DEEPER PROCESSING :
SPREADING ELABORATION AND INTEGRATIVE ELABORATION

by

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A thesis submitted to the Department of Psychology
in conformity with the requirements for
the degree of Doctor of Philosophy

Queen's University
Kingston, Ontario, Canada

June, 1979

ABSTRACT

Eight experiments are reported which examine the effects upon later retrieval of processing certain items by way of activating more semantic information from semantic memory, and by way of integrating this information into coherent units. In Experiments 1 and 2, the effect of processing the target words in varied sentence contexts was investigated by presenting the target words in different numbers of input sentences and either in the same(repeated) sentence or in different(varied) sentences. It was found that the greater the number of input sentences, and the more varied the input sentences, the better was recall performance. In Experiment 3 to 8, the effects of processing the target words in coherent or cohesive sentence contexts were examined. Experiment 3 revealed that target words presented in STORY sentences(of higher coherence) were recalled better than those presented in DEFINITION, or UNRELATED sentences (of lower coherence). In Experiment 4, the effect of cohesiveness among the input sentences was investigated by varying the number of coreferent ties (the number of reoccurrences of the same word concept across input sentences). Recall, in general, was better with an increase in the number of coreferent ties from 0 to 2; with 3 coreferent ties, however, relatively low recall was observed. In Experiment 5, we found this low recall in

the 3 coreferent condition could not be attributed to a difference in the number of non-coreferent items. In Experiment 6, the tendency of the stories with 3 coreferent ties to be recalled by way of a greater number of verb propositions suggested that some variables other than the number of coreferent ties might be responsible for the low recall in the 3-coreferent tie condition of Experiments 4 and 5. Experiments 7 and 8 showed that the low performance in the 3-coreferent tie condition could be partly attributed to the smaller number of CAUSATIVE and CONTRASTIVE sentence connections in the 3-coreferent condition. When CAUSATIVE and CONTRASTIVE connections were clearly present, the effect of the number of the coreferent ties was insignificant.

The general findings were further discussed as supporting a new conception of 'deeper processing' in terms of 'spreading elaboration' and 'integrative elaboration'. It was proposed that 'spreading elaboration'-- a type of 'deeper processing' which presumably operates by way of activating a greater amount of semantic information-- and 'integrative elaboration' another type of 'deeper processing' which operates by way of integrating the activated information into coherent units of a higher level of abstraction-- interact with each other and entail better retention performance because they give the target information greater distinctiveness and reconstructability.

ACKNOWLEDGEMENTS

I wish to thank Dr. David J. Murray, my supervisor, for his guidance and supervision of this research, and for his patience and understanding during the completion of this thesis. Thanks are also extended to Dr. B. Butler and Dr. L. Cuddy for serving as members of my committee. Appreciation is also extended to Rizwan Kheraj for his aid in construction of the materials and for his helpful comments. I am also grateful to the subjects for their participation and interest.

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"we can see the two complementary efforts aiming at the elucidation of a comprehensive entity. One precedes from a recognition of a whole towards an identification of its particulars; the other, from the recognition of a group of presumed particulars towards the grasping of their relation in the whole. I have called these two efforts complementary since they contribute jointly to the same final achievement, yet it is also true that each counteracts the other to the same extent at every consecutive step. Every time we concentrate our attention on the particulars of a comprehensive entity, our sense of its coherent existence is temporally weakened; and every time we move in the opposite direction towards a fuller awareness of the whole, the particulars tend to become submerged in the whole. The concerted advantage of the two processes arises from the fact that normally every dismemberment of a whole adds more to its understanding than is lost through the concurrent weakening of its comprehensive feature, and again each new integration of the particulars adds more to our understanding of them than it damages our understanding by somewhat effacing their identity. Thus an alternation of analysis and integration leads progressively to an ever deepening understanding of a comprehensive entity."(Michael Polanyi, 1969,p 125)

PART I. INTRODUCTION

CHAPTER I

OVERVIEW

In our everyday life very many stimuli affect our experience,---things, events, and concepts. Some of them we can later recall clearly, some vaguely, and others we forget completely. Why does this happen? Why do we remember some things better than other things? These questions have always intrigued students of memory. To those who investigate the nature of human memory, the answer to the above question has always been considered the crucial key needed to unlock the mystery of 'how we do remember'. For the past one hundred years of experimental studies on human memory, this question of why some things are remembered better than others have been asked and investigated in different manners , depending on the personal biases of the inquirers or on the prevailing Zeitgeist. Before the 1960s, there were many studies on learning and retention; yet these studies had not produced any global theory to account for why we remember some things better than others and how we remember. These studies were almost entirely centered on the effect of certain stimulus characteristics. They paid

relatively little attention to the question of what we really do when we recall something better.

In the early 1970s Craik and Lockhart(1972) proposed a levels of processing framework , and threw an entirely new perspective on the questions of how we retain and why we retain some things better than others. Their proposal that our retentive abilities were a function of the levels, depth, or degrees of processing imposed on the input materials gave us a framework that was very simple but general enough to help in answering the above two questions to some degree. The main contribution of this levels view is that it has successfully redirected the focus of contemporary memory research from studies of memory as a function of certain material characteristics or studies of memory from a multiple storage view towards studies of memory as it relates to the quality of the encoding processes; that is, the question is now asked, "what do subjects do in memory tasks, and what kind of encoding analysis do subjects perform upon the input materials?" This shift of emphasis has not only produced a number of investigations of the relevance of the concepts and assumptions of this approach, but has also laid the basis for, furthered, and buttressed the rise of studies on those comprehension processes which have become recognized as key

processes in cognition (Perfetti,1976). Perhaps the most important achievement of the depth of processing framework so far is, I suggest, the provision of a broad framework within which most of the memory studies----conventional verbal learning and retention studies, studies on memory as a multi-storage system, and recent studies on prose memory and comprehension ---can be reinterpreted and interrelated in a continuous and integrative perspective.

