CHAPTER XI

EXPERIMENT 7

Experiment 7 was conducted to investigate whether the low recall in the 3-coreferent condition in Experiment 4, 5 and 6 was due to the fewer number of CAUSAL connections across the story sentences in the 3-coreferent condition. The concept of CAUSAL connections or conjunctions across sentence or paragraphs has, until recently, been studied and refined mainly by linguists. Among the linguists who have centered their studies on this matter, Halliday & Hassan(1976) present the most detailed descriptions on the problem of connection and cohesion. They classify text cohesion in 3 major types: the lexical cohesion, the referential cohesion, and the conjunctive cohesion. They further classify conjuctive cohesion into 4 types of conjunctive relations; ADDITIVE, ADVERSATIVE, CAUSAL, and TEMPORAL relations. Van Dijk(1977) presents a similar classification of connectiveness or coherence but does not use the concept of cohesion.

Recently, some psychologists have discussed the importance of 'CAUSAL LINKS' (Schank, 1976; Frederiksen,

1977) in text comprehension and text memory. J. Mandler & Johnson (1977) classify the major types of sentence connections into 3 types; 'CAUSE', 'AND', and 'THEN' connections; and they have suggested that 'CAUSE' "connects two nodes in a tighter, more integrated structure than does either THEN or AND(p. 116)." If we stretch this interpretation of the effect of CAUSAL connections further, we could argue that the target word stories with fewer CAUSAL connections could be stored in less well integrated and less coherent units, and that this could cause a poor recall of the story sentences and the target words embedded in it. Since we showed in the discussion of the previous experiment that the story sentences of the 3-coreferent condition had smaller number of CAUSAL connections than did the stories of the 2-coreferent condition, it is highly plausible that the poor recall of target words and sentences for the 3-coreferent condition in the previous experiments could have been produced by this imbalance of the number of CAUSAL connections across the different coreferent conditions. This possibility is tested in the present experiment.

Method

Subjects. The subjects were 15 Queen's University students

registered in an Introductory Psychology class.

Materials. From the 48 sets of story sentences of Experiment 6, story sentences involving 32 of the target words were selected, and these sentences were further modified and reconstructed by controlling the number of CAUSAL connections and ADDITIVE connections across the 4 sentences of each story. The classification of CAUSAL connections and ADDITIVE(NON-CAUSAL) connections was based mainly on Halliday and Hassan's(1976) classification scheme explained in the Discussion section of Experiment 6. If two sentences could be implicitly connected by using one of Halliday's 'CAUSATIVE' conjunctions (e.g., 'therefore '), then the connection was classified as a CAUSAL connection; if two sentences could be connected implicitly, by using Halliday's 'ADDITIVE' conjunctives (e.g., 'and'), the connection was classified as an ADDITIVE connection. In all sentences, the conjunctives (either of CAUSATIVE or of ADDITIVE) were not given explicitly, thereby forcing the subjects to generate these conjunctions implicitly in their effort to connect the sentences.

The number of ADDITIVE connections and the number of CAUSATIVE connections was systematically varied for each story. If there were more than 2 ADDITIVE connections among the 3 sentence connections, the story was classified as an

ADDITIVE STORY; and if there were more than 2 CAUSATIVE connections, the story was classified as a CAUSATIVE STORY. There were 16 ADDITIVE stories and 16 CAUSATIVE stories. The 16 CAUSATIVE stories were further divided into 4 CAUSATIVE stories with no coreferent tie, 4 CAUSATIVE stories with 1 coreferent tie , 4 CAUSATIVE stories with 2 coreferent ties, and 4 CAUSATIVE stories with 3 coreferent ties. The same applied to the 16 ADDITIVE stories. The mean number of propositions in each story was kept around 10 propositions per story.

Procedures. The experimental procedures of Experiment 5 were employed again.

Design. The experimental design was a 4x2 within-subjects design. The two Within-Subjects factors were the number of coreferent ties with 4 levels (0,1,2,3) and the types of stories with 2 levels (CAUSATIVE vs. ADDITIVE).

Results

The number of correctly recalled target words were taken as the score. The mean number of recalled target words as a function of the types of stories and of the number of coreferent ties is shown in Figure 7. The analysis shown in

Table 7.

An Analysis of Variance of the Number of Target Words Recalled as a Function of the Number of Coreferent Ties and the Types of Sentence Connection : Experiment 7.

Source of Variance	Sum of	df	F	p
Number of Coreferent T Ties	4.49	3	2.05	---
Error (a)	30.63	42		
linear	4.00	1	4.97	$p < .05$
error(a1)	11.27	14		
quadratic	0.01	1	0.01	---
error(a2)	12.37	14		
cubic	0.48	1	0.96	---
error(a3)	6.99	14		
Types of Sentence Connections(T)	4.41	1	11.29	$p < .01$
Error(b)	5.47	14		
Interaction : R X T	0.49	3	0.26	---
Error(c)	26.13	42		
linear	0.38	1	0.73	---
error(C1)	7.20	14		
quadratic	0.08	1	0.10	---
error(c2)	10.80	14		
cubic	0.04	1	0.07	---
error(c3)	8.14	14		

