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Automatic Information Processing and Social Perception: The Influence of Trait Information Presented Outside of Conscious Awareness on Impression Formation

John A. Bargh
New York University

Paula Pietromonaco
University of Michigan

The accessibility of a category in memory has been shown to influence the selection and interpretation of social information. The present experiment examined the possibility that information relevant to a trait category (hostility) presented outside of conscious awareness can temporarily increase that category's accessibility. Subjects initially performed a vigilance task in which they were exposed unknowingly to single words. Either 0%, 20%, or 80% of these words were semantically related to hostility. In an ostensibly unrelated second task, subjects read a behavioral description of a stimulus person that was ambiguous regarding hostility, and then rated the stimulus person on several trait dimensions. The amount of processing subjects gave to the hostile information and the negativity of their ratings of the stimulus person both were reliably and positively related to the proportion of hostile words to which they were exposed. Several control conditions confirmed that the words were not consciously perceived. It was concluded that social stimuli of which people are not consciously aware can influence conscious judgments.

The social perceiver is continuously confronted with a formidable array of environmental information to interpret. Bruner (1957, 1958) was one of the first to recognize that this information is manageable only by selectively attending to certain features of the stimulus field and by further reducing this limited range of information by assigning it to cognitive *categories*—abstract representations of conceptually related information. In this increasingly popular view (e.g., Cantor, 1981; Mischel, 1979; Neisser, 1976; Norman & Bobrow, 1976), perception consists of the interaction between the cognitive structure of the perceiver and the environmental context.

The relative accessibilities of these categories, therefore, partly determine the selection and interpretation of social information (Bruner, 1957; Higgins & King, 1981; Wyer & Srull, 1981). The more accessible a category, the more likely it is to be used to process relevant information. Category accessibilities are critical to the outcome of social perception because a considerable percentage of social information is at least somewhat ambiguous (Bruner, 1958), and an ambiguous stimulus will tend to be "captured" by the most accessible category for which it is relevant.

Categories can become more accessible through greater recency or frequency of activation. A category's *acute* or temporary accessibility is directly related to its recency of activation: The more recently a category has been used, the greater its acute accessibility (Hayes-Roth, 1977; Higgins & King, 1981; Srull & Wyer, 1979, 1980). In a study by Higgins, Rholes, and Jones (1977), subjects first performed a color-naming task in which they were presented with a word to hold in memory until the color had been named. These memory words included four personality trait terms, either positive or negative and either relevant or irrelevant to

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Requests for reprints should be sent to John A. Bargh, Department of Psychology, New York University, 6 Washington Place, Seventh Floor, New York, New York 10003.

the stimulus material of the next task. In the second task, allegedly unrelated to the first, all subjects read the same behavioral description of a stimulus person. Subjects exposed to the relevant trait terms evaluated the stimulus person in line with the denotative character of those traits (i.e., either positively or negatively), whereas the positive and negative irrelevant trait terms had no effect on subjects' evaluations. Higgins et al. (1977) concluded that the earlier exposure to the trait terms had activated trait categories that influenced subsequent processing of trait-relevant but not trait-irrelevant information.

Srull and Wyer (1979, 1980) replicated and extended this finding. In an ostensibly unrelated first task, subjects were exposed to behavioral exemplars of a trait. In a second task, they read a behavior description relevant to that trait. Evaluations of the stimulus person on the relevant trait (e.g., "hostile"), and also on evaluatively similar traits (e.g., "conceited" and "narrow-minded"), were influenced by the earlier exposure to the trait-relevant information. Apparently, although an activated trait category only influences the processing of category-relevant information (Higgins et al., 1977), the effect of this processing can be to influence judgments along other trait dimensions as well (Srull & Wyer, 1979). It should also be noted that presenting the priming information after the behavioral description has no effect on trait ratings (Srull & Wyer, 1980), underscoring the importance of category accessibility during information acquisition in determining how that information will be interpreted.

A given category also can differ across individuals in its long-term, or *chronic*, accessibility. In general, the more frequently a category is activated the more accessible it becomes, requiring decreasing amounts of stimulus energy to detect congruent information (Bruner, 1957; Higgins & King, 1981; Shiffrin & Schneider, 1977).[1] Individuals will vary in the frequency with which different categories become active, due to variance in their past experiences, and their repertoires of chronically accessible categories will vary accordingly. A recent study by Higgins, King, and Mavin (1982) illustrated the influence of chronically accessible categories. Subjects read a behavioral description of a stimulus person. After an intervening task, they wrote down the behavioral description as accurately as they could, followed by their impression of the stimulus person. The contents of the story reproductions and impressions varied with the subjects' individual category accessibilities, which had been assessed previously via a card-sorting task. More accessible trait information was included in both the reproductions and impressions than was inaccessible trait information.

Higgins and King (1981) have argued that category priming effects can be passive, that is, not require a conscious expectancy or set on the part of subjects. They held that subjects in the Higgins et al. (1977) study were not aware of the connection between the two allegedly unrelated experiments they participated in, and that this, coupled with the subjects' relatively low level of recall for the adjectives used in the first task, demonstrated a lack of conscious awareness of the priming information during performance of the second task. The subjects had certainly been *momentarily* aware of the priming adjectives during the color-naming task, however, and were able to recall over half of these adjectives after evaluating the stimulus person, so that to an extent they still were conscious of the prior presence of the priming adjectives at the time they read the description of the stimulus person.