The present study is an attempt to show how we can bring the past and current studies of memory into a common perspective of a 'deeper processing' framework, and to search for what kinds of conceptual clarifications, theoretical reformulations, and experimental undertakings are needed to steer this integrative framework in the direction of a better understanding of the process of how we retain and the reason why we retain certain things better than others. In the following chapters, I will try, first, to present an integrative perspective of this sort, by reviewing and relating the past and present studies of memory in the context of the depth processing view; there will also be a discussion of the problems and issues of the current depth processing approach. Secondly, an alternative approach to the concept of depth processing will be discussed. Thirdly, eight experiments and their results will be discussed in relation to the above alternative approach.

And finally, a reformulated version of the depth processing approach will be presented, based on the implications given by these experiments.

CHAPTER II

MATERIAL CHARACTERISTICS AND RECALL

From the late nineteenth century to the 1950's memory studies were very much influenced by the paradigm laid down by Ebbinghaus. This paradigm made students of memory limit their investigations of memory to the material characteristics controlled in those investigations. Thus, the basic questions of how we remember and why we remember some things better than others were investigated mainly in relation to the characteristics of small unit materials.

Among the characteristics of individual items investigated around this time, the 'meaningfulness' occupied the strongest position during the first half of this century. In these studies, it was assumed that memory is a function of the meaningfulness of an item, which was defined in terms of the number of associates the item produces or in terms of the ease of producing one or several associates (e.g., Noble,1952). The major interpretation given by this approach of the reason why more meaningful items are remembered better than less meaningful items is postulated as follows; More meaningful items have a greater number of associates, and therefore a more meaningful item has a

greater probability than does a less meaningful item of implicitly generating one or some of the associates during learning session. Thus the subject might stumble on one of these associates at the time of the retention test, which in turn increases the probability that the target item associated with this associate will be recalled. These studies of memory as related to the meaningfulness of the items have failed, however, to provide us clearly with an account of what 'meaningfulness' really is and what kind of memory processes are involved in retention differences for items of different meaningulness. On the other hand, we can view this approach in a positive way; this approach, by attributing the retention difference to 'the number of associates implicitly generated', has laid the basis of the current conception of retention difference in terms of 'the the amount of different information activated'.

The next approach that arose to complement these meaningfulness studies was the approach concerned with the effect of the frequency of usage. This approach, represented mainly by Underwood and his associates (e.g., Underwood and Freund,1970), postulated a view similar to the meaningfulness approach. They stated that an item of higher frequency has a greater number of associates and associates of higher frequency than does an an item of lower frequency. They also stated that an item receives ,during

its presentation, an indirect increase in the strength through the activation of its associates. Since the higher frequency item has a greater number of associates, the indirect increase in the strength of an item through the activation of its associates is greater for a higher frequency target item than for a low frequency target item. This causes the major difference in retention at the time of retrieval test. This theory has not provided us with a general view as to why we retain some things better and what kind of memory processes are responsible for this. The approach was unable to account for the recall difference among items of the same frequencies, nor it was able to say anything on the recall differences associated with certain complex verbal materials, some visual materials, and everyday events that only occur once. The approach viewed the human memory system as passively copying and reproducing. In spite of all these flaws, this approach's explanation of the effects of the frequency of usage in terms of the number of associates activated and the greater discriminability it entails, has succeeded, in my view, in suggesting that the amount of information activated from our memory is a major source of differences in retention. It has, however, not accounted for the question of how we do successfully recall.

Another approach that has emphasized other kinds of material characteristics was that concerned with imagery. This approach -- an early combination of the traditional material-characteristics oriented memory studies and the storage-process oriented memory studies of the 1960s-- postulated that the most crucial factor that determines the memorability of an item is the imaginability of the item and that the higher the imagery evoking power of an item is ,the better is the memory of that item. To explain why high imagery items are recalled better than low imagery items, Paivio(1971) has proposed a dual code theory. This theory assumes that the high imagery items are encoded in two codes, that is verbal codes and visual codes, while the low imagery items are coded in verbal codes only. The effects of these two different codes are additive (Paivio,1975,1977). Thus, the availability of two codes for the high imagery item provides more alternative ways of accessing the stored item than does the single verbal code of the low imagery item . This difference in the number of memory codes (or number of cognitive systems involved;Paivio,1975) entails a difference in retention performance. This version of the dual coding of imagery theory is basically arguing that memory is better if an item is encoded in a greater number of codes or if a greater extent of the cognitive system (verbal representation system

and visual representation system) is involved in processing the input item.

As Paivio(1975) has acknowledged, this position is fundamentally in line with the variable encoding hypothesis which considered that any item we experience more than once is experienced in different contexts, and that the greater number of contexts or amount of contextual information encoded with the target item, the better is the memory. Paivio also stated that high imagery items are more unique and distinctive. This distinctiveness concept is, however, toned down in Paivio's theoretical framework, while Begg(1972,1973) attributed the effect of high imagery items mainly to the distinctiveness and unitizedness of the items. Anderson & Bower(1973) also ascribe the imagery effect---though they argue for one type of representational system(propositional) instead of Paivio's dual representational system---to the distinctiveness of an item at the time of retrieval. This distinctiveness results from the richer, more detailed representation of the items in memory(Anderson & Bower,1973). In sum, studies on the effect of imagery on memory find the source of the easy access and better discrimination of items in the availability of a greater number of codes, or alternatively in more detailed and elaborate information.