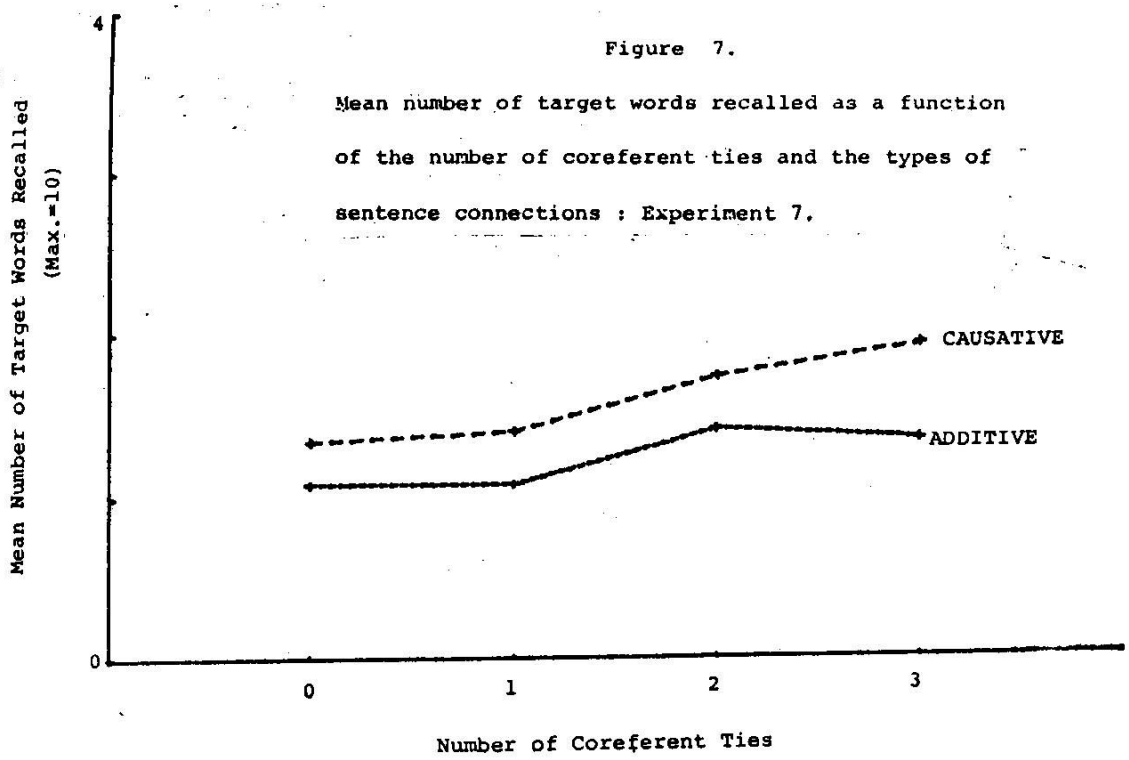

Figure 7.

Mean number of target words recalled as a function of the number of coreferent ties and the types of sentence connections : Experiment 7.

Table 7 discloses that the effect of the types of stories(in other words, the number of causative and additive connections) was significant ($F(1,14)=11.29$, $p<.01$). As shown in Figure 7, the target words embedded in CAUSATIVE stories(with more CAUSAL connections) were recalled better than those embedded in ADDITIVE stories. The number of coreferent ties had a significant linear effect---though very much reduced---on the recall of target words ($F(1,14)=4.97$, $p<.05$). The recall amount showed no significant curvilinear trend with the increase of the number of coreferent ties. Contrary to the results of Experiment 4 and 5, it was a straight linearly increasing function of the number of coreferent ties with recall under the 3-coreferent condition being slightly better than that of the 2-coreferent condition. This tendency for recall to be better for the 3-coreferent condition than for the 2-coreferent condition was clearer in stories with CAUSATIVE connections. However, the interaction between the number of coreferent ties and the types of stories (or types of connections) was not significant ($F(3,42)=0.26, p>.10$), even though the slope of the increase in recall amount across the 4 different conditions was steeper with the CAUSAL stories.

Discussion

From the above results we can infer that the low recall in the 3-coreferent condition of Experiments 4 and 5 was produced mainly by the inequality in the number of CAUSAL connections in the 2-coreferent condition as compared with the 3-coreferent condition. This point becomes clearer when we compare the amount of recall in the 2- and 3- coreferent conditions of Experiments 4 and 5 with the amount recalled in the '2-coreferent CAUSATIVE story' and 'the 3-coreferent ADDITIVE story' of this experiment. The collapsed data of experiments 4 and 5 show that the percentage of target words recalled out of the maximum possible number of target words was 40.67 % for the 2-coreferent conditions and 29.67 % for the 3-coreferent conditions, and in this experiment, it was 43.30 % for the '2-coreferent CAUSATIVE story' condition and 33.32 % for the '3-coreferent ADDITIVE story' condition----the comparison was made in percentages because the total number of target words presented for each condition was unequal in Experiments 4, 5, and this experiment. This analysis reveals that there is a clear correspondence between the above two conditions of this experiment and the results of previous experiments, implying that the previous finding of low recall in the 3-coreferent

condition was mostly due to the fact that the 3-coreferent stories had a greater number of ADDITIVE sentence connections, while the 2-coreferent stories had more CAUSATIVE sentence connections. All these findings suggest that recall of target words is a positive function of the number of CAUSAL connections as well as of the number of coreferent ties, and that the positive linear effect of the number of coreferent ties shows up only if the number of different types of sentence connections is controlled.

With respect to how and why CAUSAL connections produce greater integrative processing and better memory performance, we can propose several interpretations. First, we can consider, as implied in Halliday & Hassan(1976), that CAUSAL connections or CAUSAL relations between two or more sentences are a way of providing abstract coreferences between two or more neighbouring sentences. In causally related events or sentences, an antecedent happens first and then a consequent follows, the former giving the sufficient reasons for the happenings of the latter(Mandler & Johnson,1976); this relation can be rephrased as 'something A happens, and because of that (or as a consequence of that) something B happens.' In this format of rephrasing, the pronoun 'that' is referring to the entire antecedent event. In other words, subjects are implicitly repeating or

activating antecedents again while processing the information presented by the following events. This they do through the use of causative conjunctions such as 'because of that', or 'as a consequence of that.' Thus, we could argue that the presence of CAUSAL relations or connections has the same role as the presence of coreferent items has;it provides subjects with some basis for making referential connections, and thereby to practice retrieving the antecedent information, to comprehend the input sentences more easily, and to employ more inferential information. These advantages would lead to a positive effect on recall performance in much the same way as the coreferent ties did.

Another reason why CAUSAL connections have positive effects on recall might be found in a further aspect of CAUSAL connections: the relational concepts used in the processing of CAUSAL connections are higher level abstract concepts which are more unique and more easily reconstructable than the lower level individual word concepts. This availability of higher abstraction level relational concepts would give extra richness and specificity to the descriptions of the encodings. At the time of recall, these abstract memory codes would make the target information more discriminable from other information and more easily reconstructable. The codes could

serve as retrieval cues much as category names function as retrieval cues in the clustering phenomenon found in free recall.

Yet the main reason why processing certain sentences with causative connections leads to better recall performance could be that the above two processes provide a basis which allows diffusely activated information---literal or inferential meanings---to be integrated into a coherent unit. This entity could then be represented in memory codes of a higher level of abstraction such as the 'thematic frames' of Minsky(1975), the 'scripts' of Schank and Abelson(1977), or the 'discourse topic' of Kintsch(1977). This availability of the total information encoded as an abstract unit would give a greater distinctiveness and specificity to the target encodings, thereby making them more unique, more discriminable, and more easily reconstructable. This could have brought about the strong positive effect of causative connections in the present experiment.