A more stringent and conclusive test of the existence of passive, automatic priming effects would require the priming information to be presented outside of subjects' conscious awareness. In an investigation of the influence of social constructs on selective attention, Bargh (1982) found that people for whom the trait category of independence was chronically accessible (i.e., a trait very

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[1] This point is a source of difference between the category accessibility models of Higgins and King (1981) and Wyer and Srull (1981). In the Wyer and Srull "storage bin" model, a category not frequently used can still have long-term effects as long as it was the *most recently* used (i.e., is on the top of the bin). In the Higgins and King model, as here, frequent activation is a necessary condition for chronic accessibility.

frequently used in reference to the self) showed evidence of processing independence-related information of which they were not consciously aware. This suggests that chronically accessible categories are capable of becoming active outside of consciousness. Therefore, presentation of category-consistent stimuli below the threshold of conscious recognition should result in the activation of chronically accessible categories, with this automatic activation resulting in passive priming effects.

To test this prediction, a partial replication of the Srull and Wyer (1979) Experiment 1 was conducted.[2] In an initial vigilance task, subjects reacted as quickly as they could to "flashes" on a cathode-ray tube (CRT) screen by pressing a button. The flashes were actually words, some related to hostility, the remainder unrelated. The word flashes appeared on the screen very briefly (100 msec each) and were immediately masked. In addition, the time and location of their occurrence on the screen were made unpredictable, and they were presented outside of the subjects' foveal visual field. These steps were taken to ensure that no conscious awareness of the word content occurred. Depending on the condition to which the subject had been randomly assigned, either 0%, 20%, or 80% of the experimental trials contained hostile words. Next, subjects read a behavioral description of a stimulus person that was somewhat ambiguous with regard to the trait of hostility. Finally, they rated the stimulus person on several trait scales, half of which were related to the trait of hostility and half of which were not.

This design allows the replication and extension of an earlier study that demonstrated automatic processing of trait information (Bargh, 1982). The presence of automatic processing of the words would be indicated by relatively fewer correct responses and longer reaction times to the flashes, as less of the subject's limited processing capacity (Kahneman, 1973; Miller, 1956; Norman & Bobrow, 1976) would be available for the vigilance task. In two control conditions, subjects did not rate the stimulus person but were tested either for recognition memory or for momentary awareness of each word flashed on the screen. These conditions were included to ensure that subjects had not been conscious of the hostile information.

Experiment 1

Method

Overview

Subjects were randomly assigned to either the rate, test, or guess condition. Those assigned to the rate condition were exposed to either 0%, 20%, or 80% hostile words (the remainder being neutral control words) while performing the initial vigilance task. This task required subjects to react as quickly as they could to flashes (actually words, but subjects were told nothing about the nature of the flashes) on a CRT screen. After completing the 100 trials of the vigilance task, rate-condition subjects read a brief description of a stimulus person and rated him on 12 trait dimensions, half of which were related to hostility and half unrelated. Subjects assigned to the test condition were exposed to either 20% or 80% hostile words in the vigilance task and then were given a recognition memory test on the hostile and control words to which they had been exposed. All subjects assigned to the guess condition were exposed to 80% hostile words during the initial phase of the experiment. Unlike all other subjects, however, guess-condition subjects did not perform the vigilance task. Instead, they were informed that the flashes they would see were actually words and that they should try to guess each word as it was presented.

Subjects

The subjects were 108 male undergraduate students participating to partially fulfill a requirement for the

[2] Srull and Wyer (1979) also used stimulus words related to kindness in a second experiment. Our original intention was to do the same, but subjects were able to consciously detect the presence of the "kind" words on the CRT screen. Subjects in the momentary awareness condition correctly guessed 9.2% of the kind words presented, whereas subjects trying to guess the hostile words were correct on only .6%. Moreover, subjects exposed to the 80% kind-word list recognized reliably more kind words on the memory test than did subjects in the 20% condition (58% vs. 47%, $p = .06$). This difference in sensitivity between kind and hostile words is most likely due to the much greater frequency of the former in the English language, with a mean frequency of 109 per million, compared to 13 per million for the hostile words (Carroll, Davies, & Richman, 1971). Subjects would thus have a lower recognition threshold for the kind words (Solomon & Postman, 1952); unfortunately, the physical specifications of the apparatus used in the experiment did not permit words to be flashed any faster than 100 msec. Hence we were unable to replicate Srull and Wyer's (1979) Experiment 2 with subliminal stimulus presentation. In addition, Srull and Wyer (1979) did not utilize a baseline 0% condition, as we did here.

introductory psychology course at the University of Michigan. Subjects were randomly assigned to one of the six cells of the design and participated in groups of one to four. Subjects were asked before the start of the experimental session if they had normal or corrected-to-normal vision and if English was their native language. One subject was excused from the experiment and replaced in the design because he could not see the CRT screen clearly.

Apparatus and Materials

Experimental room. The main room was divided into six individual booths, three on either side of the room. These booths had doors that, when closed, allowed each subject to perform the tasks with a minimum of external distraction.

