SEMANTIC AND ORGANIZATIONAL FACTORS IN MEMORY FOR SPOKEN TEXTS: IMPLICATIONS DERIVED FROM BRAIN-DAMAGED POPULATIONS

by

Elkhonon Goldberg

A dissertation submitted to the Graduate Faculty in Psychology in partial fulfillment of the requirements for the degree of Doctor of Philosophy, The City University of New York.

1976

This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

August 19, 1976
date

L J Gerstman
Chairman of Examining Committee

Aug 20, 1976
date

Florence L. Denmark
Executive Officer

Leon Gorlow
L J Gerstman
Leon Mitte
Supervisory Committee

The City University of New York

ACKNOWLEDGEMENTS

Appreciation is due to Louis Costa and Louis Gerstman, whose help and advice in the process of finalizing this dissertation can hardly be overestimated. Steven Mattis offered insightful discussions of the manuscript at various stages of its preparation.

The collaboration with Alexander Luria and his associates, which I enjoyed for many years, was an exciting experience in an otherwise grim scene. Both intellectually and humanly, the support of these people was enormous. They should be credited for whatever merits this dissertation may have, and whatever contributions my research in the future may bring, if any at all.

TABLE OF CONTENTS

Table of Contents (cont.)

LIST OF TABLES

LIST OF FIGURES

CHAPTER I

INTRODUCTION

Several directions along which human neuropsychology contributes to the general psychology of normal behavior as an area of basic science can be outlined.

First of all, it is "brain-behavioral relations"--nervous structures and their interaction that mediate various cognitive processes.

Secondly, the analysis of information-processing deficits observed in neuropsychological populations can be much finer than the analysis of processing deficits as required for clinical purposes. Models of processing comparable to, but deviant from, the normal one are thus provided as another perspective of normal behavior.

The logic of this approach is that given a certain model of normal processing, the question is asked, what alterations in the function occur that produce the pathological phenomena observed in impaired individuals. The deficits are described in terms of concepts and models already created in normal experimental psychology by its own means.

It takes only one logical step to modify the above question and arrive at the following one: "What properties should the normal model possess in order to account for

pathology produced by brain damage once the latter is understood as an insult to normal structure?" This question is constantly asked by many serious, cognitive psychologists and they incorporate the data offered by neuropsychologists into their thinking. Strangely enough, it is not very often asked by neuropsychologists themselves. It is not a matter of professional labels - "experimental psychologist" vs. "neuropsychologist." The point is that the neuropsychological data which later become available to those concerned with normal processing are of a "post-hoc" nature. They had been originally obtained in order to answer questions which are quite different from those that would have been essential to ask in a normal processing context. Indeed, they are either about the differentiating ability of certain tests, or about brain behavior relations. It means that a lot of valuable information for understanding normal processing remains underived due to not asking the "right" questions. The purpose of the present study is to explore the possibilities of deriving rather direct inferences for the normal semantic memory from experimentation with neuropsychological populations.

Brain pathology certainly creates unique preparation for studying normal processing, since the levels and operatives of processing that are inseparable in the norm become disassociated or missing in certain types of brain pathology. This provides an opportunity for a very subtle operational analysis of processing. However, there is inevitably an assumption in such an approach that the cognition changed

due to the damage is a disintegrated, "broken," normal cognition, rather than a rearranged cognition. It is this kind of assumption that can hardly be supported a priori for all possible cases. In each case, the logical step from pathology to the normals should be justified separately; and, inevitably, on many occasions the models obtained in such a way will have to remain hypothetical constructions, until they have been directly tested on normal subjects. But the heuristic value of this approach can hardly be argued. Furthermore, in order to enable subtle operational analysis of information - processing it is necessary to put, more often than not, a normal subject in "abnormal" conditions, either by presenting artificial stimuli, or by producing artificial conditions of their presentation, etc. On the other hand, brain-lesion population can provide non-trivial dissociation of different aspects of processing even when stimuli are complete, that is closer to the natural ones. It is hard to say which of the two sources of artifact is worse.

One can make the following plausible assumption as to what kind of pathology is better for "normal" inferences: that is where the chance of compensation is least possible (the re-structuring of the cognitive strategies to counter-balance the damaged dimensions of processing can hardly occur). Within the focal brain-lesion population, these are the cases, where: a) the damage is recent; and/or b) the frontal lobes are involved. The latter condition almost certainly indicates that no compensation took place, since in order for

compensation to occur, the frontal lobes ought to be intact (because of their major involvement in purposeful activity which is necessary for any kind of compensatory behavior).