In conclusion, studies of memory as a function of certain specific characteristics of the material have suggested the amount of information (whether in terms of associative words or different types of memory codes) activated or involved at the time of storage is the prime source for better retention. Thus, they have prepared the way for the encoding variability hypothesis and the levels of processing approach; these give an emphasis to the effects of variable or more elaborate processing of the input materials. On the other hand, they have not pursued the possibility of explaining memory in terms of the quality of processing at the encoding stage.

CHAPTER III

PROCESSING CHARACTERISTICS AND RECALL

From the early 1960s through to the 1970s, the former emphasis on studies of memory investigating the effects of certain material characteristics had been slowly shifted toward a new emphasis on the studies of memory as a function of encoding, storage and retrieval processes. With this change of emphasis there flourished new types of experimental paradigm which centered upon what the subjects in memory experiments really do with the materials at the time of input and at the time of retention test. In other words, these studies were more interested in the characteristics of processing than in the characteristics of individual materials.

Among these paradigms, the most influential ones in regard to the search for answers to the question of 'why do we remember some things better than others?' were the studies related to the encoding variability hypothesis (especially in its relation to repetition effects), the encoding specificity principle, and the levels (or depth) of processing framework. In my opinion, these paradigms were

important not only because they enabled a formulation of more sophisticated accounts of the questions of how we retain and why we retain some things better than others, but also because they provided some conceptual frameworks that allowed us to reevaluate the past and current studies on memory and to formulate a new framework that provides a perspective whereby these studies can be integrated on a common ground.

1.Encoding Variability and Repetition Effects.

The earliest form of studies investigating deeper processing could be found in those connected with repetition effects. A repeated presentation of an item provides more occasions for processing the item and thereby a greater chance for deeper or greater processing. This possibility of deeper processing of repeated items did not occur to the early researchers of repeated presentation. They simply assumed that repetition somehow entailed an increase in the strength or durability of an item ---as in the case of a repeated impression on wax. They didn't raise the question of the degree or depth of processing that might be imposed on the repeated items. Neither did they investigate the possibility that the retention difference could be attributed to the difference in retrieval accessibility of

repeated items and non-repeated items, rather than to a simple difference in the doubtful concept of trace strength.

Departing from this conventional position, a new interpretation of Martins'(1968) encoding variability hypothesis threw a new light on the interpretation of repetition effects (e.g., D'Agostino & DeRemer,1972). According to this interpretation of encoding variability, the repetition effect can be attributed to the availability of greater contextual information encoded with the target item. The encoding contexts vary across different occasions, and repetition allows us to encode the same item in different contextual codes---that is, with more contextual information. This availability of a greater number of contextual encodings provides more alternative codes or cues through which we search for, and gain access to the target item at the time of retrieval. In short, the encoding variability theory and repetition studies have suggested that more contextually elaborated processing entails better recall performance. Though this implication was not clearly stated by the encoding variability theorists, the idea became the basis for the conception of 'elaborative encoding' in the later version of the depth processing framework.

2. Encoding Specificity Principle and Context Dependent Memory

An integration of this encoding variability concept and the studies on retrieval accessibility(Tulving & Pearlstone, 1966) brought forth the encoding specificity principle by Tulving and Thomson(1973). In this principle Tulving and Thomson search for the source of retention difference in the compatibility or disparity between the encoding context and the retrieval context, and they assume that an item can be recalled if and only if the encoding contexts are reinstated at the time of retrieval. The earlier version of this principle was put forward in a narrow form, and there were some difficulties in accounting for certain specific cases (Lee,1975 ; Santa and Lamwers,1977). And yet its upholders have succeeded in pointing out that a relatively large degree of overlap or compatibility between the encoding environment and the retrieval environment is required to ensure a better memory performance. In other words, according to this principle, the congruity of the encoded information with the information activated at retrieval is as crucial for memory as the amount of information encoded with the target item at the time of presentation. The implications of this principle have greatly influenced, throughout the present decade, a wide range of memory researches. An example of this

influence can be found, as we shall see shortly, in the later version of the depth processing framework. This encoding specificity theory has provided the concept of 'encoding - retrieval' compatibility as an additional principle in explaining the depth of processing effect(Craik & Jacoby,1979). Nevertheless, a broad interpretation of the implication of the encoding specificity principle for the depth processing view is still needed. We shall discuss this issue later.

3. Levels of Processing

Although the studies on repetition, encoding variability, and encoding specificity have redirected our attention toward the importance of the encoding processes in memory, the approach that was most influential in redirecting the major interest of memory researchers from investigations of retention as a function of some stimulus characteristics toward the investigation of memory as a function of the quality of processing operations, was the framework of levels of processing. This approach , which can be traced back to G.E.Muller and Pilzecker's concept of "perseveration" (Murray,1976), was proposed by Craik and Lockhart (1972) in reaction to the prevalent 'separate multi storage' view of memory; it was also an attempt to

incorporate the 'levels of analyses' approaches found in studies of perception and attention processes(e.g., Treisman,1964) into memory studies.