Each booth contained a chair and a table. On the table was a GBC model MV-12 CRT screen and two response panels, all directly connected to a Digital Equipment Corporation PDP-11/20 minicomputer located in a separate control room. Each response box contained a single button; one was located on the table to the subject's left and was labeled "LEFT," the other was located to the subject's right and was labeled "RIGHT."

The CRT display was under computer program control. The computer recorded each response and its latency (to the nearest msec) for each subject. The chair was located at a fixed and constant distance from the table. The location of the chair was such that the distance from the subject's eyes to the center of the CRT screen (where a fixation point was situated) was 56 cm when the subject sat straight in the chair, so that the stimuli would be presented outside of the subject's foveal visual field (see next section). It was considered necessary to establish the *maximum* possible eye-to-screen distance; if subjects leaned forward it could only restrict the span of the foveally processed region around the fixation point.

CRT screen display. At the center of the display were three Xs, constituting a fixation point on which subjects were told to focus their gaze at all times. The background state of the screen was total illumination; characters appeared as "black on white," that is, as patterns of no illumination. All screens were at the same background level of illumination of 4.3 lx.

Each stimulus word was presented for 100 msec, followed immediately by a 100-msec masking string of 16 Xs at one of four locations equidistant from the fixation point (two each to the left and right). The location order was randomized and was the same for all subjects. Of the total of 100 trials, 25 were presented at each location. Each word was centered within its location, so that the center of each word was 3.6 cm from the center of the fixation point.

No character of any word appeared closer than 2.7° of visual angle from the fixation point, or farther than 6° of visual angle. This placed the stimuli within the parafoveal visual field (from 2° to 6° of visual angle). Studies of text reading and picture viewing (Allport, 1977; Nelson & Loftus, 1980; Rayner, 1978) have found the semantic content of stimulation in this area to be processed to a small degree outside of awareness (which is generally reserved for the foveal area).

Stimulus words. Three 100-word stimulus lists were composed, containing either 0, 20, or 80 hostile words, with the remainder being control words. Each of the 100 words was flashed at one of the four locations around the fixation point on the CRT display. Subjects in the rate and test conditions were instructed to react as quickly as possible to each flash by pressing the response button corresponding to the side of the fixation point where the flash had occurred; these subjects were not informed that the flashes were actually words. Subjects in the guess condition were told that the flashes were indeed words, and were instructed to try to guess each word as it was flashed.

The 15 hostile words were taken from among those used by Srull and Wyer (1979). They were *hostile, insult, unkind, inconsiderate, thoughtless, dislikable, hate, hurt, rude, curse, beat, whip, punch, stab,* and *unfriendly.* The 15 control words were selected from among the 200 most frequently appearing words in the English language (Carroll et al., 1971); the selection criterion was that they be of approximately the same length as the hostile words. The control words were *water, long, number, people, what, little, many, something, together, different, between, said, every, another,* and *always.* High-frequency words were used as control words in order to rule out an alternative explanation for a finding of relatively greater stimulus word processing by the 20% and 80% hostile-word groups in terms of the subjects' greater familiarity with hostile words. Given the greater frequency of the control words, a familiarity effect would be exactly the opposite of that predicted for a category-activation effect: The 0% hostile-word group was exposed to 100% control words, whereas the 80% hostile-word group was exposed to only 20% control words.

Word presentation order was randomized. The positions of the minority items (hostile words in the 20% list and control words in the 80% list) were the same for the 20% and the 80% lists. Each of the 15 hostile and 15 control words appeared approximately the same number of times in each list as the other hostile and control words, respectively.

Ten additional low-frequency words (e.g., *colander, fresco*) were used during the initial practice task.

The brief duration of each word, its immediate masking, its unpredictable location and time of occurrence, and its placement outside the foveal area were all intended to prevent subjects from becoming conscious of the word contents. As a manipulation check, the following recognition test was administered to subjects in the test condition.

Recognition memory test. The 60 items of this test were composed of equal numbers of hostile targets (actually presented), hostile distractors (not presented), control targets, and control distractors. The hostile distractors were taken from the hostile words to which subjects in the Srull and Wyer (1979) study were exposed but that were not presented in the vigilance task here (e.g., *malicious, unfair, kill*). Like the control targets, the control distractors were taken from among the 200 most frequent words in the English language (e.g., *down, house, about*). The presentation order of the items was randomized.

Behavioral description. Subjects in the rate condition did not take the recognition memory test but were

given a 12-sentence paragraph to read (from Srull & Wyer, 1979). The paragraph described a stimulus person engaging in somewhat hostile behaviors. The degree to which these "hostile" acts were due to dispositional rather than situational reasons was ambiguous (e.g., "A salesman knocked at the door, but Donald refused to let him enter. He also told me that he was refusing to pay his rent until the landlord repaints the apartment.").

Trait rating form. Immediately after reading the behavioral description, subjects in the rate condition were given a form consisting of 12 traits on which to rate the stimulus person. Subjects indicated their rating by circling a number from 0 (not at all) to 10 (extremely) for each trait. Six of the trait scales were descriptively similar to hostility: Three were negative in evaluative tone (*hostile, unfriendly, dislikable*) and three were positive (*kind, considerate, thoughtful*). The remaining six trait scales were evaluatively denotative but not related to hostility: Three were negative (*boring, conceited, narrow-minded*) and three were positive (*dependable, interesting, intelligent*). The presentation order of the 12 scales was randomized.

