

Linguistic integration during recognition testing

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Current interpretations of linguistic integration assume that memory integration occurs before test sentences are presented. Using an integrated recognition paradigm like that of Bransford and Franks, subjects in one study were given acquisition sentences prior to testing. In a second study, subjects did not receive the acquisition sentences. In both studies, the subjects were tested for ability to discriminate thematically incorrect sentences from thematically correct sentences under conditions of high or low sentence imagery. Subjects in both conditions were able to locate over half of the noncases when sentences were high in imagery value. This suggests that subjects might be able to comprehend and construct ideas during recognition testing. However, low-imagery sentences produced poorer ability to detect noncase sentences in both studies, suggesting that differences in processing of abstract and concrete sentences exist.

Linguistic integration refers to abstracted memory for semantic ideas, such that the knowledge from two or more sentences becomes integrated into a single memorial representation. Bransford and Franks (1971) have developed a paradigm in which ideas from themes are presented in acquisition sentences. Acquisition sentences consist of sentences that contain one, two, or three ideas. In a recognition test, subjects are given: (1) some original acquisition sentences ("old" sentences), (2) sentences that are consistent with ideas presented in acquisition sentences but contain combinations of ideas that are not contained in acquisition sentences ("new" sentences), and (3) sentences that express incorrect relationships between ideas contained in acquisition sentences ("noncase" sentences). The subjects' task is to decide whether each test sentence is old or new and to give confidence ratings for their judgments. (In Experiment 2 of Bransford and Franks, only "new" sentences are presented for recognition.) The subjects demonstrate little ability to discriminate between old and new sentences, although they are able to distinguish between new and noncase sentences. A linear relationship between confidence ratings and number of ideas expressed in old and new test sentences is also observed. The results have led Bransford and Franks to argue that performance in the recognition task depends upon the

availability of a holistic representation in memory, such that the more ideas contained in test sentences, the more available the representation.

Current interpretations of linguistic integration have failed to consider the possibility that memory integration occurs while test sentences are presented. Information that is contained in test sentences may modify existing representational structures to produce some linguistic integration effects. In addition, information contained in test sentences may permit subjects to infer information that might not have been encoded at the time acquisition sentences were presented. These inferential processes may also help produce linguistic integration effects. However, the work of Moeser (1975) suggests that the ability to utilize such processes may be dependent upon the ability of sentences to evoke imagery. High-imagery sentences may facilitate the integration of information into more complex units, thus producing a more distinct theme. Noncases should be less difficult to locate among high-imagery sentences than among low-imagery sentences.

Two hypotheses can thus be derived. According to one view, subjects who are not presented acquisition sentences should not integrate information in test sentences, since integration is assumed to occur before testing. Thus subjects should not be able to discover noncases under these conditions, regardless of the imagery of test sentences. However, subjects who are presented acquisition sentences should be able to discover noncases, since they presumably have integrated the information expressed in acquisition sentences. According

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to a broader view of integration effects, the inferential processes described above should enable subjects who are presented acquisition sentences and subjects who are presented test sentences only to integrate information and thus discover noncases. Since high-imagery themes might be discernable regardless of whether acquisition sentences are presented (cf. Moeser, 1975), high-imagery sentences should always produce a higher detection rate for noncases than should low-imagery sentences when either test sentences alone or acquisition plus test sentences are presented.

METHOD

Subjects

Fifty-six male and female students enrolled in an introductory psychology course at Purdue University served as subjects. The subjects received course credit for participation.

Stimuli

The high imagery sentences were taken from Experiment 2 in Bransford and Franks (1971). The mean *I* value for the 10 nouns for which the *I* value was available was 6.62 from the Paivio, Yuille, and Madigan (1968) norms. The following four themes or complete ideas were used: (1) "The tall tree in the front yard shaded the man who was smoking his pipe." (2) "The old car pulling the trailer climbed the steep hill." (3) "The girl who lives next door broke the large window on the front porch." (4) "The scared cat running from the barking dog jumped on the table." Each complete idea was used to derive sentences with varying numbers of propositions. For example, the following sentences were derivable from Complete Idea 1. (5) "The tree was tall" (one proposition). (6) "The tree shaded the man who was smoking his pipe" (two propositions). (7) "The tall tree in the front yard shaded the man" (three propositions). As in Experiment 2 in Bransford and Franks (1971), the acquisition sentences contained exactly eight "ones," eight "twos," and eight "threes." Test sentences contained six noncases, such as the following: (8) "The old man who was smoking his pipe climbed the steep hill."

A set of low-imagery sentences was obtained by constructing four complete ideas from nouns with an *I* value of 3.00 or less. The four complete ideas were the following: (9) "The surtax which excluded all deductions covered temporary personnel who were influential." (10) "The abrupt answer after the comparison contained the truth about the incident." (11) "The prevailing attitude about the theory altered the popular misconception." (12) "The gala event in the facility had an outcome which changed the situation." Again, each complete idea was used to derive sentences containing different numbers of propositions. The following sentences exemplify sentences that were derived from the complete idea in Sentence 9: (13) "The surtax excluded all deduction" (one proposition). (14) "The surtax covered temporary personnel" (two propositions). (15) "The surtax which excluded all deductions covered all personnel who were influential" (three propositions). Acquisition and test sentences contained exactly the same number of ones, twos, threes, fours, and noncases as did the high-imagery sentences. The following is an example of a low-imagery noncase: (16) "The personnel who were influential came to the gala event in the facility."