In the early version of the levels of processing view, Craik and Lockhart(1972) proposed that the memory trace is the product of perceptual processes and that the trace persistence is a positive function of the levels of perceptual analysis, with deeper levels of analysis associated with more elaborate, longer lasting, and stronger traces. Craik(1973) refined this view further by presenting a more detailed conception of 'levels' or 'depth', and an experimental paradigm to test this view. He reported some experimental results which showed that the processing of target words at different levels resulted in differences in retention. Retention was best when the target items were processed at the semantic level---the deepest processing level; at the intermediate level of processing---the phonemic processing---the retention was relatively low; and at the shallowest level of processing ---the graphemic structural processing---the retention performance was poorest. In other words, the amount of recall or recognition of the target words was a positive function of the depth or levels of processing, when we loosely define the concept of 'depth' as the degree of semantic involvement. Backed by

these experimental results and paradigm, the levels of processing approach has been widely accepted and has generated a great deal of research, changing the emphasis in memory studies to encoding rather than storage, and pointing out that what the subject does with the material is at least as important as the material itself(Baddeley,1978).

But in spite of all these positive effects, there were some unclear issues in the early versions of this approach. First, the logical basis for assuming that the three different types of processing (graphemic, phonemic, and semantic) could be construed as three hierarchical levels on a continuum of depth of processing was not clear. Second, how one can activate a single type of processing without activating other levels of processing to some degree was not clear. Third, the concept of 'elaboratedness' in the 'elaborate trace' laid down as a result of deeper processing was not stated in testable terms. Fourth, the possibility that the depth processing effect might be chiefly attributable to the retrieval accessibility difference rather than to the increased strength or durability of items processed at the deeper level, was not discussed. Fifth, in relation to the fourth issue, the possible interaction effect of the compatibility between the encoding context and the retrieval context with the levels of processing was not investigated. And finally,

'depth of processing' was talked about in terms of semanticity (whether it was in semantic processing or not) rather than being discussed in terms of the degree or amount of semantic processing.

In later versions, Craik and his associates (Jacoby, 1974; Craik and Jacoby,1976;Lockhart, Craik, and Jacoby, 1976) tried to resolve some of the above problems by de-emphasizing the durability difference of memory traces, by presenting a 'two modes of retrieval' view, and by emphasizing the 'uniqueness' or 'distinctiveness' of memory traces associated with the deeply processed items. They toned down the notion of 'durability of memory trace' by stating that the decay rate of traces would be quite similar regardless of the processed levels (Jacoby,1974), and that all encoded events were equally durable but that some traces became less accessible because they were not distinctive(Lockhart et al., 1976). In their 'two modes of retrieval' view, they discussed how this distinctiveness of traces was related to the retention performance. They proposed that the retrieval processes consisted of a scanning process and a reconstruction process, and that the deeper processing had little effect on the scanning process, while it had a clear effect on the reconstruction process. A deeper encoding of an item entailed easier reconstruction at

the time of retrieval of the original encodings, they argued, because deeper encodings were more distinct and unique.

A third improvement was made by Craik and Tulving (1975), who proposed another version of depth of processing, with more emphasis on the 'spread' or 'elaborateness' of processing within the same level (especially within the semantic level). They argued for and showed by experiments that retention differences could be attributed more to the degrees of encoding elaboration than to differences in depth of the processed levels. In this elaborative or spread encoding view, the encoding operations were considered as flexible operations that were not constrained by a fixed sequence of analysis from a structural level to a semantic level. They further assumed that an effective elaboration specifies the event more uniquely. And they employed two indices of elaboratedness of encodings: first, the complexity of context (the length of the context sentence), and second, the degree of integration or congruity of the context with the target items. The first represented the encodings that specified the event uniquely, and the latter represented the encoding process of providing more congruent or applicable attributes. They supported this proposal through a series of experiments in which they found that (a) a more complex or elaborate context sentence

produced a higher retention performance, (b) a more congruent or relevant context produced a better retention performance, but (c) the complexity effect disappeared when the congruity was not present. In short, they argued that a greater degree of contextual elaboration with a higher degree of congruity between the target item and the context entails a more elaborate (deeper) processing.

This revised version provides a better way of answering the questions raised before; it can also give a better account for the fast accumulating experimental results related to the levels of processing paradigm, and it has laid a stepping stone for the 'distinctiveness' interpretation of levels of processing phenomena--- the view which prevailed at the Rockport symposium on 'levels of processing' (Cermak and Craik,1979). On the other hand, this revised version still has some unclear points that need further clarification and reformulation. Craik and Tulving did not give us a clear conception of what the encoding elaboration or the degree of elaboration really is, nor of what the 'obvious means of independent assessment' of elaboration is (Baddeley,1979). Their definition of 'distinctiveness' of a trace and its relation to the depth of processing was stated vaguely, in narrow terms. They did not fully incorporate the encoding specificity principle

into the depth processing framework. Above all, they were still maintaining a definition of 'levels of processing' based on the notion of perceptual levels.

Since Craik and Tulving's article, a number of studies have been conducted pointing out these difficulties, providing some alternative interpretations of levels effects, and refining the levels view into a broader framework. These studies can be divided into several groups depending upon the major issues they have raised. We shall adopt four main headings under which to discuss them: encoding-retrieval context compatibility, cue-sharedness, elaborative processing, and distinctiveness of encodings.