Procedure

Rate and test conditions. After arriving at a waiting room, each subject was seated in an individual booth within the experimental room. Subjects were told that the experiment would consist of two separate parts, and that instructions for the second part would be given following completion of the first part. Subjects were next informed as to the nature of the vigilance task. They were instructed to sit in an upright but comfortable position, to maintain their gaze on the fixation point on the screen in front of them throughout the task, and, as quickly as they could after seeing a flash, to press the button corresponding to the side of the fixation point on which the flash had occurred. Maintaining both accuracy (pressing the correct button) and speed throughout the entire task was stressed. Subjects first performed a 10-flash practice version of the task in the experimenter's presence to ensure that they understood the task. Any questions were answered, the booth doors were closed, and each subject responded to the 100 experimental trials of the vigilance task. An equal number of the 75 subjects in the rate condition were exposed to the 0%, 20%, and 80% hostile-word lists; half of the 24 subjects in the test condition were presented with the 20% list and half with the 80% list. The vigilance task took approximately 12 minutes to complete.

In the rate condition, the experimenter next announced that the second part of the experiment would concern how people form impressions of other people. The subjects were given the behavioral description to read through one time. As soon as a subject had finished reading the paragraph, he was given the trait rating form to complete.

After subjects in the test condition had completed the vigilance task, the experimenter explained that the flashes on the screen actually had been words. The recognition memory test was distributed, and subjects were instructed to check those items they thought had been presented. They were informed that some of the items on the test had been flashed during the vigilance task and others had not been.

Guess condition. The nine subjects in the guess condition participated one at a time. After being seated in individual booths, they were informed that words would be flashed on the CRT screen very quickly at one of four specified locations around the central fixation point. Their task was to try to guess each of these words immediately after it was flashed. They were instructed to maintain their gaze on the fixation point, as this was the best strategy for seeing each word given its unpredictable location. All subjects in this condition were exposed to the 80% hostile-word list. Subjects were encouraged to make a guess for every word, and not to worry about whether or not they were correct. The experimenter sat behind and to the right of the subject, and recorded each guess alongside a number indicating to which flash it corresponded.

At the conclusion of the experiment, all subjects were debriefed fully as to the purpose and design of the experiment and thanked for their participation.

Results

Awareness Measures

Momentary awareness. The nine subjects in the guess condition were exposed to the 80% hostile word list and tried to guess each word. They had considerable trouble in even making a guess, as they made no response at all for 705 of the total of 900 trials. Of the 195 guesses made, only 16 were correct, as scored by a lenient criterion of correctness.[3] Of these 16 guesses, 12 were control words and 4 were hostile words. That is, only .6% of the hostile words were guessed correctly. The fact that three times as many control words as hostile words were correctly recognized is most likely due to the higher frequency of the control words in the language (see Footnote 2). When the incorrect guesses were examined for their hostility relatedness, 11 were found to be related to kindness (e.g., *loving, friend, helping, smile*), and none were related to hostility.[4] The extremely low hit rate for hostile words and

[3] The addition or deletion of letters was acceptable, except to the word base, and as long as the alteration did not change the basic meaning of the word (e.g., as when the prefix "un" is omitted from "unfriendly").

[4] Two judges blind to the experiment scored the incorrect guesses on their relatedness to hostility. Neither found any hostile words. The judges scored the same 11 words to be related to kindness, with one judge scoring 2 additional words as related (*welcome* and *laughter*). The lower consensus total of 11 was considered the true number.

Table 1
Mean Hit and False Alarm Rates for the Recognition Test, Experiment 1

Rate	Percentage hostility-related words	
	20%	80%
Hostile		
Hit	.49	.51
False alarm	.45	.60
Control		
Hit	.48	.52
False alarm	.41	.27

the nearly three times as many kindness-related incorrect guesses that were given argue that subjects were not momentarily aware of the contents of the hostile words. If subjects had been momentarily aware of anything it would have been kindness information and not hostility information, which would work against confirmation of the hypotheses.

The fact that the subjects were unable to make a guess on so many of the trials is problematic, however. Subjects may have been using a strict criterion of accuracy that inhibited responding when they lacked the necessary confidence in their guess. A lower response criterion, one that allowed a guess to be made on every trial, may have served to increase the number of hostile targets detected.

Recognition test. The hit rates and false alarm rates for both the hostile and control recognition test items were computed for each test-condition subject. A repeated-measures analysis of variance of hostile test item endorsement rates, with proportion (80% vs. 20% hostile word groups) as the between-subjects factor, and item type (target vs. distractor) as the within-subjects factor, found no reliable main effects or interactions. Accepting the null hypothesis of no differences between conditions when it is in fact false is the more critical statistical decision error here, however, because our intent is to demonstrate a lack of differences between the groups in recognition memory for the hostile items. Therefore a series of t tests was performed, comparing the endorsement rates of the 20% and 80% conditions on each item type. The hit rates of the two groups on both hostile and control items did not differ reliably, and all were at the .50 level expected by chance alone (see Table 1). The 80% group did make more hostile false alarms, however, $t(22) = 2.08$, $p < .05$. Thus, although subjects could not detect hostile targets at better than a chance level, the amount of hostile words they were exposed to influenced their endorsement of hostile false alarms. The results of the recognition test, although clearly not demonstrating any memory for the items actually presented, are not conclusive as to whether subjects were aware of the *type* of item presented.