If the questions that guide neuropsychological research are concerned with the nature of "normal-processing", the design of experiments will be different from those arising from the more traditional questions asked in neuropsyhology.

First of all, the analysis of behavioral phenomena needs to be much more detailed than usual. Indeed, to go into many subtleties to describe the phenomena induced by pathology would be excessive for focal diagnostic purposes, since the latter can be done with smaller effort. Also, since differentiation in the aspects of cognition goes far beyond the specialization of the brain structures, the mapping of behavior in the brain usually would not require a very detailed behavioral description of observed phenomena.

The sampling of patients and the choice of experimental procedures also becomes different. The problem of differential description of several types of lesions requires application of a standard procedure (or group of procedures for different samples, each representing a certain localization of lesion). The problem of establishing responsibilities for a certain area of the brain (brain-behavioral-type problem) requires a fixed sample representing a lesion of the given area and an application to it of as great a variety of behavioral procedures as possible. In each of the two paradigms, the normal base-line should be obtained in order to evaluate

the existence, and extent of the behavioral deficits caused by the lesions.

On the other hand, in a situation where the questions asked are about the operational structure of normal processing, the sampling of the subject-population depends on the working model that is selected as a preliminary hypothesis. This model indicates the way of "breaking down" the processing into the dimensions to be studied. Therefore the choice of the subject population will depend on the outlined dimensions of the normal processing and on what is known about different types of focal brain pathology. The investigator will have to select those neuropsychological groups which, due to what is already known about their behavioral deficits, would be most likely to illuminate one or another dimension prompted for investigation by the researcher's working hypothesis. Therefore, different aspects of the normal model may require different subject-groups. The same considerations may hold true for the selection of experimental procedures.

If the processing under investigation is of a fairly complex nature, it would seem likely that several different groups of population will have to be united in one project with different experimental procedures for each of them so that by applying to each subject-group its own particular experimental procedure, the respective aspects of the model can be illuminated. Theoretically, it is not unlikely that even populations belonging to different types of pathology (e.g. focal brain lesions and schizophrenics) might be united in

one project. Thus the patient sampling may appear to be more eclectic from a clinical point of view.

While the behavioral descriptions in such an approach ought to be more detailed than in a clinical or a brain-behavior context, (or else all the advantages of using pathology for accessing "normal" issues will be lost), the requirements for homogenous and "clean" subject groups, from the point of view of lesion localization and/or etiology, will decrease as long as the group is homogeneous from the point of view of observed behavioral manifestations. Also, obtaining the "normal base-line" for the given experimental procedure will become less essential. Indeed, the question in this case is not to focus upon the evidence of pathology, but to explore an advantageous preparation of normal processing. If a certain group of allegedly normal population manifests the same phenomena under certain conditions, so much the better; then the researcher is released from the necessity to justify his making "normal" inferences from the observed pathological behavior.

Also, the statistical requirements for the evidence derived will be different. Indeed, in the brain-behavior or clinical context, the requirement is that a phenomenon has to be overwhelmingly present within the given population in order to be used for differential diagnostic purposes, or for determining the functional characteristics of the given area. On the other hand, in order to use a certain pathological phenomenon for determining these properties of the

normal mechanisms which could account for the given phenomenon, it is sufficient to demonstrate: a) the fact that the occurrence of this phenomenon cannot be due to some pre-morbid peculiarities of the sub-group where it has been observed (if this cannot be established, then a limitation of the "normal" inferences emerges); and b) the statistical significance of the phenomenon, i.e. that the sub-group of population, where this phenomenon is systematically observed, is not negligible. Within a group, variability in the pre-morbid peculiarities of information-processing (individual cognitive differences), is probably considerably smaller than the variability in alternations of the normal function due to the lesion, even if the pathological sample is supposedly homogeneous. To be sure, there are less focal "labels" of lesions than the actual variants of insults to brain-functioning. In other words, the assumption here is that what existed prior to the lesion and was damaged by it, is fairly invariant within the sample group, while the variability of the type (or extent) of the behavioral consequences of the damage is enormous, even within an allegedly "homogenous" pathological population.

This foregoing introduction explains the premises underlying the present study. This study deals with semantic memory for verbal discourses (simple texts).

Two aspects of memory processing are considered somewhat separately: (1) the semantic aspect proper multiple levels of representation that are hierarchically organized; and (2) the

executive aspect - interaction between the levels of representation.

In order to assess different aspects of the normal processing, different types of brain pathology are selected along the considerations that have been briefly outlined above.