3a. Subjective Preference and Encoding-Retrieval Context compatibility

This group of studies questions the reason for the superior recall performance of items processed at the semantic level, and proposes some alternative explanations of the retention difference across different levels of processing. It is argued that the depth processing effect is not a positive effect of depth of perceptual analysis performed upon the target items, but a negative effect caused by the incompatibility between the type of processing (structural or phonemic) employed at the shallow levels with the type of processing subjects prefer (semantic processing)

in everyday life situations. "Subjects come to the experiment with a life-long habit of processing English words semantically" (Postman and Krusei,1977); this disposition interferes with the phonemic or graphemic types of processing and entails a poor performance. The question of compatibility between the subject's (life-long) preferential type of processing and the experimenter imposed type of processing also leads naturally to the question of another type of compatibility ---the compatibility between the type of processing required at the time of encoding and the type of processing required at the time of retrieval. Since all the tests of retention in the levels of processing studies were done in terms of semantic recognition or semantic recall of the items---regardless of the types or levels of processing imposed at input---the levels of processing view is vulnerable to the criticism that the levels effect might have been caused by this incompatibility or inappropriateness between the encoding processing and the retrieval processing and that the levels of processing effect could be nothing but this type of incompatibility effect. It may be noted that this argument is basically an interpretation of levels of processing effects in terms of encoding specificity.

This issue was raised in experimental studies by Morris et al.(1977). They found that a large part of the

levels effect could be accounted for by the relevance or appropriateness of the processing employed at input with respect to the processing required at the retention test. The items processed at the phonemic or graphemic level were recognized better than the items processed at the semantic level, given a graphemic or semantic recognition test. Fisher and Craik(1977) and Nelson et al.(1979) further found, however, that there were some levels of processing effects present even when the effect of the encoding -retrieval processing compatibility was removed. The 'semantically encoded and semantically tested' conditions were associated with better retention performance than were either the 'phonemically encoded and phonemically tested' or the 'graphemic encoding and graphemic test' conditions. This consistent presence of the levels of processing effect, even though reduced in strength, suggests to us that we cannot simply reduce the levels effect to the compatibility between the processing type employed at input and that employed at output. The real effect of levels of processing should be explained in other ways.

3b. Cue - Sharedness.

Another group of studies that has provided a more refined view of the levels of processing effect comes from an attempt to reformulate the concept of 'uniqueness' or

'distinctiveness' of memory traces in terms of contextual cue-sharedness.

Following Lesgold and Goldman's(1973) studies on the feature-sharing effect and Watkins and Watkins'(1975) studies on the 'cue-overload' effect, Moscovitch and Craik(1976) proposed that some of the levels of processing effect could be attributed to the effect of different degrees of cue-sharedness among different levels of processing; that is, the retention difference between semantic processing (deeper level) and phonemic or graphemic (shallow) level processing might partly be due to the difference in the degree of sharing the same contextual (cue) information by a target item with other input items. In other words, a semantic encoding context is less similar to, shares fewer features with, and is more discriminable from other semantic encoding contexts, while a graphemic or phonemic encoding context shares more features with other graphemic or phonemic encoding contexts. Because this contextual cue information is shared less with others, a target word processed at the semantic level is more discriminable and is better recalled or recognized. Moscovitch and Craik cited some experimental evidence that supported this argument. They further showed that there were still some effects of levels of processing even when the cue sharedness effect was deducted from the total effect of

levels of processing. The semantic processing still showed superiority to other types of shallow processing. On this ground, Moscovitch and Craik concluded that both the 'principle of depth' and the 'principle of uniqueness in terms of cue-sharedness' were needed to account for the levels of processing effect.

When we review these two groups of studies---the studies on 'encoding-retrieval processing compatibility' and the studies on 'cue-sharedness'---we find that these studies are incomplete in two respects. First, we do not have concrete experimental evidence for the presence of the levels of processing effect stripped of both the cue-sharedness effect and the input-output compatibility effect. Moscovitch and Craik's study(1976) shows us the presence of the levels of effect after the cue-sharedness effect is removed, while Fisher and Craik(1977) and Morris et al.(1977) give us the levels effect after the effect of the input-output processing compatibility is removed. But we do not have, to my knowledge, any evidence for the levels of processing effect free of both cue-sharedness and compatibility effects. Second, these two groups of studies have not succeeded in providing us with a detailed conception of 'elaboratedness' and 'distinctiveness' of memory traces. Moscovitch and Craik's conception of

uniqueness or distinctiveness in terms of cue-sharedness is a narrow conception. This conception of uniqueness is unable to account for the general distinctiveness produced by the degree of integration of the encoded features or by the degree of elaboratedness of encodings. We need a further clarification of the concepts of elaborative processing, distinctiveness, and of their interaction.

3c. Elaborative Processing

In their 1975 version of the depth of processing view, Craik and Tulving put emphasis on 'elaborative processing' or 'encoding elaboration' as terms more descriptive of the effect of degrees of deeper processing than was the depth of processing 'metaphor.' Nevertheless, as we discussed earlier, this concept of 'elaborate processing,' 'encoding elaboration,' or 'spread of processing' by Craik and Tulving has some unclear points that need further discussion. We may begin by remarking that Craik and Tulving were not clear about what 'encoding elaboration' or 'the degree of elaboration' means or stands for. It is necessary to define the nature of elaborative encodings and to manipulate this elaborative encoding process in more definite testable terms, rather than simply state it as "all kinds of further processing (after the initial recognition) within the

semantic level." Elaborative encodings may mean simply the continual addition of semantic features, thereby increasing the total number of encoded features. It may also mean the continual attempts on the part of the subjects to organize or to integrate the processed features into more meaningful units, thereby producing a better configuration of the collection of encodings. Or it may mean both of these two processes.