To ensure that sentence sets varied in imagery, imagery ratings for sentences were obtained. Sheets for each of the following were prepared: (1) high-imagery acquisition sentences, (2) low-imagery inability acquisition sentences, (3) high-imagery test sentences, and (4) imagery test sentences. In each set, all sentences were ordered randomly. Next to each sentence, seven

numbers (1-7) appeared. A rating of 1 designated that it was "very difficult" to produce a mental image for a sentence, and a rating of 7 designated that it was "very easy" to produce a mental image. Thirty-two additional undergraduate subjects rated sentences for imagery value. Sixteen subjects were randomly assigned to rate all low-imagery value. The mean imagery rating for high- and low-imagery sentences was 6.42 and 3.41, respectively. This difference was statistically significant [$F(1,30) = 212.79, p < .001$].

Test sentence sets used in the rating task were used in the experiment. The alternatives "YES" and "NO" appeared after each test sentence. Elliptical questions similar to those used by Bransford and Franks (1971) were prepared. For example, the question for Sentences 6 and 14 was "What did?" in both cases.

Procedure

Two studies were conducted. In the memory task study, subjects were told that a series of sentences would be presented and that they would have to write down answers to each question. Acquisition sentences were read in a male voice at a rate of approximately 5 sec/sentence. An elliptical question was asked after each sentence was read, and subjects were required to write down the answer to each question on a piece of paper that was provided. After a 4-sec pause, another sentence was read, another pause was taken, and so on, until all acquisition sentences were read. Twenty seconds after the last acquisition sentence was read, subjects received test booklets. Instructions at the top read: "Now read each sentence below and decide if it is a sentence which was presented previously. If it is, mark YES, and if not, mark NO." Subjects were also instructed to cover each sentence with a piece of paper after making each response. Twenty-eight subjects participated in this condition, of which half received high- and half received low-imagery sentences.

Twenty-eight subjects participated in the test sentence alone study. Again, half of these subjects received each type of sentence. Instructions were as follows: "Please read all of the sentences. Almost every sentence is from one of several themes. Although most sentences clearly belong to a theme, several sentences do not. These sentences are unique in that several ideas from different themes are combined, or that these unique sentences are the only sentences related to one particular idea. Your task is to determine which sentences are thematically related to other sentences by circling YES to the right of these sentences, and circling NO to the right of thematically unique sentences."

Confidence ratings were not taken in either study, because this procedure would have been inappropriate in the test sentence alone study. In addition, James, Hillinger, and Murphy (1977) have shown confidence ratings to be inferior to proportion of "old" responses as a dependent measure in the Bransford-Franks (1971) recognition task. Participants in both studies were given as much time as they needed to complete the task.

RESULTS

The number of "no" responses to noncases was the dependent variable in both studies. In the memory-task study, the mean number of "no" responses was 5.93 for high-imagery sentences and 2.57 for low-imagery sentences. A *t* test revealed that this difference was statistically significant [$t(26) = 10.80, p < .001$]. In the no-memory task study, the mean number of "no" responses was 3.07 and 1.00 for high- and low-imagery sentences, respectively. This difference was also statistically significant [$t(26) = 3.70, p < .01$].

DISCUSSION

The subjects who received high-imagery sentences in the no-memory task study were able to locate over half of the noncases without having been exposed to ideas expressed in acquisition sentences. However, subjects who received low-imagery test sentences only were able to locate considerably fewer noncases. The same pattern of results was observed in the memory task study. Although performance in both studies is not directly comparable because different instructions were used, the overall level of performance (i.e., noncase detection rate) in the memory task study appeared to be higher than that in the test sentence only study.

These results suggest that integration effects may not be attributable solely to processes occurring as a result of presentation of acquisition sentences. If integration effects occurred only during acquisition, then subjects in the no-memory task should not have been able to detect noncases. Activities such as detection of themes occurring at the time of recognition testing may have pronounced effects upon linguistic integration measures. However, the ability to construct and integrate ideas in test sentences depends upon the imagery-evoking potential of test sentences. Apparently, when sentences are abstract and a limited number of sentences are presented, it is difficult to perceive thematic boundaries for each of the four themes. Thus it is difficult to abstract the "gist" of the themes and to establish integrated representations (cf. Moeser, 1975). This inference suggests that concrete and abstract sentences may not be processed in a similar manner, contrary to the view of Franks and Bransford (1972).

The two studies reported in this paper utilized somewhat different instructions. However, conclusions from this research are not based on the assumption that the memory and no-memory studies were absolutely equivalent. Instead, our intention is to propose a logical explanation of what subjects might actually do during recognition testing. The results of the no-memory study show that subjects are able to comprehend and construct ideas expressed in test sentences and that subjects are able to utilize this abstracted information effectively in an integrated recognition test. The parallel results for the two tasks suggest that similar processes occur in both tasks.

Kamil, Schultz, and Bernbach (Note 1) have shown that linguistic integration effects are robust over a wide range of

conditions. The present results suggest that the robustness of these effects may be due in part to integration effects occurring during testing.

Psychologists such as Bransford, Barclay, and Franks (1972) and Jenkins (1974) have argued that the construction of an idea involves more than extracting the literal meaning of a sentence. One's knowledge of the world plays a large part in the construction of meaning. Our studies are supportive of this notion, in that they suggest that the learner may attempt to draw from a number of sources of information when generating output for an integrated recognition test. One important source is very likely the recognition test sentences themselves.

REFERENCE NOTE

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