The subsequent discussion will follow these lines: Chapter 2 - review of the data and theories of semantic memory and specification of the problems to be assessed in this research; Chapter 3 - rationale for the selections of the types of brain lesions for study and review of respective neuropsychological data; Chapter 4 - experimental populations and procedures; Chapter 5 - results of the experiments; Chapter 6 - discussion both in terms of the normal semantic memory inferences and the nature of the memory deficits observed in experimental groups.

The research was done at Department of Psychology, University of Moscow, in 1970-1973. The patients were provided by the Burdenko Institute of Neurosurgery of Academy of Medicine in Moscow.

CHAPTER 2

SEMANTIC MEMORY: BIBLIOGRAPHICAL REVIEW

2a. Levels of Representation

The units of memory representation of a discourse will be discussed in this chapter. The main concern will not be the aspects of processing (execution), but the units in terms of which this processing occurs (semantics). This distinction should not be confused with the one existing in psycholinguistic literature: the notion of the engram as a static semantic unit versus its being a set of rules for the potential generation (reconstruction) of the original content.

Either of these two forms of representation have to deal with some description of the original material, i.e. semantic units; and the problem of determining them is a semantic problem regardless of which of the two viewpoints is preferred. In semantic context, the choice between the above two alternative viewpoints is not so crucial because for each generation-type representation, an equivalent "static" way of description can be designed. By and large, the opposite fact also holds true (although not always). This "equivalency" rule is apparent from looking at more general languages, those of mathematical logics, - e.g., Boolean algebra ("static" representation) versus Gentsen "natural calculus" (generative representation).

Following the distinction made by Svedelius (1898) between the "communication of events" and the "communication of relations," we will restrict the topic under consideration to the "communication of events."

The existing theories of semantic memory will be screened together with the descriptive languages existing in psycho-linguistics, (those explicitly not devised for dealing with semantic memory, but rather with the formalization of semantic aspects of verbal material), with the intention of organizing them into a hierarchic model of representation. The significance and psychological reality of each of these levels will be discussed, and an attempt will be made to determine a "gap" in the hierarchy.

Probably the most sophisticated descriptions of this sort are those constructed in terms of basic primitives (Shaumyan, 1961, 1965; Melchuk, Zholkovsky, 1965, 1967, 1972). Having introduced a set of "axiomatic" semantic markers-- terms and markers--relations, the authors then use them to describe the meanings of the language units. Semantic trees such as the ones designed by Fodor and Katz are of somewhat similar nature, with the only difference being that, instead of postulating a set of artificial "primitives," these authors produce their descriptions in terms of the units of natural language (real words).

The graphs obtained in this fashion are complete in the sense that they (at least, by the authors' intent) cover all the possible references of the given linguistic units in any

possible context.

Due to their being context-free, in the sense that they cover all the possible contexts, these "languages" can serve as fairly good descriptions of the above-discussed "universal graph." The reality of such a "universal graph" in the memory representation will be discussed in Chapter 5, and, here, only one additional consideration should be mentioned: the very way of designing these languages makes them psychologically real.

The way of introduction of basic primitives is to look for those semantic features that can discriminate between the reference areas of different words and/or the different connotations of the same word.

This way of representing information is plausible provided that, most new communications consist of recombinations of elementary relations, each of which is already known to the subject or is inferred by him.

There is a different group of psycholinguistic descriptions which bear some resemblance to the ones described above. Osgood (1963) offered the idea of "kernel assertions," Kintsch (1974), that of "text-base propositions." A text is presented as a partially ordered list of propositions. A single proposition here is similar to a statement made in a natural language. It means that such a representation of the text is closer to the description in terms of natural events encountered there, than in terms of semantic markers (as in the previously discussed formalizations), which by and large do not correspond to any natural event or object.

This type of description is more compact than a "primitives' language" type. On the other hand, it still provides a complete description of the text content.

There is a great deal of data demonstrating the psychological reality of the "kernel assertions" or "text-base" level of representation. Kintsch (1974) demonstrated that the time required for the comprehension of a phrase does not depend on its actual (verbal) length, but depends on the number of "text-base propositions" in terms of which it can be described.

MacLay and Osgood (1959) demonstrated that the pauses in a subject's speech occur on the borders between those chunks that can be described by different "kernel assertions."

The experiments with clicks which were performed simultaneously while the subjects were listening to a phrase (Fodor and Bever, 1965) demonstrated that the subjects tended to "misplace" the clicks in such a way that they were on the borders between the clauses, in the manner predicted by Chomskyan derivative grammar when applied to the given phrase. It is easy to see that these clauses will correspond to the propositions in Kintsch's or Osgood's terms (except that Kintsch's propositions were sometimes of more than two-place form, which means that one Kintsch proposition would sometimes correspond to a whole group of Chomsky's clauses). Similar results were obtained by Lounsbury (1965). It is noteworthy that the inner speech (Vygotsky, 1934) consists of predicates, each of which can serve as a single-word label

for a "kernel assertion" or "a text-base proposition."