CHAPTER XII

EXPERIMENT 8

In the previous experiment we investigated the effect of the degrees of cohesion between sentences in terms of two types of sentence connections; ADDITIVE and CAUSATIVE connections. Another type of sentence connection listed by Halliday & Hassan(1976) and which contribute to the cohesiveness of a text is the ADVERSATIVE type of connections. As discussed following Experiment 6, the 3-coreferent condition and the 2-coreferent condition differed not only in their number of ADDITIVE and CAUSATIVE connections but also in their number of ADVERSATIVE connections. It is thus possible that the low recall in the 3-coreferent condition in Experiments 4, 5, and 6 could have partially been caused by unequal numbers of ADVERSATIVE connections. This possibility is investigated in Experiment 8, in which the number of ADVERSATIVE connections is explicitly controlled.

Method

Subjects. The subjects were 40 Introductory Psychology students at Queen's University.

Materials. Based on the materials of Experiment 7, a new set of materials was prepared as follows, using 40 target words. For each target word, two stories were constructed; one was a 'CONTRASTIVE' story, and the other was 'NON-CONTRASTIVE' story. A contrastive story was a story in which one of the 4 sentences states an information that is somewhat 'contrary to expectation (Halliday & Hassan,1976)' or 'contrary to the content of the information(van Dijk,1977)' in other sentences. In most cases, a subject reading the sentences could connect them in his thought by using ADVERSATIVE conjunctions such as 'yet', 'but', 'though', 'in fact', 'however', 'instead', 'rather', etc. As in Experiment 7, these conjunctives were not given explicitly in the sentences. Subjects had to generate these conjunctives implicitly when they tried to connect the sentences in a meaningful way (see Appendix I). In some other cases, these adversative conjunctives were not usable, even though two sentences stated some events or happening that resulted in a strong reaction or in a counteraction to the events or things in other sentences. We included these reactive conjunctions, as well as Halliday & Hassan's adversative conjunctions, in the CONTRASTIVE stories. An example of a story with reactive-contrast connections is as

follows.

A cactus had many sharp thorns.

A thorn pricked a toe of a child.

With his teeth the child pulled out the thorn.

The child, in anger, struck the thorn back into the cactus.

All other stories that did not have either adversative connections or reactive connections were classified as NON-CONTRASTIVE stories. Half of the CONTRASTIVE stories and the NON-CONTRASTIVE stories were presented with CAUSATIVE connections, whereas the other half were presented with ADDITIVE connections. Thus, stories connected with 10 of the target words were CAUSATIVE-CONTRAST stories, stories connected with another 10 of the target words were CAUSATIVE-NONCONTRAST stories, those of another 10 of the target words were ADDITIVE-CONTRAST stories, and those connected with the remaining 10 target words were ADDITIVE-NON-CONTRAST stories. To counterbalance the story-specific effect, two lists were constructed so that each target which appeared in a CONTRASTIVE story in one list appeared in a NON-CONTRASTIVE story in the other list, and vice versa. Each subject was shown only one of these two lists.

Procedure. The general procedure was the same as it was in Experiment 7. An additional control of list

presentation was made to insure that a causative story was followed by an additive story, and a contrastive story was followed by a noncontrastive story.

Design. The experimental design was a 2x2x2x2 mixed design with 1 between-subjects factor and 3 within-subjects factors. The between-subjects factor was the list variable with 2 counterbalancing lists; the 3 within-subjects factors were [1] presence of contrast with two levels(CONTRAST vs. NON-CONTRAST), [2] causativeness with two levels (CAUSAL story vs. ADDITIVE story), [3] and the number of coreferent ties with two levels(2 coreferent condition, and 3-coreferent condition).

Results

The number of correctly recalled target words were taken as the score. The mean number of recalled target word as a function of the CAUSATIVENESS and CONTRASTIVENESS of sentence connections, and the number of coreferent items is presented in Figure 8-1. Figure 8-2 further shows the mean number of recalled target words after the data were collapsed across the two levels of coreferent ties. A summary of an analysis of the data is given in Table 8. The table shows that only the main effects of contrastiveness and causativeness were significant. The target words

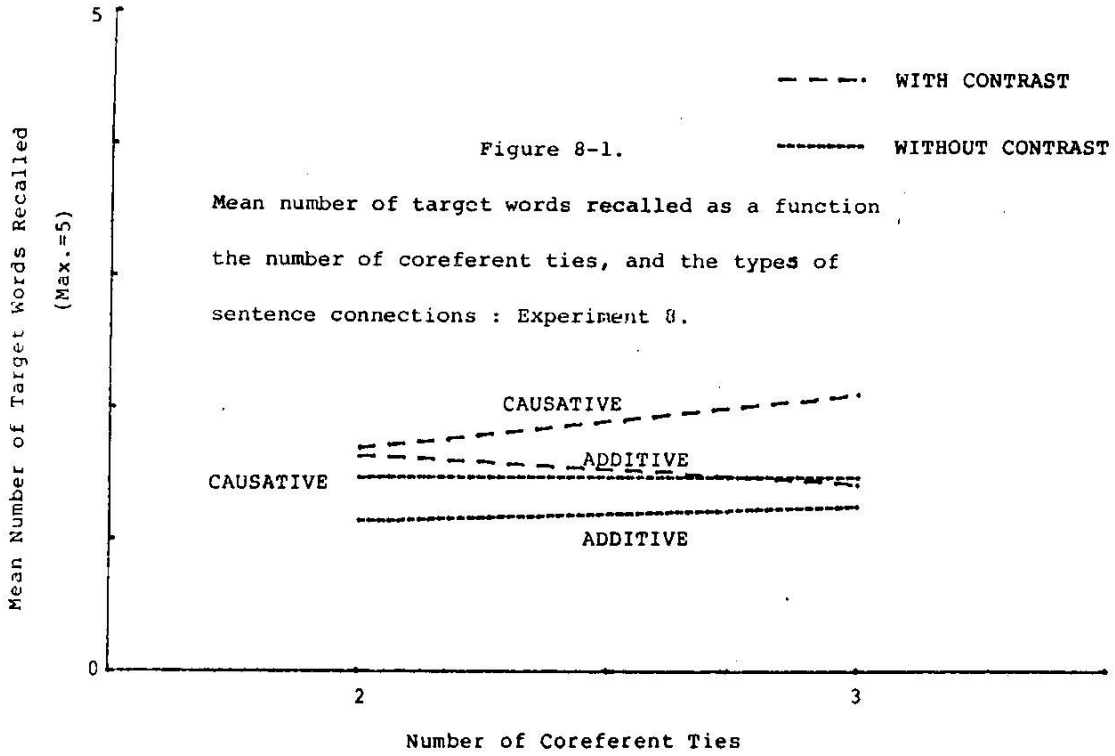

Figure 8-1.