Without a clear assumption about the nature of elaborative encodings, Craik and Tulving investigated the effect of the degrees of elaboration. They assume that elaborative encodings---whatever their nature may be--- are totally dependent upon the contexts, and that the degree of elaboration is a simple function of contextual complexity or contextual congruity (between the contexts and the target items). In other words, they implicitly assume that encodings become more elaborate, if the complexity of the context (e.g., the length of the context sentence) is increased, or the congruity between the target items and contexts is increased. By restricting themselves to this assumption as the basis of their discussion of elaborate encoding processes, Craik and Tulving do not investigate other kinds of degrees of elaboration (such as the total number of encoded features, or the integratedness of the encoded features).

However, progress has recently been made by others in reformulating the concept of 'elaborative processing' into a more refined and testable one. Herriot(1974) proposed that the depth of processing effect could be attributed to the difference in the number of attributes available at retrieval, and that a greater number of memory codes or attributes provided better discriminability: Frase and Kammann (1974) showed that a processing of a target item in two different semantic categories produced a better retention performance than processing it in a single category. Klein and Saltz (1976) and Battig and Epstein (1977) reported that a broader processing in terms of two or three semantic dimensions which were relatively uncorrelated produced a better retention performance than did a narrower processing in terms of two or three semantic dimensions which were highly correlated. Moreover, Paivio(1975) and D'Agostino et al.(1977) brought the dual coding theory of imagery and the levels of processing view onto the common ground of the 'effect of the number of codes activated by the orienting task,' and showed that the effect of these codes at retrieval were additive. Goldman and Pellegrino's (1978) study on the effects of multiple processing within the semantic domain or across different domains can also be interpreted along the same lines. Finally Anderson(1976)

argued that the effect of deeper processing or elaborative procesing lay in the greater availability of productions of redundant connections across propositions or idea nodes, thereby producing redundant retrieval paths.

These studies are basically an extension of the elaborative - spread processing concept of Craik and Tulving(1975), but they go beyond Craik and Tulving's limited conception of elaborative encodings of contextual congruity or contextual complexity in that they are arguing for a broader conception of elaborative processing in terms of the number of encodings, number of semantic dimensions or features activated: in other words, the amount of information activated and involved from our semantic memory.

Once 'depth of processing' is approached in terms of the amount of information activated in semantic memory, a new way is opened up of viewing 'depth of processing', namely, viewing it, not in terms of perceptual levels, but in terms of the degree or depth of comprehension. It is also a way of relating the 'depth of processing' concept to modern neo-Bartlettian studies of prose memory, since recent studies on comprehension and prose memory have emphasized the activation of larger and larger domains of knowledge as a factor in the comprehension and remembering

of prose.

Even before the formal launch of the levels of processing view in 1972, there were some studies that argued for a view of memory as a function of depth of comprehension. Rohwer's (1966) paired associate learning studies with contextual sentences, and Pompi and Lachman's (1967) studies with thematic cues showed retention performance which was a positive function of the extent of knowledge activated during the processing of the target words. Bobrow and Bower (1969) interpreted their paired associate learning data using the term 'depth of comprehension' explicitly. This line of approach has been kept alive by the Lachman and Dooling group's 'thematic effect' studies (e.g., Lachman & Dooling,1974)---these are a contemporary version of the Würzburg School's 'set effect' studies; by the Vanderbilt University group's 'inference-integration' studies (e.g., Bransford & Johnson, 1973); by the studies of Norman and Bobrow(e.g.,1976) on the degree of 'descriptions'; and by the researches of yet others (e.g., Haviland & Clark,1974; Carpenter & Just,1977). All of these studies showed that certain sentences or prose materials could be recalled differentially depending on the degree, extent, or type of knowledge brought to, being activated, or being contributed to the comprehension of those materials. The views expressed in these studies can be

rephrased as asserting that retention is a by-product of an effort to comprehend; that retention differences can be attributed to differences in the degree of comprehension or to differences in the extent of the knowledge system employed to understand the input materials; and that the better comprehended materials, or the materials which activated a greater extent of knowledge requisite for comprehension, have more detailed descriptions (Bobrow & Norman,1979), are more specified (Klein & Saltz,1976), are more distinct and discriminable from other information (Bobrow & Norman,1979; Stein et al.,1978; Klein & Saltz, 1976). This approach is basically in line with the approach that tried to refine the concept of 'elaborative processing' in terms of number of encodings and number of processed semantic features or dimensions. Both of them are arguing for a reformulation of the 'deeper and elaborative' processing in terms of the amount of information activated within our semantic memory or knowledge system.

All these studies ostensibly connected with 'elaborative processing' were put forward in relative isolation and were dispersed loosely in different fields of memory research. It seems we need an attempt to interrelate these scattered piecemeal views, and integrate them into a broader conception of 'elaboration.'

