Journal of Experimental Psychology:
Learning, Memory, and Cognition
1983, Vol. 9, No. 4, 725-729

A Puzzle About Affect and Recognition Memory

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We describe an experiment that was designed to replicate an unpredicted and puzzling asymmetry found in the data of surprise recognition tests given in several earlier, unpublished experiments. In the present experiment, which used foils that were affective transformations of presented sentences, the affectively negative foils consistently produced a significantly higher rate of correct rejections than did the positive foils. This effect occurred in the absence of a difference in hit rates between positive and negative sentences. We consider various possible explanations but argue that the results cannot be accounted for in terms of factors (such as sentence integratedness or congruence) that effect memorability. We propose an explanation in terms of differential changes in the strength of affective responses to positive and negative sentences as a possible way of accommodating the data.

In a series of unpublished experiments investigating the processing of positive and negative sentences, a puzzling and interesting result in the recognition phase of the experiments was discovered: The rate of correct rejections for (new) negative sentences (e.g., *The friendly lady missed the express train)* was repeatedly found to be higher than for (new) positive sentences (e.g., *The rude intruder left the birthday party)*, despite an absence of a corresponding effect on hit rates. This result is puzzling because there seems to be no reason to expect such a difference, and it is interesting because it suggests that affective aspects of stimuli interfere with what are usually considered to be relatively "cold" recognition mechanisms.

The sentences used in the present and in the earlier experiments were all subject–verb–object sentences. Positive sentences described positive events; negative sentences, negative events. In two of the earlier experiments (one involving semantic [plausible/implausible] judgments and the other involving affective [good/bad] judgments as the main task) there was no difference in the hit rates (about 76%) for positive and negative sentences in the surprise recognition test. However, subjects were substantially more accurate in rejecting new negative sentences (about 90%) than they were in rejecting new positive ones (about 76%). Whether the judgment task was semantic or affective made no difference to the pattern of data. The new sentences for which this effect was found were all transformations of old sentences accomplished by changing the verb in some of the original sentences so as to produce new sentences with the opposite valence. For example, a sentence, originally negative, such as *The gifted genius dropped the novel toy,* appeared in the recognition list as the new positive sentence, *The gifted genius invented the novel toy.*

The finding that correct rejections of new negatives was consistently higher than correct responses in the other three categories (new positives, old negatives, and old positives) was neither anticipated nor readily explicable. Because the experiments were not specifically designed to examine this issue, it seemed desirable to attempt to replicate the phenomenon and to eliminate trivial explanations.

This research was supported in part by the National Institute of Education Contract HEW-NIE-C-400-76-0116 and in part by a Spencer Fellowship awarded to the first author by the National Academy of Education. We wish to thank Robert Abelson, Richard Anderson, William Brewer, Ali Iran-Nejad, George Mandler, and Charles Osgood for commenting on earlier versions of this article.

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Method

Subjects, Materials, and Design

The subjects were 12 undergraduate students at the University of Illinois. All were paid volunteers.

Two sets of sentences were constructed, all containing a subject noun phrase, a verb, and an object noun phrase. Both the subject noun phrase and the object noun phrase consisted of a definite article, an adjective, and a noun. Thus, the stimuli, although used for a rather different purpose, in many ways resembled those used by Gollob (1974) and Heise (1969). In both sets of sentences the verb was always in the past tense and in the active voice. Half the sentences were constructed to have an overall affectively positive total valence (+TVAL) for their meaning, and half were constructed to have a negative valence (−TVAL). Within each of these groupings half of the sentences contained a subject of positive valence (+SVAL) and half a subject of negative valence (−SVAL). Further, within each of these divisions half of the sentences had a positive object (+OVAL) and half a negative object (−OVAL), resulting in a completely balanced factorial design with respect to subject, object, and total sentence valence. Eighty sentences were constructed in this way and formed the first set of sentences (List 1).

The second set of sentences (List 2) was created by changing the verb in each sentence of the first set so that TVAL was reversed. All subject/object combinations that were in positively valenced sentences in List 1 were in negatively valenced sentences in List 2. Likewise, negative List 1 sentences were positive List 2 sentences. Associated with each of these two input lists were two recognition test lists. Each of the two recognition lists for a given input list was produced by selecting half the sentences from that input list ("old" sentences) and half from the other input list ("new" sentences). Table 1 provides examples of items used in these lists. Input and recognition lists were crossed to form four list combinations. Three subjects were randomly assigned to each combination.