Amount-of-Processing Measures

Assuming for the moment that subjects were not aware of the hostile stimuli, any differential perceptions of the stimulus person by the three proportion groups would strongly suggest that subjects had automatically processed the contents of the flashed hostile words. However, direct support for the proposed mediating process of automatic category activation would be provided by poorer performance on the vigilance task by the 80% hostile word group relative to the 20% group, and by the 20% group relative to the 0% group. As argued previously, to the degree to which the hostile trait category had been activated, the subject would have less of his limited processing capacity for the demands of the vigilance task, resulting in poorer performance. Together with subjects' lack of awareness of the hostile word contents, such differences in task performance would provide compelling evidence of automatic activation of the hostile trait category. The two measures of vigilance task performance were the number of correct responses and the average reaction time to the word flashes.

Number of correct responses. For each subject, the percentage of correct responses (pressing the correct left or right button within 3.5 seconds after a flash had occurred), incorrect responses (pressing the wrong button), response latencies, and misses (failing to press either button) were tabu-

lated for each 20-word trial block of the task. Calculating a separate score for each trial block allowed examination of the amount of processing given to the task over its time course.

An analysis of variance was conducted on the percentage of correct responses, with proportion of hostile trials (0%, 20%, or 80%) as the between-subjects factor and trial block as the within-subjects factor. There were reliable main effects for the proportion factor, $F(2, 92) = 4.47$, $p < .025$, and trial block factor, $F(4, 368) = 5.11$, $p < .001$. The Proportion × Trial Block interaction was marginally significant, $F(8, 368) = 1.87$, $p < .07$.

Figure 1 illustrates these effects. Newman-Keuls tests (Winer, 1971, pp. 518–532) revealed that the 80% condition made fewer correct responses than either the 20% or the 0% groups ($p < .05$). In addition, the trial block main effect was attributable solely to Block 5, which was significantly lower than every other block ($p < .01$). Given the marginally significant Proportion × Trial Block interaction, however, and the patterns of means shown in Figure 1, contrasts were performed between the three proportion conditions at each trial block. These contrasts indicated that the proportion factor had a reliable simple main effect both at Trial Block 1, $F(1, 92) = 4.35$, $p < .05$, and at Block 5, $F(1, 92) = 14.79$, $p < .001$. Finally, comparisons of individual means within Blocks 1 and 5 showed that the 80% group differed marginally from the other two at Block 1, $F(1, 92) = 3.78$, $p < .06$, and the 80% and 20% groups both differed reliably from the 0% group at Block 5: 80% group, $F(1, 92) = 15.06$, $p < .001$; 20% group, $F(1, 92) = 8.36$, $p < .01$.[5]

Incorrect responses and misses. An examination of the nature of the incorrect responses shows that most were incorrect button presses (left instead of right and vice versa), with the remainder being complete misses (no response made at all). The pattern of the incorrect responses by proportion over trial blocks is nearly identical to the inverse of Figure 1. The analysis of variance reveals the proportion and trial block main effects and their interaction all to be reliable. In addition, comparisons of the individual

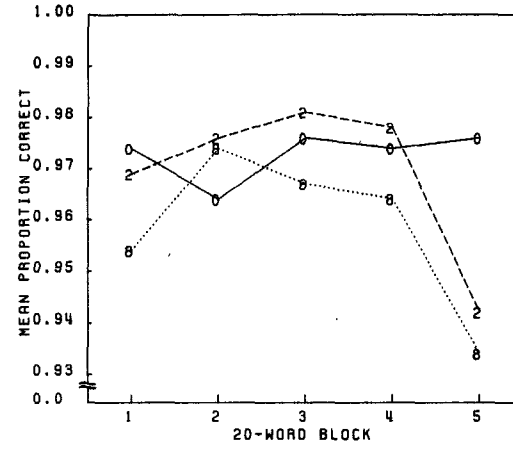

Figure 1. Proportion correct responses over time, Experiment 1 (0 = 0% hostility-related words, 2 = 20%, 8 = 80%).

proportion means at Block 1 show the 80% group to have made significantly more incorrect responses than the 20% or 0% groups, $F(1, 92) = 6.65$, $p < .02$.

The very low number of misses (1% of all trials) did not allow trial block to be included as a factor in the analysis of misses. Although the pattern of mean proportion misses was consistent with the previously given findings (80% group = .018; 20% group = .009; 0% group = .011), the proportion main effect was not reliable.

Reaction times. An analysis of variance of average reaction time,[6] again with proportion and trial block as factors, found a reliable effect of trial block, $F(4, 368) =$

[5] Because the simple main effects of the between-subjects factor at single levels of the within-subjects factor were being tested, the denominator of the F statistic for the contrasts was formed by pooling the between-subjects and within-subjects mean square errors. The denominator degrees of freedom for the corresponding F distribution is given by Satterwaite's f. The numerator for the test of the simple main effects is the mean square for the proportion factor at the given level of the trial block factor (Winer, 1971, pp. 518–532). Due to the unequal number of subjects at each level of the proportion factor, the numerator of the contrasts between the three proportion means within a trial block is $(2A - B - C)^2$ divided by the summed ratios of the squared weights and cell ns (Winer, 1971, p. 215).