3d. Distinctiveness of Encodings

This effort to refine the concept of 'elaborative processing' in terms of the activation of a greater amount of information leads us to another major issue connected with the depth of processing view;namely, the concept of 'distinctiveness' of the encodings or the memory traces. As discussed earlier, the original conception of distinctiveness referred to the distinctiveness of a whole trace as it resulted from an elaborate encoding. Later, however, in Moscovitch and Craik(1976), we find this conception has somehow branched into two kinds of uniqueness; the uniqueness in terms of cue-sharedness and the uniqueness or distinctiveness of the whole trace. This leaves us with the unanswered question of 'what does the distinctiveness of the elaborate memory trace really mean?' and to the associated question of 'how can we define and specify it and how can we approach it experimentally?' There are a few studies that have tried to answer these questions by refining the concept of 'distinctiveness' as it relates to the concept of elaborative processing. Although they do not explicitly discuss distinctiveness or uniqueness, Klein and Saltz(1976) attribute the distinctiveness of a deeper processed item to a precise specification of the location of the target words in cognitive space; they propose that through the activation of a greater number of specified

dimensions a concept is more precisely specified in cognitive space, and this in turn results in better recall performance. In other words, their basic idea is that deeper encodings will be more easily retrieved because they are more uniquely specified and thus more discriminable from other encoded events. Morris et. al.(1977) and Stein et.al.(1978) present a similar view. They propose that distinctiveness is the product of an effective elaboration that activates our knowledge system precisely to comprehend the unique aspects of the target items relative to the events in which they are embedded and hence differentiate them from the contextual events and other potential inputs. Norman and Bobrow(1976) propose a similar interpretation. They view distinctiveness in terms of the elaborate contextual discriptions that disambiguate the target items from the retrieval context, and thereby entail a better addressing of the trace at the time of the retention test.

All these views present some advanced conception of distinctiveness by discussing the relationship between elaborative processing and distinctiveness in detail. Jacoby & Craik(1979) adopt a similar view and state that "the fuller description would also serve to specify the object among other less similar sets of alternatives(within the semantic encoding dimension,at least). Thus more

complete descriptions" --i.e., deeper elaborative encodings -- "confer both greater distinctiveness and greater generality as a basis for discriminating one object from others" (p.4). They further suggest a better way of studying the concept of 'distinctiveness' in terms of 'contrast' relative to the contextual events. All these revised interpretations of the concept of 'distinctiveness' provide a way of specifying and investigating the concept in terms of the characteristics of elaborative processing. Nevertheless, the views are still in the developing stage. We need a more detailed theory of the relationship between elaborative encodings and distinctiveness---a framework that can give us a broader conception of 'depth of processing; and that can account not only for the results of past studies on levels of processing effects, but also of other related studies in prose memorry and comprehension.

4. Levels of Abstraction

With all these modifications and refinements of the concepts of 'elaboration' and 'uniqueness,' the new version of the 'depth processing' view is still not broad enough to give a proper account of the wide variety of research results in the area of prose memory. It does not properly explain why the gist or content rather than the

details or forms are better remembered, nor why abstracted general ideas are better retained. Nor does it account for the presence and its effects of certain kinds of qualitatively different levels within semantic memory which can not be simply seen as different degrees of elaboratedness or as variations in amount of activated information : for example, quite apart from the mainstream view of the levels of processing studies, the existence of some other kinds of processing levels within the semantic domain has been repeatedly shown in other paradigms. We may denote some earlier studies on form (verbatim) vs. contents(gists) -- such as Newman's(1939) studies on essential ideas vs. nonessential ideas -- as attempts to show some form of different levels of codes within the semantic domain. Studies on organization in terms of the superordinate categories(e.g., Bousfield, 1953; Mandler, 1967) can also be interpreted as studies connected with the effects of different levels of hierarchies in semantic memory. In recent years, however, most evidence for some hierarchical processing levels in the semantic domain have come mainly from investigations of prose memory and compreshension. In 1966, Daws showed that set relation is remembered better than individual ideas. Pompi & Lachman(1967), Lachman & Dooling (1968), Sulin & Dooling(1974), and Dooling & Christiaansen (1977) have

convincingly argued for better retention of concepts related to higher levels of abstraction(e.g., surrogate structure, stable core, thematic ideas, etc.). B. Meyer(1974), Kintsch(1974; 1977b), McKoon(1977), Bower(1976), Minsky(1975), Rumelhart (1977b), and Norman & Bobrow(1978) have all shown that the ideas or propositions at higher levels of the propositional, thematic, or text-grammatic hierarchies are recalled better; these findings imply that the meaning of the input information is stored in multiple levels of a representational structure, and that materials represented at the higher levels of these hierarchies are remembered better. Though these studies are not quite in agreement among themselves as to where more emphasis should be given--- whether to the hierarchical structural properties of the input text or to the constructive activities of the subjects--- they all point to the importance of hierarchical structures in our memory system and to the importance of the levels of abstractedness of the memory codes. They suggest a conception of levels or depth of information processing that is broader than Craik's perceptual levels or depths. In fact, these studies force us to go through yet another step of broadening and reformulating the concept of 'deeper processing' or 'elaborative processing', if we are to ensure that the 'depth processing' view offers a general framework broad enough properly to account for all these prose memory studies.

CHAPTER IV

A REFORMULATION

There have been few efforts in this direction of a broader interpretation of the levels of processing studies and the prose memory studies. An exception is the work of Dooling and Christiaansen(1977). Dooling and Christiaansen, however, limit themselves to observing the similarities and communalities between their Bartlettian view of levels of abstraction and Craik's early version of the 'levels of processing' framework; they stop short at interrelating and integrating their view with Craik & Tulving's(1975) 'elaborative processing' view to form a common comprehensive framework of 'deeper and elaborative processing'. How, then, can we bridge the concept of Craik & Tulving's 'elaborative processing' and the 'levels of abstraction' or other hierarchical concepts of memory derived from the prose studies? In what way can we or must we reformulate the concept of 'depth processing' or 'elaborative processing' if we are to allow the concept of 'distinctiveness of memory traces' and the concept of 'abstraction levels' to be properly explained in this new framework of 'depth' or 'elaborative' processing ?

