**Title**

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**Journal**

Proceedings of the Annual Meeting of the Cognitive Science Society, 17(0)

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**Publication Date**

1995

Peer reviewed

# A Scowl is Worth a Thousand Words: Positive and Negative Facial Expressions Automatically Prime Affectively Congruent Information in Memory

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### Abstract

Does affective context automatically activate congruent information in memory (e.g. positive context/ positive information) and/or inhibit incongruent information (e.g. negative context/positive information)? Context was elicited by presenting either a positive, negative, or neutral facial expression briefly on a computer screen. Immediately after setting the context, subjects saw a positive, negative or neutral word and had to pronounce it as quickly as possible. The experiment was designed to eliminate subject strategies. The results indicated that subjects pronounce words faster in a congruent context, relative to a neutral baseline. There was no evidence of a slowing down in the incongruent context. These findings suggest that affect automatically activates congruent information in memory. Results are discussed in relation to previous mood findings which suggest that affective priming is not found in semantic tasks.

The central question in this paper is, does affective context automatically activate congruent information in memory (e.g. positive context/ positive word) and/or inhibit incongruent information (e.g. negative context/positive word)? In this paper "affect" will be used synonymously with "valence" and can be either positive or negative. Affect is not equivalent to mood or emotion but is assumed to be a basic dimension or component of these states (Watson & Tellegen, 1985; Davidson, 1992). An automatic process is one that is involuntary, effortless and operates outside of awareness (Shiffrin, 1988; Bargh, 1989; Mathews & MacLeod, 1994; but see Bargh, 1989, for some qualifications regarding this definition).

Bower's (1982, 1991) associative network model suggests that affective context will automatically activate all affectively congruent information in memory. More specifically, activation of an emotional memory leads to the activation of a valence node associated with the memory. Activation of the valence node then leads to activation of all other memories associated with that valence. Memories, once activated, are more quickly and easily retrieved. Bower's model (1982) also suggests that opposite affective states (e.g. fear and joy) may inhibit each other. Though only weakly implied by the model, it is possible that if a valence node is inhibited, then a memory associated with that node may take longer to be activated. This is because when the memory is activated, it will receive less feedback activation then normal from the inhibited affect node.

Consistent with Bower's (1991) position, a number of studies have provided evidence suggesting that the efficiency of recall is biased by the congruence between an existing mood and the affective tone of the material involved, a phenomenon termed mood congruent recall (Blaney, 1986; Bower, 1981; Clark & Teasdale, 1985; Laird, Wagener, Halal, & Szegda, 1982). There is evidence that mood congruent recall may be the result of either an increase in the ease of retrieving congruent memories ("facilitation," Clark & Waddell, 1983) and/or a decrease in the ease of recalling incongruent memories ("inhibition," Natale & Hantas, 1982).

There are, however, ways of explaining mood congruency aside from Bower's associative network model (Blaney, 1986). One alternative explanation is that mood congruency is the result of strategic processes associated with the mood (Blaney, 1986; Mathews & MacLeod, 1994; Perrig & Perrig, 1988; Wyer & Frey, 1983). For example, subjects may engage in a motivated search for data in order to provide an attribution for their mood (Schwarz, Bless, & Bohner, 1991). This search leads subjects to selectively recall information that is congruent with the to-be-explained mood.

Using a lexical decision paradigm that is quite different from the mood induction paradigm discussed above, Hill and Kemp-Wheeler (1989) and Kemp-Wheeler & Hill (1992) found some evidence that appeared to support Bower's model. They asked subjects to determine as quickly as possible whether or not a letter string was a word and found that subjects evaluated an emotionally aversive target faster when it was preceded by an emotionally aversive prime than when it was preceded by a neutral prime (e.g. "snake--wars" trials were faster than "pilot-rats" trials). This finding is consistent with the possibility that the affect elicited by the prime activated all congruent words in memory.