Mean number of target words recalled as a function the number of coreferent ties, and the types of sentence connections : Experiment 8.

Figure 8-2.

Mean number of target words recalled as a function of the CAUSATIVENESS and the CONTRASTIVENESS of each story : Experiment 8.

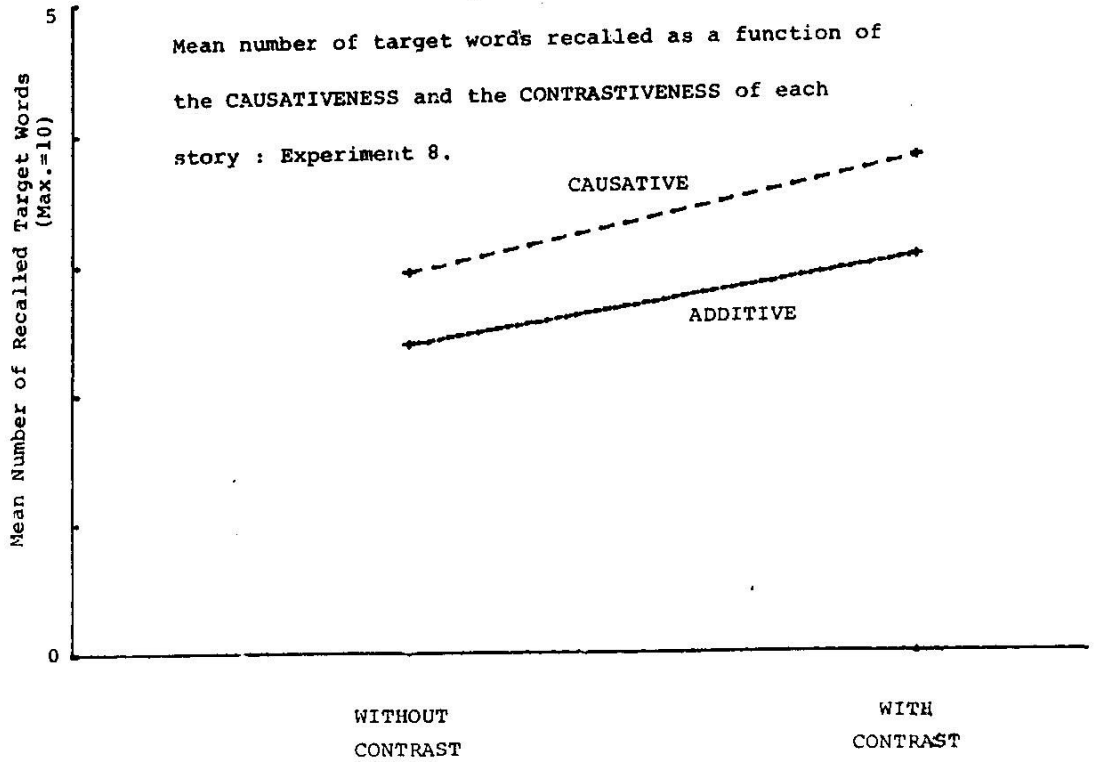

Table 8.

An Analysis of Variance of the Number of Target Words Recalled in Experiment 8.

Source of Variance	Sum of Squares	df	F	p
Lists (L)	0.09	1	0.08	---
Error(a)	35.37	34		
Contrast (O)	10.50	1	14.67	$p < .001$
Interaction : C X L	0.28	1	0.39	---
Error(b)	24.34	34		
Causativeness (C)	7.67	1	11.24	$p < .01$
Interaction : C X L	1.25	1	1.84	---
Error(c)	23.20	34		
Number of Coreferent Ties (R)	0.42	1	0.49	---
Interaction : R X L	1.25	1	1.47	---
Error(d)	28.95	34		
Interactions				
: O X C	0.17	1	0.17	---
: O X C X L	0.17	1	0.17	---
Error(e)	34.28	34		
: O X R	0.03	1	0.04	---
: O X R X C	3.34	1	3.81	---
Error(f)	29.76	34		

(continued from page 121)

Source of Variance	Sum of Squares	df	F	p
: C X R	1.25	1	1.72	---
: C X R X L	0.03	1	0.04	---
Error(g)	24.84	34		
: O X C X R	2.53	1	2.22	---
: O X C X R X L	3.34	1	2.93	---
Error(h)	38.36	34		

presented in contrast stories were recalled better than those presented in non-contrast stories($F(1,34) = 14.67$, $p<.001$), and the target words presented in CAUSATIVE stories were recalled better than those presented in ADDITIVE stories($F(1,34)=11.24$, $p<.01$). There was no clear interaction effect between these two variables ($F(1,34)=0.17$, $p>.10$). There was also no significant effect of the number of coreferent ties, of the lists, and of their interactions with other variables. The non-significant effect of the number of coreferent ties (2 and 3 coreferent ties) in this experiment suggests that the effect of these referential aids to cohesion becomes minimal--- though they play important roles in integrating and giving cohesiveness among the encoding sentences--- when other types of sentential connections(semantic coherence of causativeness and contrastiveness) are clearly present.

Discussion

The results show that the CONTRASTIVE connections had a clear effect on the recall of target words. The effect was as strong as the effect of CAUSATIVE connections. When strong CAUSATIVENESS and CONTRASTIVENESS were present across sentences, the effect of coreferent ties was reduced to a

non-significant level. This implies that once the referential cohesion has provided some coreferent items as the basis for the connection of neighbouring sentences, then the types of semantic cohesion (CAUSATIVENESS, ADDITIVENESS, and CONTRASTIVENESS) take over as the major determinants of further integrativeness and cohesiveness of text.