Procedure

Subjects were instructed to decide whether the overall meaning of the sentence represented "a good thing or a bad thing." They were told to respond quickly without making errors. They received eight practice trials with sentences similar to those in the experimental trials. The 80 experimental sentences were then presented one at a time on a CRT screen in a different random order for each subject. Each trial was initiated by the subject pressing the space bar on the keyboard. *Positive/negative* responses were made with the right and left index fingers. The assignment of response to hand was counterbalanced across subjects. Each trial ended with the presentation of accuracy information, either CORRECT or INCORRECT. Subjects were told that the correctness of their response to any given sentence was determined by whether their response matched the response of 95% of a large group of subjects. These 95% norms were determined in an earlier experiment.

After the 80 experimental trials, instructions for a surprise recognition task were presented on the screen. Subjects were told how to use a familiarity scale and were informed that their responses were not being timed. The scale values 1 through 6, along with descriptions of the meaning of each value, remained on the screen for the duration of the recognition task. The numbers 1–3 were used by subjects to indicate that they believed an item to be new and the numbers 4–6 were used to indicate that they believed the item to be old. The smaller the number,

Table 1
Examples of Sentence Pairs

SVAL	OVAL	TVAL	Sentence pairs
+	+	+/−	The warm blanket covered/smothered the new puppy. The powerful jetliner avoided/shook the quiet hospital. The talented musician staged/canceled the free concert. The intelligent scientist made/forgot the brilliant discovery.
+	−	+/−	The honest detective investigated/overlooked the cruel homicide. The graceful dancer jumped/carried the stagnant sewage. The warm shower cleansed/stung the infected wound. The executive director eliminated/concealed the terrible loss.
−	+	+/−	The wounded criminal saved/shot the harmless baby. The greedy thief returned/stole the priceless necklace. The ugly spider helped/ruined the beautiful roses. The tasteless weeds sustained/poisoned the hearty hiker.
−	−	+/−	The dangerous landslide buried/scattered the rotton garbage. The hateful tramp denounced/conducted the foul torture. The vulgar convict rejected/expressed the greedy desire. The hardened gangster dropped/used the lethal weapon.

Note. Each sentence pair differs only in the verb. The two verbs, separated by a slash (/), are associated with positive and negative values of TVAL—in the corresponding order indicated under the column headed TVAL. SVAL = subject valence; OVAL = object valence; TVAL = total sentence valence.

the greater the degree of belief that the item was a new one.

Results

Reaction Time Data

The main effects of the decision phase were similar to those found in the earlier experiments. The mean time to produce an affective rating was 2,858 msec. There was no effect of TVAL on response time ($F < 1$), but there were significant main effects for SVAL, $F'_{min}(1, 29) = 8.4$, $p < .01$, and OVAL, $F'_{min}(1, 35) = 21.3$ $p < .01$. Sentences with positively valenced subjects or objects were more rapidly rated than were sentences with negative subjects or objects. The average rate of "errors" in the affective rating was 11%. In the analysis of errors, SVAL was significant, $F'_{min}(1, 109) = 6.4$, $p < .05$, with positive subjects producing a higher error rate. OVAL was also significant and positively correlated with error rate, $F'_{min}(1, 53) = 5.7$, $p < .05$.

Recognition Data

Analyses of the data from the earlier experiments had been carried out using both the 6-point familiarity scale as a measure and a dichotomized variable (old/new) as a measure. Both variables yielded essentially identical results. Consequently, for this experiment the results of the recognition task are reported only in terms of the old/new data. An *old* response refers to scale responses 1–3, inclusive, and a *new* response refers to scale values 4–6, inclusive.

Percentage correct data were partitioned into old items and new items for analysis. The results appear in Table 2. The overall average percentage correct for old items was 77%. As in the earlier experiments, there were no effects for any of the valence variables (SVAL, OVAL, TVAL) in the analyses of the old items. However, analysis of the foils (affectively transformed old sentences) produced different results in this experiment, as in the earlier ones. The correct rejection rate for positive TVAL was 78%, and for negative TVAL, 90%, $F'_{min}(1, 64) = 9.5$, $p < .01$. Correct rejection of sentences with positive SVAL was 90%, and with negative SVAL, 78%, $F'_{min}(1, 31) = 5.3$, $p < .05$. Scores for positive and negative OVAL were 88% and 80%, respectively, $F'_{min}(1, 150) = 5.7$, $p < .05$. There were no significant interactions.