There are problems with the Kemp-Wheeler and Hill studies, however, that make it difficult to use them as evidence in support of Bower's (1991) model. First, there is some question as to whether the neutral prime trials used in those studies allow one to establish a "true" baseline from which to derive facilitation (facilitation is the decrease in reaction time in the congruent context). Facilitation in both studies was derived by comparing the negative prime-negative target condition to the neutral prime-negative target condition. For example, "snake--wars" trials were compared to "paper--nightmare" trials. Researchers have argued that primes used in different conditions should be identical to each other in terms of their physical appearance, ease of encoding, memory demands, and potential to alert subjects (Groot, Thomassen, & Hudson, 1982; Jonides & Mack, 1984). In the Kemp-Wheeler and Hill studies, the neutral primes and valenced primes probably differed not only in terms of valence, but also in terms of alerting or arousal characteristics. If it is assumed that aversive primes may induce some arousal, and there is evidence for this (Kemp-Wheeler & Hill, 1987),then it may be that anything that follows an aversive prime will be responded to more quickly. So the facilitation findings in these studies may be attributable, at least in part, to arousal.

The second problem with the Kemp-Wheeler and Hill studies is intrinsic to the type of task used. The researchers used a lexical decision task that presented the stimuli in prime-target pairs (e.g. in one trial, a subject may be asked to read the prime and then make a lexical decision to a target 200 ms later). When prime and target are presented in pairs, subjects tend to notice relationships between these pairs, which allows them to use various strategies to speed up their lexical decision time (McNamara & Altarriba, 1988; Neely, 1977, 1991; Shelton & Martin, 1992). One such strategy is called semantic matching (Neely, 1991). After lexical access for the target has occurred, but before subjects have time to make their word/non-word decision, they may use information indicating whether the target semantically matches (is related to or semantically similar to) the word prime that preceded it. If there is a semantic match between prime and target, subjects are able to quickly respond that the target is a word since there is never a semantic match when the target is a non-word.

The review of the literature thus far suggests that two basic issues must be addressed when testing for automatic affective facilitation and inhibition. 1) How do you know the results are due to automatic rather than control processes? 2) How do you establish a "true" neutral baseline from which to derive inhibition and facilitation scores?

Ciarrochi (1995) attempted to address both of these issues in the context of a lexical decision task. To deal with the issue of strategies, he used the single presentation lexical decision task, which has been specifically designed to eliminate strategies (McNamara & Altarriba, 1988; Shelton & Martin, 1992). In this task, stimuli are presented singly with no obvious pairings between stimuli. A lexical decision is made to each word, whether it is a prime, target, or filler. A subject might see the following list of stimuli flash up on a computer screen, one at a time: paper, smorf, laughter, valentine, book, telephone, glom, sickness, accident (critical prime-target pairs are underlined). In this task, subjects do not notice relationships between prime and targets (because the pairings are not obvious) and thus are not able to use strategies based on this knowledge to speed up there decision times (McNamara & Altarriba, 1988; Shelton & Martin, 1992).

With respect to the problem of establishing a neutral baseline and controlling for the arousal effects of primes, each prime and target acted as its own control and each prime type and each target type was crossed with one another (Ciarrochi, 1995). For example, the target "vacation" occurred at different times after the primes, "birthday", "cruelty", "seat" and "torsin," and the prime "birthday" occurred before the targets "vacation", "panic", "opinion" and "predent". This design allowed Ciarrochi (1995) to establish a estimate of facilitation and inhibition, while controlling for any unintended differences between words. For example, because the same positive prime occurred before both a positive and neutral target, any differences in processing between those targets could not be attributable to any constant effect (e.g. arousal) of the prime.

Ciarrochi (1995) found that lexical decisions were faster in the congruent context while there was no slowing in the incongruent context. These results were interpreted as supportive of Bower's (1991) model. There was, however, a potential confound in the study. Unintended associations between the prime--target pairs may have influenced the results, despite Ciarrochi's (1995) attempts to eliminate such a possibility. For example, positive words like "birthday" and "valentine" might be linked by some semantic relationship that is independent of valence. Such a link might explain the priming effects.

## Experiment

The present experiment attempted to replicate Ciarrochi (1995) while reducing the possibility that any observed priming effect was due to unintended relationships between primes and targets. To accomplish this, novel facial expressions were used as primes. In an attempt to increase generalizability, the naming task was used instead of the lexical decision task.

Subjects were required to pronounce positive, negative or neutral words as quickly as possible after having been briefly exposed (51 ms) to a picture of a face expressing a positive, negative, or neutral emotion. Murphy and Zajonc (1993) have shown that briefly presented pictures of positive and negative facial expressions can be used to elicit affect automatically.