No definite theory is available to explain why CONTRAST connections produce better recall performance. Clark & Clark(1977), Halliday & Hassan(1976), and van Dijk (1977) have presented simply some classificatory schemes of contrastive conjunctions from the linguists' viewpoint; they have not proposed any psychological theory on the mechanism of the effect of contrastive sentence connections. Lacking any available coherent theory, we propose the following tentative interpretation of the contrast effect which we arrived at by combining the concepts of 'distinctiveness in terms of contrast'of Jacoby & Craik(1979), 'contrast giving new information' of Bobrow & Norman(1975), 'fending off illegitimate generalizations' of Hobbs(1979), and 'contradiction to expectation' by Halliday and Hassan (1976).

We can assume that in processing prose materials subjects usually build up expectations about the development

of the events or theme in the prose, and then test the relevance of the expectations in the course of processing the succeeding sentences. When the prose sentences evolve in the way subjects expect, subjects are merely confirming their expectations, and they are not adding any extra information to the information already activated through their expectation build-up. "If an event occurs that is totally expected, there is little information to be gained from its detailed analysis." ---on the other hand, "if the event deviates from our expectations, or if an event that is expected fail to occur, or if an event that is not prepared for does occur, then these are special events and must be given priority in processing. ... we process them until we know how to account for them (Bobrow & Norman,1975, p. 144)." In other words, the unexpected event or contrastive information forces the subjects to do some deeper and more elaborative processing to bridge the gap between their built-up expectations and the contrastive information. Subjects would have to activate an additional set of 'event schemata' (Rumelhart & Ortony,1977) that can provide a resolution of this unexpected contradiction of their expectation. This would involve a series of new activations of inferential information(mainly of pragmatic inferential information), and consequently the resulting encodings will have fuller and more distinctive descriptions. In turn,

these will make the encodings more discriminable and reconstructable at the time of recall. We could also surmise that all these processes of contrasting would make the total encoding more cohesive and highly distinctive through a mechanism similar to the 'enhanced difference'(Woodworth,1938) which perhaps operates in the case of 'simultaneous contrast effects' in visual perception studies. In addition to this we could further assume that the 'contrastiveness' itself would be stored as an additional memory code of a higher level of abstraction; it could serve as a functional retrieval cue---as the relational concept of CAUSATIVENESS in Experiment 7 does--- at the time of recall, leading the target encodings to be more easily accessed and reconstructed. All or some of these features could have brought about the superior recall of the target words embedded in the CONTRASTIVE stories.

Whether all this extra elaborative processing due to the presence of contrastive information concerns 'spreading' elaboration , or 'integrative' elaboration is a difficult question to answer. One view could be that both spreading elaboration and integrative elaboration are involved; the activation of extra inferential information could be seen as a spreading elaboration, whereas the process of increasing the cohesiveness and distinctiveness of the whole encodings through 'enhanced difference', or through the availability

of the abstract concept of 'CONTRASTIVENESS' could be seen as integrative elaboration. The above interpretation of the effect of CONTRASTIVE sentence connections is still unrefined and speculative. To clarify further how CONTRASTIVE information is associated with better memory performance, we need futher experimental studies on what subjects really do when faced with some contrastive or adversative information.

CHAPTER XIII

GENERAL DISCUSSION

We may begin the general discussion by summarizing the results of the eight experiments.

In Experiment 1 we observed that activating more information through varied encoding sentences entailed better recall performance than resulted from simple repetitive encodings.

Experiment 2 showed that when encoding sentences were varied(different), processing the target words in a greater number of encoding sentences produced better memory of the target words than did processing in a smaller number of sentences.

In Experiment 3, we found that when varied encoding sentences were employed and different numbers of encoding sentences were used, greater coherence (in terms of same-themeness) among the encoding sentences had a more positive effect on recall than did a lower degree of coherence or absence of coherence.

Experiment 4 revealed that once a certain degree of thematic coherence is present among the encoding sentences, then referential cohesion (number of coreferential items) is

important for further integrative elaboration; recall of target words increased monotonically, in general, with the number of coreferential ties. Recall under the 3-coreferent condition was , however, poorer than recall under the 2-coreferent condition.

Experiment 5 showed that we could not attribute the reason for this exception in the 3-coreferent condition to the difference in the number of non-coreferent items.

Experiment 6 showed a tendency for 3-coreferent stories to be recalled by way of a smaller number of verb propositions.

In Experiment 7, it was found that the low performance in the 3-coreferent condition of Experiments 4 and 5 could be partly attributable to the smaller number of CAUSATIVE sentence connections in that condition, and that recall of target words was a positively increasing function of the number of CAUSATIVE connections among the encoding sentences.

Experiment 8 showed further that CONTRASTIVE sentence connections had an effect on recall as strong as that of CAUSATIVE connections, and that when causativeness and contrastiveness were both present, the effect of the number of coreferent ties was no longer significant.

In providing a theoretical background for the interpretation of these eight experiments, we have suggested that the positive effect of deeper or greater degrees of processing is the result of the activation of a greater amount of semantic information and of the integration of the individual units of information into coherent higher level units. The fact that recall is a monotonically increasing function of the number of encoding sentences and the variedness of these sentences indicates that spreading elaboration by activating or employing a greater amount of contextual or semantic information produces better memory performance. The positive effect of 'same-themeness', the effect of the number of coreferent items, and the effect of CAUSAL connections have also shown that integrative elaboration which gives coherence, connectiveness, or cohesiveness to the target encodings also produce better retention performance. The experimental findings of Experiments 3 through Experiment 8 have cast further light on the nature of the interaction between these two modes of elaborative processing. Processing the input materials by activating or employing a greater amount of information has a strong effect on recall upto a certain point. Beyond this point, the effectiveness of proce sing through activating

greater amount of information (spreading elaboration) becomes dependent upon the presence or the degree of integrative elaboration, which integrates the information into coherent units of a higher level of abstraction. Within the integrative elaboration mode, the degree of or the presence of coherence in terms of thematic coherence seems to be the primary factor that initiates the integrative processing and that determines the ease of integrative processing. Once a certain degree of thematic coherence has been established, the integrative elaboration is furthered by coreferential connectiveness among certain word concepts which link encoding sentences, by CAUSATIVE connections and by CONTRASTIVE connections. The CAUSATIVE connections and the CONTRASTIVE connections advance the integrative processing by providing some abstract relational concepts. All these findings indicate that our conception of deeper and elaborative processing in terms of activation of a greater amount of information and in terms of the integration of information into coherent units has substantial support.