[6] This measure included reaction times to both correct and incorrect responses. A separate analysis of correct-response reaction times alone produced nearly identical results.

45.70, $p < .001$. In general, response latencies increased over time, most likely due to fatigue. There was no reliable effect of the proportion factor.

It appears, therefore, that the differential processing of the hostile information had its effect on response accuracy instead of speed. Subjects had been instructed to be both accurate and fast, but when they were not able to perform both accurately and quickly they traded accuracy for speed.

In summary, accuracy reliably decreased as the amount of hostile information presented increased, supporting the argument that the processing of the hostile information would take capacity away from the vigilance task.

Impression of Stimulus Person

An overall hostility rating was computed for each subject by taking the mean of the ratings on the six hostile traits, after reversing the scales for the three kindness traits. Similarly, an overall hostility-unrelated trait rating was computed for each subject by taking the means of the ratings on the six hostility-unrelated traits after scale reversal on the three positive traits. These average ratings were then subjected to a repeated-measures analysis of variance, with proportion as the between-subjects factor and relatedness (ratings on hostility-related vs. unrelated traits) as the within-subjects factor. This analysis is summarized in Table 2.

In general, the higher the proportion of hostile words to which a subject was exposed, the more negative his impression of the stimulus person (see Table 3). Subjects also rated the stimulus person in a more extremely negative direction on those traits related to hostility than on the hostility-unrelated traits. To determine the source of the significant interaction between proportion and relatedness, a series of planned comparisons was conducted. An examination of the simple main effect of proportion on hostility-related traits showed the 80% hostile-word group to have rated the stimulus person significantly more negatively than the other two groups, $F(1, 128) = 4.15$, $p < .05$ (see Footnote 5). For hostility-unrelated traits, however, both the 80% and 20% groups rated the stimulus person reliably more negatively than the 0% group, $F(1, 128) = 10.06$, $p < .01$. For both hostility-related and unrelated traits, therefore, those subjects exposed to more hostile words during the vigilance task rated the stimulus person reliably more negatively, replicating the finding of Srull and Wyer (1979).

Table 2
Summary of the Analysis of Variance of Trait Ratings, Experiment 1

Source	*df*	*MS*	*F*	*p* <
Proportion (P)	2	6.84	3.67	.03
Error between	72	1.86	—	—
Relatedness (R)	1	87.16	98.98	.001
R × P	2	3.34	3.79	.03
Error within	72	.88	—	—
Total	149	—	—	—

Table 3
Mean Rating of Stimulus Person by Trait Type and Proportion, Experiment 1

	Percentage hostile information		
Trait type	0%	20%	80%
Hostility related	6.99	6.78	7.47
Hostility unrelated	4.95	5.77	5.94

Note. 0 = extremely positive; 10 = extremely negative.

Discussion

The ambiguity of the results of the two awareness conditions does not permit an evaluation of the hypothesis of automatic processing of the hostile stimuli until it is demonstrated beyond any doubt that subjects were not aware of the hostile stimuli during the vigilance task. The greater hostile item false alarm rate for the 80% group may well be another manifestation of the automatic processing of the hostile stimuli that presumably produced the differences in impressions of the stimulus person—a bias toward hostile items caused by passive priming. But it could also be argued that the false alarm rate difference indicates a degree of awareness that hostile words had been

presented. Certainly the other results provide substantial support for the hypothesis of automatic priming if subjects' lack of awareness is assumed. Increases in the proportion of hostile words presented decreased task performance, indicating a usurpation of limited processing capacity by the automatic processing of the stimuli, and also increased the negativity of subjects' impressions of the stimulus person.

The persuasiveness of these converging lines of evidence hinges upon a more convincing demonstration of the subjects' lack of conscious awareness of the contents of the flashed words. Accordingly, a second experiment was conducted that was designed to eliminate the problems in interpretation of the awareness conditions used in Experiment 1. The guess-condition procedure was altered so that subjects were told that they *must* guess on every trial, and were prompted to do so if at first they did not. This was intended to lower their guessing criterion and to provide a fairer test of their momentary awareness of the stimuli. In the test condition, instead of taking the recognition test after all 100 trials had been completed, subjects selected the word they thought had been presented on each trial from three alternatives supplied to them on the CRT screen immediately after that trial. Better than chance performance on this test would indicate that subjects were aware of the stimulus words to some degree.

Experiment 2

Method

Overview

The experimental setting, apparatus, and stimulus word list used in the second experiment were the same as those used in the first experiment. The 80% hostile-word list was presented on the CRT screens to subjects at the same random locations and random time intervals. Each word was again presented for 100 msec and was followed immediately by a 100-msec masking string of Xs.

Subjects

Twenty male undergraduates enrolled in the introductory psychology course at the University of Michigan volunteered to participate in the experiment and were paid $3 each for their time. They were randomly assigned to either the guess or the test condition.

Procedure

The procedures for the guess and the test conditions were identical to those used in Experiment 1, except for certain modifications intended to eliminate the earlier deficiencies.