As in the Ciarrochi (1995) study, each prime and each target acted as its own control, which allowed the elimination of any constant effects of the prime type (e.g., arousal). Potential error due to intrinsic differences between targets (e.g. target length) was also eliminated. Concerning the issue of strategies, the naming paradigm used in the present study has been shown to greatly reduce the possibility that subjects will use strategies (Neely ,1991; Seidenberg, et al, 1984). For example, information about whether the prime and target semantically match may help an individual in the lexical decision task (this is the semantic matching strategy discussed above) but does not help an individual retrieve a phoneme. As a result, subjects do not appear to use the semantic matching strategy in the naming task (Neely, 1991).

Another aspect of the experiment that makes strategy use unlikely is the short SOA (time from onset of the prime to the onset of the target). Neely (1977) has shown that the 85 millisecond SOA used in the present experiment is short enough to eliminate subjects' ability to use certain time consuming strategies.

The following predictions were made: **1)** subjects would be able to retrieve a word's phoneme and pronounce a word more quickly in a congruent context (positive prime/positive target and negative prime/ negative target) than in an incongruent context (positive prime/negative target and negative prime/positive target).**2)** The speed to pronounce targets in a congruent context would be faster than a neutral baseline (affective facilitation). Facilitation effects are calculated by taking the difference in means between a valenced target in a congruent context and a neutral context minus the difference in means between a neutral target in the same two contexts. For example, positive facilitation is equal to [ (positive prime/positive target minus neutral prime/positive target) minus (positive prime/neutral target minus neutral prime/neutral target)]. **3)** Targets in an incongruent context would be slower than a neutral baseline (affective inhibition). Inhibition was calculated by taking the difference in means between a valenced target in a incongruent context and a neutral context minus the difference in means between a neutral target in the same two contexts. **4)** Women would show stronger effects of affective context then men

The fourth prediction requires some explanation. Clark and Teasdale (1985) found that women, and not men, showed mood congruent retrieval of verbal materials. Clark and Teasdale argued and provided evidence for the possibility that, for women, affect may have been more strongly associated with the verbal materials used in the experiment. Ciarrochi (1995) also found that only women showed affective priming effects in a lexical decision task and that affect was more strongly associated with the verbal materials. These findings provided the imputes to test for gender differences in the present experiment. Although less critical to the main purpose of the experiment, differences between gender may be important.

## Subjects

Ninety-Six University of Pittsburgh undergraduates participated in the study for class credit. All subjects were native English speakers

## Materials

The materials consisted of 3 types of primes (positive, negative, and neutral) and 3 types of targets (positive, negative, neutral). Each prime and each target acted as its own control. The target stimuli consisted of 42 positive, 42 negative and 42 neutral words used in previous studies (e.g. Bellezza, Greenwald, & Banaji, 1986). The priming stimuli were 21 colored photos, 7 positive (happy), 7 negative (4 angry, 3 disgusted) and 7 neutral. The photos were of 7 individuals, each of whom posed for a positive, negative, and neutral photo. Practice stimuli consisted of nine additional photos (three positive, negative and neutral expressions) and eighteen words (six positive, negative, and neutral).

## Procedure

The stimuli were presented on the computer screen of a 486 IBM-compatible computer with a VGA non-interlaced color monitor and a 16.72 refresh rate. Reaction time (RT) was recorded by computer.

Subjects were seated in front of a computer and told to rest their chin on a chin rest whenever working through a trial. A microphone was attached to the chin rest, about two inches from the subject's mouth. Subjects were given instructions and 18 practice trials. Subjects started each trial by pressing a space bar. When the bar was pressed, they saw a cross hatch and then a face presented for 50 ms. The screen then went blank and 34 ms later, a word appeared in the middle of the area where the face had been. Subjects pronounced the word as quickly as possible. After the word disappeared, subjects were given feedback on how long it took to pronounce the word. Below this feedback, either the letters "NQ" or "Q" appeared. If "Q" appeared, subjects were asked, "Was that face expressing emotion?" and were instructed to answer either "yes" or "no" "NQ" appeared on two thirds of the trials and stood for "no question." This manipulation was designed to ensure that subjects attended to the pictures.