There are certain drawbacks in citing the results of this study as solid evidence for our conception of the deeper processing view. The first problem is the effect of the number of coreferent ties. Throughout this study, the number of coreferent ties was defined as 'the number of

times some non-target words recurred across the 4 sentences of each story.' In this definition we have deliberately disregarded the number of times each target word recurred across the 4 sentences in each story. That was because the number of target word recurrence was the same (3 recurrences or repetitions) for each story for all the conditions. If we include the target word recurrence in the number of coreferent ties, then the number of coreferent ties for each condition becomes 3, 4, 5, and 6, instead of 0, 1, 2, and 3. That means the 0-coreferent condition actually had 3 repetitions of target words. Therefore the coreferent effects produced in this study could be seen as being the residual effect beyond the base line effect of 3 repetitions of the target words. This could possibly explain why the effect of coreferenc ties was not so prevalent in our study as Kintsch & van Dijk (1978) would have expected. These authors view 'referential coherence as the most important single criterion for the coherence of text base'. We could have had stronger coreferent effects had we varied the number of target word repetitions as well as the number of non-target word coreferent ties.

The second problem with our study concerns the issue of the classification scheme of CAUSAL, and CONTRASTIVE sentence connections. In constructing and classifying the

sentence materials of Experiment 7 and 8 into different types of connections, we have relied heavily on Halliday & Hassan's (1976) scheme of 'classification of conjunctions' because there was not any psychological work available that gave a broad framework for classifying sentence-connections into different types. Schank's 1976 study could be seen as an exception, but his proposal of 4 types of CAUSAL links is mainly about causal relationship between a subject and object within a sentence rather than about the types of causal relations across encoding sentences. But we found that Halliday & Hassan's classification scheme was not sufficiently broad and detailed enough to account for all the cases of sentence connections of our materials. Thus, some sentence connections were in the hazy boundary where certain sentence connections can be viewed either as CAUSAL connections or ADDITIVE connections, or can be viewed either as CONTRASTIVE connections or NON-CONTRASTIVE connections. These cases could cast doubt on our interpretation of the effects of types of sentence connections. The lack of any clear definitions by the prose memory researchers of CAUSAL, ADDITIVE, and CONTRASTIVE connections adds further difficulties. Further extensive studies on the types of sentence connections and the mechanisms whereby they have effects on memory and comprehension are necessary.

Another drawback in citing the present study as

providing solid support for the positive effect of deeper processing in terms of spreading elaboration and integrative elaboration is that the deeper processing investigated throughout this study was induced and controlled by experimenter imposed conditions and material structures rather than initiated and generated by the subjects themselves. Thus, the present study is vulnerable to the criticism that the elaborative or deeper processing investigated here was a 'passive' elaborative processing rather than a subject initiated 'active' elaborative processing. It is this latter which we should investigate if we want to explain memory performance in terms of the quality of encoding operations subjects impose upon the input materials (Craik, 1973). This problem could be partially solved by employing Bellezza et al.'s (1977) method of elaboration by asking subjects to generate different types of sentences; this method, however, would not be appropriate for inducing integrative processing in terms of using different number of coreferent ties, and different numbers of CAUSAL-ADDITIVE, or CONTRASTIVE connections.

In spite of these drawbacks, the present study has perhaps succeeded in pointing out the reasonableness of conceiving 'deeper processing' in terms of the interplay of

two modes of elaboration, spreading elaboration and integrative elaboration. Furthermore, it suggests some possible tenable interpretations concerning the mechanisms by which these two modes of elaboration bring about better recall performance.

On the question of how spreading elaboration has a positive effect on recall: we discussed, following Experiment 3, two possible interpretations ---the simple 'trace-durability' interpretation and the 'availability of more alternative retrieval search paths'--- and we found them based on a static and too simplistic view of memory. As an alternative we proposed an interpretation of the effect in terms of the specificity of the descriptions of target encodings and the ensuing discriminability and reconstructability of the target encodings. It was proposed that spreading elaboration which activates a greater amount of information entails fuller and more specific descriptions of the target information, and that these fuller descriptions lead to a less confusable, more distinct memory trace, with a greater number of content features on which to base the discrimination of the target trace from other traces and which can be employed for the reconstruction of the original encodings at the time of recall. As discussed earlier this interpretation is quite in accord with Norman & Bobrow's(1979) view of 'specificity

of descriptions.' It is also in line with Jacoby & Craik's(1979) conception of the 'relationship between elaboration and distinctiveness' , and to some degree with Klein & Saltz's 'specification on the cognitive space' theory.

Several possible reasons have been given to explain why integrative elaboration produces better memory performance, These reasons can be summarized as follows.

First, we can attribute the positive effect of integrative elaboration to the fact that integrative processing might involve implicit retrieval of certain information during the input stage. As Carpenter & Just(1977) have pointed out, the basic part of integrative processing is the process of determining how the current sentences relate to the representation constructed from the previous discourse. Therefore, integrative processing always involves the process of reactivating certain 'old' or 'given'(Haviland & Clark,1974) information and relating it to the 'new' or relevant information in the present sentence. This process of reactivation of old information basically involves a process of implicit and repeated retrieval of old information during the processing of the current new information. This process of retrieving old information brings about a positive effect on recall

because this information can be easily accessed at the time of recall since it has been implicitly retrieved during the encoding stage. The plausibility of this interpretation has been indirectly suggested by Carpenter & Just (1977), Kintsch & van Dijk(1978), and Clark & Haiviland(1977); this interpretation, however, was not explicitly discussed by them in context of the general framework of deeper and integrative processing.

A second possible reason for the positive effect of integrative elaboration derives directly from the first possible reason. The presence of 'old', 'given', 'coreferent', and 'repeated' information or related information in the new sentences, makes the input sentences easier to process and to comprehend, thereby allowing subjects to spend their encoding time and effort not so much for processing the literal meanings of the input sentences but rather for processing the sentences further for a deeper (mainly inferential) meaning (Manelis & Yekovich,1976; Kintsch et al.,1975). This would lead to an activation of a greater amount of information, which in turn would give richer descriptions and distinctiveness to the target encodings.