Table 2
Proportions of Hits and Correct Rejections for Sentences at Time of Test

	Sentence type				
TVAL	+SVAL +OVAL	+SVAL −OVAL	−SVAL +OVAL	−SVAL −OVAL	*M*
Hits					
+	.78	.77	.77	.80	.78
−	.77	.82	.73	.73	.76
Correct rejections					
+	.85	.82	.80	.63	.78
−	.98	.93	.90	.80	.90

Note. TVAL = total sentence valence; +OVAL = positive object valence; −OVAL = negative object valence; +SVAL = positive subject valence; −SVAL = negative subject valence.

In addition to the above analyses, signal-detection measures were calculated. Sentences with positive and negative TVAL had d's of 2.66 and 3.37, respectively, $F(1, 11) = 6.4$, $p < .05$, indicating better discrimination for negative sentences than for positive sentences. The beta scores for positive and negative sentences were 1.04 and 1.21, respectively, $F(1, 11) = 7.6$, $p < .02$. Subjects thus had a bias toward reporting negative sentences as new. There was also a significant difference between the d' measures for sentences with positive SVAL (3.54) and those with negative SVAL (2.48), $F(1, 11) = 11.26$, $p < .01$, indicating that the higher correct rejection of sentences with positive subjects was due, at least in part, to better discrimination of new from old sentences.

All of these measures were computed on the basis of sentence characteristics (i.e., valence) shared at the time of test. But because each foil was uniquely associated with one of the originally presented sentences, the design of the experiment provided the unusual opportunity to compute d' measures on the basis of shared characteristics at the time of initial presentation. Such an analysis appears to produce opposite results for TVAL, indicating better discrimination for (originally) positive than for (originally) negative sentences; d' for positive TVAL was 3.51 and for negative TVAL, 2.49, $F(1, 11) = 11.55$, $p < .01$. (The results of all other analyses remain unchanged.) The difference between the two analyses can be

reconciled by considering that all changes to initially positive sentences (which the second analysis suggests are very noticeable) are manifested at time of test as new negative sentences (which the first analysis suggests are very noticeable). Thus the two analyses reflect the two (opposite) sides of the same coin. However, in doing so, they provide different perspectives on the data and suggest different interpretations of them. We shall refer to these interpretations as the *appearance of negatives* interpretation and the *change in positives* interpretation, postponing discussion of their implications until after our discussion of the data themselves.

Discussion

As with the original experiments, this experiment clearly demonstrates that although there was no difference in the hit rates, there was a marked asymmetry in the rate of correct rejections for new sentences with negative versus positive overall valence. Because the two forms of each sentence were counterbalanced (each test sentence being an old sentence for some subjects and an affectively transformed foil for others), the results do not seem to be due to a confounding with a materials effect. Furthermore, the fact that the hit rates for positive and negative sentences were virtually identical in this and in two previous experiments militates against an explanation in terms of sensitivity differences between hit rates and rates of correct rejections. It also makes it implausible to argue that this equality of hit rates is merely a fortuitous effect of the level set for the criterion.

An examination of the materials and data suggests that the locus of the effect is not in the verbs. Although the correlation between the valence of the verb and TVAL is positive in three of the four combinations of SVAL and OVAL, when SVAL and OVAL are both negative (the fourth block of examples in Table 1), the correlation is negative. For example, the positive TVAL sentence, *The hardened gangster dropped the lethal weapon,* uses a negative verb, whereas its related negative sentence uses a positive one *(used).* If the effect were merely due to the valance of the verb, it would be difficult to explain why it is greatest (rather than reversed) in this condition (see Table 2, column 4).