The main phase of the experiment consisted of 126 prime-target trials. The order of the trials was randomized by the computer.

# Results

The first set of analyses involved mean correct response latencies and mean error rates, collapsed across items. To calculate the error term for the set of planned comparisons, two 3 (prime) x 3 (target) x 2 (gender) x 48 (subjects within gender) ANOVAs were conducted. Dependent measures in these analyses were reaction time and error. The mean square errors were 750.71 for the reaction time analysis and 20.95 for the error analysis (error scores were converted to percentages).

The overall effect of context was significant, $t(752)=3.888$, $p<.0001$. (All comparisons were planned and one tailed unless otherwise stated.) Congruent trials were 10.87 ms faster on average than incongruent trials. Figure 1 shows the overall effect split into facilitation and inhibition for men and women separately and combined. When collapsed across gender, the facilitation effect was significant, $t(752)=-1.82$, $p=.034$, whereas the inhibition effect was not significant, $t(752)=.634$, $p>.1$. (The positive prime/positive target condition and negative/negative conditions were combined to determine the facilitation score. The positive--negative and negative--positive conditions were combined to determine the inhibition score.) The congruent trials were 8.06 ms faster than baseline (facilitation) while incongruent trials were 2.8 ms slower than baseline (inhibition).

The overall effect was qualified by a significant interaction with gender, $t(752)=1.66$,$p=.049$. Affective context had more impact on women's naming time than on

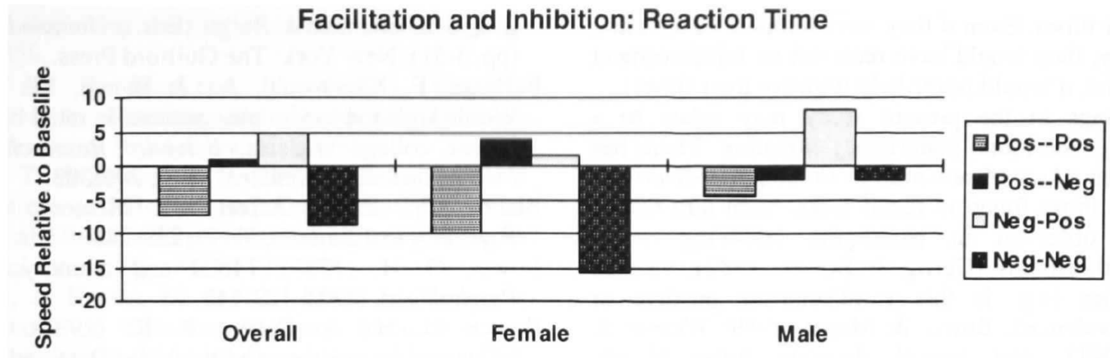


Figure 1: Neg-Pos refers to the negative prime---positive target condition. A negative score indicates that the mean RT was faster than baseline; a positive score indicates that the mean RT was slower than baseline. The Pos-Pos score was derived as follows:[(Positive prime--positive target condition minus neutral--positive) minus (positive--neutral minus neutral--neutral)]

men's. Women's naming latencies for congruent trials were 15.51 ms faster than incongruent trials, $t(752)=-3.921, p<.0001$. Men's naming latencies for congruent trials were 6.24 ms faster than incongruent trials, $t(752)=-1.578, p=.057$.

For women, the facilitation effect was significant, $t(752)=-2.06, p=.02$, but the inhibition effect was not significant, $t(752)=.424$, $p>.3$ (Figure 1). Performance on congruent trials was 12.86 ms faster than baseline and performance on the incongruent trials was 2.65 ms slower than baseline. For men, neither facilitation nor inhibition was significant ($p>.3$) (although the overall effect was significant).

With respect to the error data, the overall effect of context was significant, $t(752)=2.395$, $p=.008$. Pronunciation of words in a congruent context was 1.12% more accurate than in an incongruent context. When the overall effect was split into facilitation and inhibition , neither facilitation nor inhibition was significant ($t<1$). Subjects were not significantly more accurate in a congruent context than a neutral context and not significantly less accurate in a incongruent context than a neutral context.

There was a non-significant trend for affective context to impact men's error data to a greater extent than women's error data, $t(752)=1.57, p=.116$ (two tailed). Men were 1.86 % more accurate in congruent than incongruent trials while women were .38% more accurate. Because the overall gender-by-error interaction was not significant, tests were not performed on men and women separately.