The third possible reason for the positive effect of integrative processing comes from the fact that integrative

processing involves a great deal of inferential processing, as just indicated. In an attempt to construct an integrated representation of the input sentences, subjects usually make inferences not only concerning the coreferential relationships between certain words in a sentence and other words in other sentences, but also concerning the general presuppositional, pragmatic, or thematic meanings. These various inferential processes naturally lead to an involvement of a great amount of information (Paris & Carpenter,1975). The information activated by the inferential processing can be conceived of as being of two types: first lower level information of individual word concepts or propositions; and second, some higher level information of relations (such as, 'sequence', 'causality', 'contrastiveness', 'comparision', 'evaluation', etc.). We could further assume that this inferred information would give---as in the case of spreading elaboration--- additional specificity and richness to the descriptions of the target information. At the time of recall, these fuller descriptions produced by inferential processing would make the target encoding more discriminable and reconstructable, thereby enhancing the recall performance. This process of activating lower and higher levels of information through inference is in a sense similar to that of spreading elaboration; yet it differs from spreading elaboration in

that [1] it is activating mainly the inferential meanings rather than the literal meanings of the input sentences, [2] it is activating more global relational information that can give a higher level of specificity and distinctiveness to the target encodings as well as serving as 'functional retrieval cues' for accessing and reconstructing the target information (Paris & Carpenter,1976); and [3] it produces, as an end product of the integrative inferential processing, an integrated unit of a higher level of abstraction (such as 'a macrostructure in terms of discourse topic'(Kintsch & van Dijk,1978), thereby making another source of the integrative elaboration effect possible.

The fourth source of the positive effects of integrative elaboration could be the availability of the total encoding as an abstract entity, a coherent unit of a higher level of abstraction. We assume that these abstract units---whether they are 'surrogate structures'(Pompi & Lachman,1967), 'memory codes of higher abstraction levels'(Dooling & Christiaansen, 1977), 'thematic frames'(Minsky, 1975)', 'scripts' (Schank & Abelson,1977), or 'the higher level macrostructure in terms of discourse topic' (Kintsch, & van Dijk, 1978),---provide additional higher level descriptions to the target information; and that these abstract descriptions confer a greater

specificity , distinctiveness, discriminability, and reconstructability to the target information. This assumption of different levels of description given by information of different levels of abstraction (which , in turn, were activated by a deeper and more integrative processing) can be seen as underlying a more general interpretation according to which we can relate the concept of 'depth processing' of Craik, the concept of 'higher level abstract memory codes' in the prose memory studies, and the concept of 'descriptions' of Norman & Bobrow(1979) or the concept of 'schema specification' of Rumelhart & Ortony (1977).

In addition to the above possible causes for the efficacy of integrative processing, we could list the distinctiveness given by the CONTRASTIVE connections as a separate source of the integrative elaboration effect. It is argued that the reversal of built-up expectation or the 'fending off of illegitimate generalizations' (Hobbs, 1979) by some CONTRASTIVE sentence connections makes the contrasted and the contrasting information more cohesive and distinctive through some kind of 'enhanced difference' (Woodworth,1938) mechanism and through the availability of an abstract concept of CONTRASTIVENESS. Though a great deal of spreading elaboration is involved in the processing of CONTRASTIVE information, the above enhanced cohesiveness and

distinctiveness could be seen as the main source of contrastive integration effects.

In sum, an interpretation of the possible reasons and mechanisms whereby spreading elaboration and integrative elaboration bring forth a better recall performance has been postulated. This interpretation centers on the concepts of 'specific descriptions', 'distinctiveness', and 'reconstructability' of deeply processed information. Although this interpretation is in agreement with Norman & Bobrow(1978) , Jacoby & Craik(1979), and Dooling & Christiaansen(1977), the general format of the interpretation is very loose and speculative. It needs further conceptual refinement and experimental substantiation.

One of the major concepts that needs further clarification and refinement is the concept of 'distinctiveness.' In the Introduction we have pointed out that the levels of processing approach attributes the depth processing effects partly to the uniqueness or distinctiveness of the memory trace of deeply processed information. This conception of distinctiveness, however, was couched in terms of the distinctiveness that results from the degree of semanticity or of the complexity of contextual information. The possibility that organized and

integrated information itself is more distinctive was not discussed. In the present study we have broadened the concept of 'distinctiveness' as it applies to deeply processed information, by introducing the notion of distinctiveness as given by the availability of information at a higher level of abstraction, such as 'causality' and 'discourse topics'. We even go further in this line of thought by bringing up the conception of 'distinctiveness by contrast.' This conception is to some degree in agreement with Jacoby & Craik's view of 'distinctiveness in terms of the contrast of the target information relative to the general background contextual information', even though our emphasis is more on the aspects of enhanced difference in contrast than on the aspects of figure-groundness in contrast. In a sense we are reintroducing Craik's earlier(1973) conception of 'stimulus saliency or intensity as one of the three major factors that lead to deeper processing', in a slightly modified form. We are suggesting that the positive effect of deeply processed information should be studied in terms of distinctiveness (saliency) produced by 'contrast' and by the availability of higher level memory codes as well as by the great amount of activated information. This conception of distinctiveness provides a more detailed but broader view of distinctiveness than was given by the earlier views on distinctiveness such

as 'distinctiveness as a function of the complexity of contextual information', or 'distinctiveness in terms of cue-sharedness' (Moscovitch & Craik, 1976) Nevertheless, whether the three types of distinctiveness in our view ---distinctiveness produced by the availability of a greater amount of information activated, by the availability of higher level memory codes, or by the presence of some CONTRASTIVE information---are really quite different types and separable is still debatable. Further experimental studies are in need to clarify these points.