Guess condition. Subjects were told that they must make a guess for each word presented, even making a blind guess if necessary, in order to respond on every trial. If a subject did not guess on a trial, he was prompted by the experimenter to do so. Each subject was first presented with the 10 practice trials, and the experimenter made certain during this time that the subject understood the necessity of guessing on every trial. The experimenter wrote down all guesses for the 100 experimental trials as the subject made them. To give subjects more time to make guesses than they had in Experiment 1, the intertrial interval was increased to 6 seconds.

Test condition. The major change here was that a forced-choice recognition test was used, with subjects indicating which of three words they thought had been presented on each trial. One second after each word flash occurred, three alternatives appeared on the screen. Subjects were instructed to choose the target word from among these alternatives. The choices were presented for 3 seconds, followed by 3 additional seconds before the next trial began. During the latter interval, subjects indicated their choice on an answer sheet that listed the three alternatives for each trial. To help subjects keep track of the trial number, it was displayed for 2 seconds before the trial began.

Subjects first worked through the 10 practice trials, and during this time the experimenter made certain that they understood the procedure. For the 100 experimental trials, the three alternatives consisted of two hostile words and one neutral word, all taken from the 80% hostile-word list. The three words were as equal in length as possible. For the 80 trials on which a hostile word was the target, this word was one of the three alternatives, along with a distractor hostile word and a distractor neutral word. For the 20 trials on which a neutral word was the target, the neutral word was an alternative along with two hostile distractors. The presentation order of the three alternatives was randomized for each trial, with the constraint that the targets and the neutral words appeared first, second, and third equally often.

Results and Discussion

Guess Condition

The 10 subjects made a total of 995 guesses, failing to make a guess on only 5 of the 1,000 total trials. Thus the procedural change was successful in relaxing subjects' criterion for responding, allowing a true test of their degree of sensitivity to the hostile word contents.

The same lenient criterion of correctness was used in the scoring of the guesses as was used in Experiment 1. Subjects correctly

guessed 10 hostile words out of the 800 presented—a hit rate of 1.3%. They were able to correctly guess 6 of the 200 neutral words presented, for a hit rate of 3%. As before, the neutral word hit rate was appreciably higher than that for the hostile words. The doubling of the hostile hit rate from .6% in Experiment 1 is most likely a function of the increase in the proportion of trials on which guesses were made, from .217 in Experiment 1 to .995 in Experiment 2.

Incorrect guesses were once again examined for their relatedness to hostility or to kindness. Both of the judges were blind to the experimental hypotheses (these were not the same judges used in Experiment 1). More words were scored as related to kindness than as related to hostility (10 vs. 6 for Judge 1, 18 vs. 9 for Judge 2).

These results parallel those of the first experiment. There was again a very low hit rate on hostile words, and nearly twice as many kindness-related words as hostility-related words were given as incorrect guesses. Summing together all of the correct and incorrect guesses made that were related to kindness and summing all those related to hostility (in order to obtain an overall index of the amount of awareness of the two types of information) results in 28 kindness-related guesses compared to 25 hostility-related guesses. Again, subjects were at least as likely to be momentarily aware of kindness-related information that was not presented as they were of hostility-related stimuli that were presented. Momentary awareness of the hostile information does not appear to be a viable explanation of the impression-formation results of Experiment 1.

Test Condition

By chance alone, one would expect subjects to guess correctly 33% of the target items, as three alternatives were presented after each trial. Overall, subjects were correct on 30.7% of the 100 words, clearly not better than chance detection of the presented stimulus words. On the 80 hostile-word trials, subjects were correct on 29% of the trials, again performing no better than chance. Among the incorrect responses on the hostile-word trials, subjects preferred the hostile over the neutral distractors 40.9% to 30.1%. This was a significant difference: Hotelling's one-sample $T^2(2, 8) = 36.22, p < .01$ (see Harris, 1975, pp. 67–73). Finally, subjects correctly guessed the neutral items when they were flashed 37.5% of the time, but this was not reliably greater than the chance level of 33%, $t(9) < 1$.

Thus, even when subjects had the flashed word in front of them in a lineup of three alternatives, they were not able to select it at a better than chance level. Furthermore, the significantly higher endorsement rate for the hostile distractor items indicates that although the subjects were not consciously aware of the word contents, their meaning was still influencing subjects' responses.

The outcome of these two additional control conditions allows us to state unequivocally that subjects were at no time during the experiment aware of the contents of the flashed words. Together with the finding of Experiment 1 that vigilance task performance declined with increases in the amount of hostile information presented, this confirms the prediction that the hostile information would be processed outside of conscious awareness.

General Discussion

The pattern of results strongly suggests that the impression subjects formed of the stimulus person was directly related to the amount of hostile information to which they had been exposed (of which they had not been consciously aware). The more hostile information to which rate-condition subjects were exposed in Experiment 1, the more negatively they perceived the stimulus person, on both hostility-related and hostility-unrelated traits.

These findings extend those of Higgins et al. (1977) and Srull and Wyer (1979) by showing that social categories can be primed passively by presenting the priming information outside of the subject's awareness. Subjects in the Higgins et al. (1977) study recalled over half of the trait adjectives that had influenced their interpretation of the behavioral description (Srull & Wyer, 1979, 1980, did not explicitly test subjects' mem-

ory for the priming information). Thus, the present experiment rules out the necessity of momentary awareness and substantial memory of the priming information for passive priming effects.