Two post-hoc comparisons were conducted to determine if there was a difference in the speed/accuracy criteria used by men and women while performing the task. There was a non-significant trend for men to respond 14.8 ms faster than women, $t(752)=-.82$, $p=.41$ and a marginally significant trend for men to make .85 % more errors than women, $t(752)=-1.84$, $p=.066$.

## Discussion

The reaction time and error results suggest that affect does automatically influences the accessibility of information in memory. Pronunciation of words was faster and more accurate in the congruent context than in the incongruent context. When the overall RT effect was split into facilitation and inhibition effects, only facilitation was significant.

The overall RT effect was qualified by a significant interaction with gender. Affective context exerted a stronger influence on women than on men, although the effect was significant for both genders. When the overall effect was split into facilitation and inhibition within gender, facilitation was significant for women only and inhibition was not significant for either gender. Gender differences on this task may have been due to a stronger association between affect and verbal materials (as discussed above). Gender differences might also reflect, at least in part, differences in the speed/accuracy criteria used while performing the task. There were non-significant trends for men to make more errors, pronounce words faster, and to show more impact of affect in their error data than women. Future research will be needed to assess these possibilities.

The conclusion that the priming effect resulted from an automatic process might be challenged on the following grounds. Subjects were asked to report whether or not the face prime was expressing emotion. This manipulation was designed to ensure that subjects attended to the pictures. It might be argued that explicitly drawing the subjects' attention to the emotional content of the faces may have led them to engage in some strategy that involved relating the affect of the face with the affect of the target word. This might account for the priming results. There are, however, a number arguments against this position: 1) The time from onset of the prime to the onset of the target (SOA) was only 85 milliseconds. This short interval has been shown to eliminate subjects ability to use certain strategies (Neely, 1977). 2) The naming paradigm, used in the present study, has been shown to eliminate certain strategies like semantic matching (see above) (Neely ,1991; Seidenberg, et al. 1984) 3) Because there was no predictive relationships between primes and targets, subjects could not have used strategies to successfully improve their times. Even if they were tempted to try using some strategy, they would have received no reinforcement for using it (i.e. it would never help improve their times).

The findings in the present study may relate to a discrepancy in the mood congruency literature. There has generally been a lack of semantic mood congruence effects analogous to those found in recall tasks. Such null results have been observed in paradigms involving word-recognition thresholds (Gerrig & Bower, 1982), valence decision times (e.g. is this word/sentence positive or negative in valence?, Bower & Mayer, 1989; Weaver & Mcneill, 1991), and lexical decision times (Clark, Teasdale, Broadbent, & Martin, 1983). Such findings may be interpreted as contradicting Bower's (1981) claim that affect automatically activates all information associated with it in memory. If such a claim were true, then a particular mood should activate all concepts and words associated with it, leading to lower word-recognition thresholds, faster valence judgments, and faster lexical decision times for the activated words.

The present results provide evidence that affective priming effects can be observed in a semantic memory task. How are these results to be reconciled with the null effects observed in mood congruency paradigms? It might be that the affect (or valence) elicited by the facial expressions is completely different from the affect that Watson and Tellegen (1985) found to be one of the basic components of a mood. Thus, the present results might have no bearing on the mood results.

An alternative explanation might start by assuming that the state that is elicited in a mood induction and the brief state that is elicited by the presentation of a facial expression share a common component: valence. (This is not to imply that there are not important differences between a mood and a simple affective reaction. One such differences is probably level of arousal.) The null results in mood studies might be explained as follows: Semantic tasks require subjects to respond as quickly and accurately as possible and thus force subjects to engage in very concentrated, short-lived focusing that might disrupt an induced mood (Bower, 1991). That is, because the subject is focusing on the task, the mood may not be activated at the time of retrieval and thus would have no effect. In the present study, a facial expression was presented less then 100 ms before the person was required to retrieve a phoneme. This procedure probably ensured that affect was activated when the subject made the phoneme retrieval. Perhaps if a procedure is used that ensures a mood is activated when a subject retrieves information in a semantic task, then mood congruency would be observed for such tasks. Future research will be needed to assess this possibility.

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