Although linguistically, the above two groups of descriptions are somewhat different, they have a very basic common quality: they provide a complete description of a text-content.

Again, we want to avoid making a choice between the two alternative types of models of normal memory: the static semantic-net representation in which case the problem of full content reproduction becomes the problem of adequate retrieval of a previously tagged sub-graph from a universal graph; or, the content generation (inference) model, in which case the problem of full content reproduction becomes the problem of actual tagging the relevant sub-graph in the process of reproduction.

It is clear, however, that the full content level of representation is only the final stage of retrieval or reconstruction process.

For a sufficiently long discourse, the full content representation would be enormously large and non-observable. It means that a set of addresses (descriptions of the "locations" in memory) is necessary to retrieve it (or bases for inference are necessary to reconstruct it).

Therefore, a higher-order level of the text representation is necessary and it has to be compact enough to be immediately observable.

Besides logical considerations, the reality of this assumption is demonstrated by the mere fact of the normal

human's forgetting the exact content of communication in the presence of the general idea of its content.

Intuitively, it is clear what this higher-order level of representation implies: almost every sequence of events can be assigned to a class, like "gratitude," "hostility," "good luck," "accident," etc.

In this fashion, a two-leveled representation (or reconstruction process can be assumed: the "general idea" level and the level of the full content representation, the former serving as the retrieval address or the inference cue for the latter. (By the full content level we mean the language user's final reconstruction of the text rather than the text itself.) However, it is apparent that if a possible class of concrete situations represented by the "general idea" label is large (which is typically the case), then the full content retrieval or reconstruction within such a model is highly improbable.

This means that a two-leveled model would fail to produce a sufficiently good approximation of the original material. A more-than-two-level model should be postulated, so that each unit of a higher level (i) would serve as an address for an observable part of the representation on a lower level (i + 1). Miller's notion of 7±2 can be applied to this reasoning: a single unit of the higher level should serve as an address only to such a part of the lower-level representation as is observable, i.e. consists of no more than 7±2 units of the latter level.

A hierarchy of narrations of different levels of generality will provide several levels of ever more specific retrieval-addresses or cues of reconstruction. The two above-described levels of representations--"single general idea" and "the text-base"--would form the extreme ends in this hierarchy.

Such a model of semantic memory is reminiscent of generative grammars. It has also been suggested by several authors in a broader context than memory. Bernstein (1935, 1966) maintains that the multi-leveled semantic representation corresponds to the multi-leveled organization of the execution of movements (so that each level of execution deals with its own code of representation). Miller, Galanter and Pribram (1956) indicated the possibility of a hierarchy of plans nested into one another. In reference to memory proper, Kintsch (1974), Crothers (1972), and Johnson (1970) indicated that the hierarchy of propositions constitutes a basis for recall. The problem of "filling the gap" between the above described levels of a text-content representation was apparent to much earlier students of memory, for example, Henderson (1903).

The problem of singling out the units of higher-order representation of a discourse dealing with a sequence of events is not that of inventing new labels for a linguistic description of the given level, but that of singling out what groups of events themselves--not their description in terms of language--may be viewed as comprising a whole. The

sequence of events should be segmented along the logic of the events themselves.

On the other hand, once the problem of describing the higher-order levels of the discourse representation in memory is raised, it is based on the assumption that some kind of invariants can be observed among the chunks of events represented as compact units.

Limitations should be established regarding the kind of invariants that can be expected as far as the nature of these segments is concerned. Indeed, different natural sequences of events would suggest to an observer different natural ways of clustering them. Thus, it would be problematical to think of any invariants at all.

When talking about invariants, one can mean either content invariants of formal invariants. There is, probably, only one area of verbal discourse where linguists were able to find strong content invariants among the types of events encountered in the discourses. This area is mythology. Propp (1921), Bremond (1967), found that the whole spectrum of events encountered in myths can be clustered into a fairly compact (no more than 50) list of themes in such a way that any specific myth can be described as a very compact ordered sequence (or a group of "event-lines" because they are not necessarily distinguished sequentially in the discourse), each of which is easily represented in the description by a single proposition. Also, the way of singling out a sub-sequence of events corresponding to a given theme from the whole discourse

is fairly unambiguous.