Another issue that needs further discussion is the issue of the nature of the interplay of the two modes of elaboration. In Experiment 3, we found that spreading elaboration depended heavily on the presence or degrees of integrative elaboration as the amount of processed information increased. On the other hand, other experiments in this study have shown that integrative elaboration involves a kind of spreading elaboration when inferential processing is involved. To relate a series of items of input information to each other and to integrate them into coherent units a great deal of additional information (mostly relational and other abstract information) are introduced by way of inference. Therefore we could say that spreading elaboration to some degree necessitates

integrative elaboration and that integrative elaboration calls for spreading elaboration. In other words, they are not two independent and successive processes, but are simultaneously and continuously combining two facets of one general elaborative process. To some degree, this view is similar to Bobrow & Norman's(1975) conception of the interplay between 'bottom-up(data driven)' processing and 'top-down (source driven)' processing, and also to Rumelhart & Ortony's(1977) conception of schemata activated by their constituents , with the constituents in turn being activated by their superordinate schemata. We can consider our concept of 'spreading elaboration necessitating integrative elaboration' as a bottom-up, data-driven process that can 'analyze input information with increasing levels of sophistication (Norman,1976)' and that 'engages lower level constituents which in turn suggest and activate its schemata (Rumelhart & Ortony, 1977)'. And our conception of 'integrative elaboration calling for spreading elaboration' can be seen as a top-down, source-driven processing that starts with the higher level expectation of information which is then further refined by analyses of particulars (Norman,1976) and which makes a particular schema specialized by searching for and activating its constituents and particulars (Rumelhart & Ortony,1977). As Norman(1976) puts it, both of these processes are "taking place

simultaneously, each assisting the other in the completion of the overall job of making sense of the world(p.41)." These two views and our view of the simultaneous interplay of the two modes of processing are basically restatements of Neisser's concept of 'analysis by synthesis', and of philosopher Michael Polanyi's thesis that two complimentary efforts contribute jointly to the same final achievement of understanding --- that "an alternation of analyses and integration leads progressively to an ever deepening understanding of a comprehensive entity (Polanyi, 1969, p. 125)."

In general, a highly speculative interpretation of 'spreading elaboration' and 'integrative elaboration' has been put forward and the nature of the interplay between the two modes of elaboration has been discussed. There are still some issues not clarified. We have emphasized the importance of discriminability and reconstructability, but we have not presented a detailed mechanism to account for discrimination processes and reconstruction processes at retrieval. Neither have we discussed the implications of the encoding specificity principle for our conception of elaborative processing. What is more, the effect of elaborative processing was investigated and discussed mainly in terms of the elaboration of individual target words. We have not investigated the elaborative processing of grosser units

such as target sentences, target paragraphs, or other lengthier prose materials. Further studies should be directed to remedy these shortcomings of the present study.

We conclude therefore with the following remarks. In an attempt to interpret the past and current studies in the frame of Craik's 'depth of processing', eight experiments were conducted. The results were discussed in the context of a new version of a 'deeper processing view' which involved the concepts of 'spreading elaboration' and 'integrative elaboration'. Elaborative processing in memory was viewed as an effort on the part of subjects to comprehend and to interpret the target information in the form most compatible with the cognitive structure of the subjects---always steering toward a continuous search for a greater amount of meaningful information, and toward a more meaningful integration of this into coherent units of higher abstraction, thus giving the target information greater distinctiveness and reconstructability. In other words, memory performance is viewed as a function of the quality of analysis and integration subjects have imposed upon the input materials, and as a function of the quantity and quality of meaningful information subjects have extracted through the encoding operations This interpretation answers, to some degree, our initial question of 'why do we

remember some things better ?'. We could tentatively say that we remember some things better because the descriptions of those things in our memory are more distinct and more easily reconstructable at the time of recall since they were encoded in terms of a greater amount of information and with a higher level of integration.

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APPENDIX I. SAMPLE SENTENCES

EXPERIMENT 1 . SAME ENCODING SENTENCE CONDITION
(Number of input sentences = 4)

A stiff harness was fastened to a horse.
A stiff harness was fastened to a horse.
A stiff harness was fastened to a horse.
A stiff harness was fastened to a horse.

EXPERIMENT 1 . DIFFERENT ENCODING SENTENCE CONDITION
EXPERIMENT 2 . (Number of input sentences= 4)

A leather harness was fastened to a horse.
A rancher took a harness off a wounded horse
A harness made a creaking sound.
A harness was studded with silver.

EXPERIMENT 3 . UNRELATED SENTENCE CONDITION

**The sentences of the DIFFERENT ENCODING SENTENCE CONDITION of Experiments 1 and 2 were used again.

EXPERIMENT 3 . DEFINITION SENTENCE CONDITION
(Number of input sentences= 4)

A horse is controlled with a harness.
Leather is used to make a harness.
A harness makes a squeaky noise.
A harness is for a carriage horse.

EXPERIMENT 3 . STORY SENTENCE CONDITION
(Number of input sentences= 4)

(continued on next page....)

(continued)

A stiff harness was fastened to a horse.
The horse didn't like the harness.
The horse bit the harness into pieces.
The rancher put a new harness on the horse.

EXPERIMENT 8 . CAUSATIVE-CONTRASTIVE condition

A stiff harness was fastened to a horse.
The horse didn't like the harness.
The horse bit the harness into pieces.
The rancher put a stiffer harness on the horse.

EXPERIMENT 8 . CAUSATIVE-NONCONTRASTIVE condition

** the last sentence in the above example was changed to;

The rancher put a new harness on the horse.

EXPERIMENT 8 .ADDITIVE-CONTRASTIVE condition

An uncle made a cradle for his niece.
The uncle attached a tiny chime on the cradle.
The uncle mounted the cradle on a rocker.
When put in the cradle, the niece always cried bitterly.

EXPERIMENT 8. ADDITIVE-NONCONTRASTIVE condition

** the last sentence in the above example was changed to;

When put in the cradle, the niece always slept well.

APPENDIX II. SAMPLE SENTENCE MATERIALS FOR EXPERIMENT 4.

' 0-coreferent tie'	
A boy was blowing bubbles with a straw. A bubble flew across the room. A puppy yelped at the bubble. Thw bubble bursted near the T.V. set.	
" 1-coreferent tie'	** the coreferent word is the word 'target'.
An arrow was shot at a target. The arrow whizzed through the air. The arrow missed the target. The arrow fell on the ground.	
' 2-coreferent tie'	**the coreferent word is the word 'wife'
A big diamond was dug up in Africa. A millionaire bought the diamond for his wife. The wife showed the diamond to her friends. The wife lost the diamond in a ballroom.	
'3-coreferent tie'	**the coreferent word is the word 'horse'
A leather harness was fastened to a horse. The horse didn't like the harness. The horse bit the harness into pieces. The rancher put a new harness on the horse.	

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