al., 1993), it is unlikely that an individual being aware of their arm flexion or arm extension would result in the kind of correction processes that have been found in research on mood (Schwartz & Clore, 1983). Finally, the importance of these effects may not stem from the magnitude of the immediate attitude change they produce but from the subtle bias they engender in how an individual feels about a stimulus. The initial positive reactions engendered by upper arm flexion, for instance, may influence and guide subsequent interactions with a wide variety of novel stimuli, ranging from strangers one encounters at social gatherings to new food products that individuals might sample in grocery stores.

NOTES

1. As in prior research, no significant differences in the like/dislike judgments were predicted or observed (Cacioppo et al., 1993). Subjects were instructed to provide the like/dislike judgment to ensure

that evaluative processing was engaged when subjects attended to the attitude stimuli. In the absence of this evaluative processing, no motor processes effect would be predicted (Cacioppo et al., 1993).

2. We report the data in terms of difference scores because this resembles the choices people must make when selecting between mutually exclusive response alternatives (e.g., elections, durable consumer products). It should be noted, however, that given the type of stimulus (words vs. nonwords) was manipulated between subjects and that subjects were required to place an equal number of stimuli in each rating bin, analyzing the raw scores using flexion versus extension as a within-subjects factor yields exactly the same results as analyzing difference scores.

3. The difference score was subjected to a preliminary 2 (attitude stimulus) \times 2 (activation order) ANOVA. Neither the main effect for activation order nor the Activation Order \times Attitude Stimulus interaction was significant. Therefore, the analyses reported in the text were conducted pooling across order.

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