Which social category was primed by the hostile stimuli is not clear from the impression rating data. The greater the proportion of hostile words presented, the more negatively the stimulus person was perceived, both in terms of hostility-related and hostility-unrelated traits. The hostile stimuli produced a negative halo effect resulting in an overall negative reaction to the stimulus person. This could have occurred in two ways. First, the hostile stimuli could have activated the hostile trait category, with this activation spreading along associative pathways in memory to other trait categories (cf. Collins & Loftus, 1975). The traits that are associated with hostility in one's implicit personality theory (Rosenberg & Sedlak, 1972) are likely to be negatively toned as well (e.g., unreliable, foolish, boring), and so their activation would result in a negative halo effect. Alternatively, perhaps a more general social category, such as "undesirable" or "unpleasant," was directly primed by the hostile stimuli. The activation of this more global concept would then influence all trait ratings in a negative direction, regardless of their relatedness to hostility.

A third alternative interpretation does not assume that any social category was primed by the hostile stimuli. Rather, subjects may have extracted the emotional tone of the information, and this affective processing may have produced both the vigilance task performance decrements (again because of concomitant reductions in the already limited processing capacity) and the differential trait ratings. Hostile words are certainly fraught with emotional content. A recent study by Nielsen and Sarason (1981) found that sexually related words were able to attract attention in a dichotic listening task even when subjects were trying to ignore the channel on which they were presented. Nielsen and Sarason (1981) argued that emotionally salient information can receive processing outside of conscious awareness.

The automatic processing of self-relevant trait words by subjects in the Bargh (1982) study (which also used the dichotic listening technique) can be seen as further support for this interpretation when one considers the emotional nature of information related to the self (e.g., Zajonc, 1980). Of course, the mental categories for sexual as well as for self-relevant stimuli should also be very accessible, given the high frequency of their occurrence in thought. Future studies should focus on the viability of both the category accessibility and the emotional salience accounts of selective attention and automatic processing effects.

The performance curves of the three proportion conditions over the five trial blocks of the vigilance task (see Figure 1) are very suggestive as to the time course of automatic category activation, and therefore to the issue of the conditions necessary for category activation by external stimuli. The 80% hostile-word group made more incorrect responses during the first 20-word block than the other two groups, suggesting that the amount of hostile information in the first block (16 of 20 words) was sufficient to arouse the hostile trait category. The continued presence of the category-congruent information, however, apparently caused the habituation of the category, resulting in markedly lower amounts of hostile-word processing. This is evidenced by the similarity in task performance by the three proportion groups over the middle three trial blocks. As a similar fatigue effect has been found with repeated suboptimal presentations of single letters (Pomerantz, Kaplan, & Kaplan, 1969), perhaps a category also can become fatigued through continuous subconscious activation.

On the final trial block, the performance of both the 80% and 20% groups dropped markedly. The hostile-trait category of the 80%-condition subjects apparently became fully activated again due to the continuing presence of the congruent information, whereas the hostile-trait category of the 20%-condition subjects became aroused for the first time. Given the lower proportion of hostile information for this group relative to the 80% condition, it might well have taken longer for the accumulation of an amount

of relevant stimulation sufficient to activate the trait category. It is intriguing in this light that the number of hostile words that the 20% group had been exposed to just prior to the start of the fifth trial block (20% of 80 words = 16) was the same number to which the 80% group was exposed during the first trial block (80% of 20 words = 16) when their hostile-trait category was first activated. This implies that automatic processing may require a certain amount of external stimulation. It appears that this level can be reached both immediately and through the accumulation over time of congruent information. This implication merits further investigation, as does the apparent habituation of the automatically activated category with continued external stimulation.

The accessibility of categories is an important factor in determining the sources of environmental stimulation that will receive attention, how that information will be interpreted and encoded, and whether it will be remembered. Automatic category activation by congruent information increases the category's acute accessibility and thus its influence on the interpretation of subsequent information. One does not have to be aware of a source of environmental information for it to affect conscious judgments such as impressions of other people. The present research therefore extends the work of Nisbett and Wilson (1977) by showing that not only do people lack awareness of the ways in which they *process* information, they can also be unaware of the *presence* of influential information.

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Helmreich Appointed Section Editor, 1984–1985

The Publications and Communications Board of the American Psychological Association announces the appointment of Robert L. Helmreich, University of Texas at Austin, as Editor of the Interpersonal Relations and Group Processes section of the *Journal of Personality and Social Psychology* for a 2-year term beginning in 1984. Helmreich will complete outgoing section editor Ivan Steiner's term. As of January 1, 1983, manuscripts should be directed to:

Robert L. Helmreich
Department of Psychology
University of Texas at Austin
Austin, Texas 78712.

Manuscript submission patterns for JPSP sections make the precise date of completion of the 1983 volume uncertain. Therefore, authors should note that although the current editor, Ivan Steiner, will receive and consider manuscripts until December 31, 1982, should the 1983 volume be completed before that date, Steiner will redirect manuscripts to Helmreich for consideration in the 1984 volume.