The results cannot be explained in terms of differential memorability of positive and negative sentences by, for instance, appealing to characteristics of sentences that might affect sentence memorability, such as valence, distinctiveness, or congruence (e.g., Osgood & Richards, 1973). For example, suppose one were to suggest that congruence affects the memorability of the sentences. Although it is true that some of the negative sentences (e.g., *The famous doctor killed the kind gentleman)* are incongruent, whereas the parallel positive sentences (e.g., *The famous doctor cured the kind gentleman)* are not, the counterbalancing ensured that the old sentences had identical congruence properties to the new sentences. Hence, differences between positive and negative sentences cannot account for both the absence of an effect in old sentences and the presence of the effect in new sentences. Nor can it be argued that the asymmetry in the rate of correct rejections is due to perceived *changes* in congruence, because this factor was also counterbalanced.

Although the results appear to resist these and similar obvious explanations, there remains the possibility that the two interpretations mentioned in connection with the signal-detection analyses can throw some light on the issue. The *change in positives* account, as mentioned earlier, focuses on subjects' sensitivity to changes in the positive sentences. From this perspective, the fact that the changes are realized as new *negative* sentences may not be crucial; perhaps any semantic change to positive sentences is more salient than such a change to negative sentences. On the other hand, it is possible that this superiority for positive sentences only holds for (semantic changes that are also) affective changes. Although the present experiment does not permit these two possibilities to be distinguished (because semantic and affective changes are confounded), we find neither very satisfying. If positive events are less salient than negative events, as has often been suggested (e.g., Boucher & Osgood, 1969), it is difficult to imagine how changes to positive sentences could be more salient than changes to negative sentences. However, if correct, the *change in positives* account identifies a puzzling phenomenon about *positive* sentences, which needs to be explained.

In the *appearance of negatives* interpreta-

tion, the high rate of correct rejections of new negative sentences is an interesting and puzzling phenomenon in its own right—a phenomenon about *negative* sentences. Furthermore, it has the virtue of leading to an explanation that is perhaps less fragile than those considered so far. Suppose that the first, and only the first, exposure to the negative sentences is often accompanied by a particularly strong affective response compared with the response resulting from the positive sentences. If this were the case, then at time of test, an old negative sentence, being the second rather than the initial exposure, would not produce such a strong response and thus would be more difficult to discriminate from old positives on the basis of the (re)experience of it. A new negative sentence, however, would produce the "distaste" or "disapproval" response and in so doing would signal its newness to the subject. Any confidence in such an explanation would require some reason for accepting two key assumptions, namely, that the affective response is particularly strong for (a) the negative sentences on (b) the first exposure.

Evidence showing that the negative sentences were more strongly negative than were the positive sentences positive would lend support to the first assumption. Even a casual perusal of the sentences reveals that this was indeed the case. The second assumption implies a reduction in the intensity of the negative response on the second exposure. One might attempt to justify this by appealing to the "exposure effect," in which exposure alone increases the liking (hence the perceived positiveness) of a stimulus (Kunst-Wilson & Zajonc, 1980; Zajonc, 1968). However, there is research indicating that initially negative stimuli may increase in negativity with reexposure (e.g., Brickman, Redfield, Harrison, & Crandall, 1972; Mandler & Shebo, 1983). A more plausible approach, therefore, might be to argue that the intensity of the affective response is modulated by arousal resulting from the unexpectedness of the described events and that unexpectedness is greatest when the sentence is negative and encountered for the first time. This argument assumes that a reduction in the intensity of the affective response on the second exposure does not require awareness of the prior exposure (cf. Jacoby & Dallas, 1981).

Although some such explanation might account for the high rate of correct rejections for negative sentences, it fails to provide a compelling explanation of the effects for SVAL and OVAL. In the present experiment these effects show up in Table 2 as a decrease in the rate of correct rejections from left to right, that is, a decrease in the rate of correct rejections as the number of positive components decreases. The effects of SVAL and OVAL on negative sentences could be explained by arguing that arousal is increased when the total valence is incompatible with the valence of the individual elements (i.e., when the combination of sentence elements is unexpected). However, one is left with the unattractive prospect of perhaps having to explain the effects of SVAL and OVAL on the correct rejection rate for positive sentences in some completely unrelated manner.

A systematic empirical investigation of the effects that we have described is being initiated but will take a long time to complete. In the meantime, we have written this note to document the effects in the hope that others may be able to propose more promising explanations of them.

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Received August 20, 1982
Revision received January 18, 1983 ■