The present study is a small attempt to resolve this problem. We may note immediately, however, a method of resolving the issue which has been suggested by Kintsch(1977a). Kintsch asserts that the most effective encoding does not stop with the individual processing of a single item, "but organizes the to-be-remembered items into higher-order units." He also writes that "...deep processing alone does not improve recall, what is necessary, first of all, is that the elements be organized into some coherent unit." Again "If something is to be remembered well, it must be organized---thus, 'organization' appears to be the ultimate deepest level of encoding (p.244)." Kintsch is suggesting that the concept of organization or integration should be introduced into the depth of processing framework. Since Kintsch has not seriously tried to incorporate this concept of organization into the depth processing view through any experiments, and since he has not provided a more refined view of the relationship between the concept of deeper processing or elaborate processing and the concept of organization or integration, further efforts to complete this task are still needed.

Such an attempt is made in this study; we shall propose a new aspect of elaboration. This aspect is other than that of activating a greater amount of information or

of increasing the extent of knowledge employed. It is proposed that elaborative processing can occur in which the information that was made available through the initial elaborative processing is integrated into more general superordinate units which occupy higher positions in the levels of abstraction or in possible hierarchies of abstract concept nodes.

This proposal is basically a revival of the old interest in 'organization' in the 1950s and 1960s. Yet this proposal goes beyond the old 'organization' studies in that it emphasizes the organization or integration of several items of input information into units of higher levels of abstraction. This is not equivalent to simply chunking or clustering the inputs on the basis of some feature similarities or semantic categories. It adds to these in that it incorporates the concepts of coherence, cohesion, and integration, concepts which some psychological studies of prose memory and comprehension, and some textlinguistic studies, have kept alive and refined. This introduction of a new aspect of elaboration or elaborative processing forces us to distinguish two modes of elaborative processing: the mode of increasing the amount of information activated or employed, and the mode of integrating this information into higher level units of abstraction. We can denote the former

aspect of elaborative processing as 'spreading elaboration' (following Craik's original idea 'of spread of processing') and the latter as 'integrative processing'. The present study will attempt to incorporate the results of the various studies discussed here into a common framework of 'deeper and elaborative processing' by using these two concepts of 'spreading elaboration' and 'integrative elaboration'.

SUMMARY OF INTRODUCTION

Starting from the question of 'why do we remember some things better than other things?', various approaches of memory studies were reviewed.

It was suggested that past studies on memory which investigated the effects of certain material characteristics(such as meaningfulness, frequency of usage, and imagery) could be positively interpreted as one of the starting points of the conception of deeper processing in terms of the amount of information activated, and of the conception of greater discriminability with a greater extent of activated information. Studies on encoding variability and on repetition were discussed along similar lines. Investigations of the encoding specificity principle were interpreted as having made possible for the levels framework to be reformulated into a broader framework.

Then the levels of processing or depth of processing framework was reviewed with a discussion of its current status and its flaws. The main themes of the discussion were; [1] that the original conception of 'depth of processing' in terms of levels of perceptual analysis should be reformulated in terms of the degree of 'elaborative processing', and [2] that 'elaborative processing' should be conceived broadly enough for it to account also for the

concept of distinctiveness and for the conception of 'levels of abstraction' in the prose memory studies.

In sum, all the studies directly or indirectly involved with studies done in the depth of processing framework suggested to us in what directions the depth of processing view should be reformulated in order to achieve a better account of various memory studies and to give a broader framework for answering the questions 'why do we remember some things better?' and 'how do we remember?'

On the basis of the major points made in the above review the present study offers evidence favouring a new version of the depth processing approach, stating with the following proposals: [1]the emphasis of the levels of processing framework on processing across different perceptual levels should be shifted toward an emphasis on 'deeper and elaborative processing' within the semantic domain; [2] the concept of elaborative processing should be broadened and stated in testable terms; and [3] elaborative processing can be conceived as a process with the following two main features. First, elaborative processing could be seen as a process of maximizing the number of encodings or the amount of information activated from our semantic memory or contributed from our knowledge. Second, the other aspect of the elaborative processing should be viewed as a process

of integrating this activated information into more coherent meaningful units of higher levels of abstraction.

It is also assumed that these two aspects of 'elaborative processing' entail better retention performance because they entail a greater degree of distinctiveness and of discriminability.

The present study tests these new conceptions of 'elaborative processing' and investigates the nature of the mechanism whereby elaborative processing has selective effects on memory. There will be a heavy emphasis on the effect of the integrative or cohesive aspect of elaborative processing.

In the first two experiments, elaborative processing in terms of increasing the number of encodings or increasing the extent of activated information is investigated. In the third experiment, integrative elaborative processing will be examined in the context of the coherence of or same-themeness among the different encodings. In the remaining five experiments, integrative elaboration will be further investigated with respect to the cohesiveness of the activated items of information. In Experiments 4 and 5, the effect of the degree of cohesiveness among the encodings will be manipulated in terms of the number of times

coreferent items appear across different encodings. There will be additional control of the number of non-coreferent items in Experiment 5, and an investigation of the effect of the mean number of stored propositions, in Experiment 6. In Experiment 7, integrative elaboration is studied as it relates to the number of causal and noncausal connections across encoding sentences. In Experiment 8, the effect of the presence of contrastive connections is investigated in addition to the causal vs. noncausal connection effects.

In the final chapter, the implication of these experiments will be discussed in relation to the proposed version of 'deeper elaborative processing' view.