Were it the case that such a situation holds true for any type of discourse, there would be strong content-invariants across the segments of the event-sequences. For this reason, mythology attracted experts in semiotics.

However, what is possible for a highly ritualized sphere of communications, such as myths, can hardly be expected from discourses conveying the events of the real world. Thus, if there are any invariants at all, one should look for formal invariants of "super-large" segmentation.

Let us formulate the following preliminary requirements for these segments:

(a) the chunk of a discourse must refer to a sequence of events which is autonomous from a behavioral point of view (being self-causative);

(b) its language representation must already have the properties of a context, i.e. the pragmatic value of one statement must depend upon the others;

(c) it would also be desirable to deal with those behavioral patterns of contexts that are intuitively minimal.

It will be the concern of this study to try to determine the nature of these intermediate levels of discourse representation in memory.

2b. Interaction Between the Levels

Once the memory processing is understood to have the basic features of any hierarchically organized psychological process (a point that can hardly be disputed), then the control aspect of the processing should be postulated in any model of memory. This control aspect would be the one corresponding to the "test" stage of the T-O-T-E scheme (Miller, Galanter, Pribram, 1956); the "backwards afferentation" of Bernstein (1935, 1966); and the "activity acceptor control" of Anokhin (1962). Shiffrin (1970) in his model of memory explicitly postulated the existence of a "match" procedure as a separate one from retrieval.

The control function consists of monitoring the "description" of the text-content that is being generated (or retrieved) on a lower level of representation by "matching" it with the "description" as it might exist on a higher level.

In other words, a higher level of representation is establishes semantic "borders" against that which can be generated on the levels dealing with a more precise description of the material. A mechanism should exist ensuring that these borders are not violated (Bernstein, 1966).

Generally speaking, two types of level-interactions can exist in hierarchic systems: (a) strictly "vertical" ones, so that the higher levels fully "prescribe" the behavior of the lower levels of the system: (b) "horizontal" ones, where

the lower levels are relatively independent of the higher ones, and the responsibility of the latter ones is to establish restrictions to the activity initiated on the former ones. Of course, one can think of models in which these two features are combined.

It has been fashionable to think in terms of strictly "vertical" systems, as far as psychological models are concerned. However, a glance at a variety of self-regulating systems of a different, non-psychological nature indicates that in order for a system to be efficient the lower levels should have a certain degree of independence from the higher ones. It is true as far as economic systems are concerned; it was established for hierarchically organized mathematical automata (Gelfand and Tsetlin, 1962, 1966). This principle was called "the minimal interaction principle." Bernstein (1953, 1966) demonstrated that in the nervous apparatus of the motor functions, the lower level structures have considerable amounts of degrees of freedom from the higher ones.

Whichever of the alternative types of models--strictly "vertical," "horizontal," or mixed--is preferred for memory, the requirement remains for efficient control of higher levels over what is being generated on the lower levels of the original material reconstruction. The more degrees of freedom that are assigned in the model to the lower levels, the more requirements that are imposed on the control function.

Due to the fact that coherent material (and a discourse is a good example of it) can be encoded on several semantic

and contextual levels, the memory for discourses is usually better than that for non-coherent material (Bartlett, 1932; Buller, 1943; Smirnov, 1966).

The density of semantic connections makes it easier to store a discourse. The way of encoding by inclusion into a semantic net also provides greater availability for retrieval, since there are natural addresses for the stored items. These advantages of a context were known even in ancient times, and led to the formulation of mnemotechnic techniques for dealing with non-coherent material by artificially including the items into a common context. Later on, these techniques were elaborated by Vygotsky (1934) and many other researchers.

However, what may be considered an advantage of coherent material for memorizing, places increased demands on the cognitive and executional aspects of the process. Indeed, the multiple semantic connections that are possible for each single item of a discourse (a single event, subject, relation) are far beyond the ones relevant to the given context; they are capable of "triggering" a great variety of irrelevant contexts into which the given item can be potentially included. Thus, a story, when stored, automatically serves as an address for an enormously excessive semantic graph which in its greater part is irrelevant to the communication task of reproducing the particular story. What actually is required by the communication task is singling out a fairly small sub-graph which represents the original material. This

singling-out process has to overcome the natural metrics of the universal graph which had not been especially formed for any specific context, but rather represents a statistical mean across all the possible contexts which would yield the requirement of plausibility from the point of view of the graph "holder's" experience.

The idea of every on-line-processed item being embedded into the "universal graph" which consists of all the possible semantic connections and has its own "metrics," has been advanced by Vygotsky (1934) in his analysis of relations between the meaning and the reference. Luria and Vinogradova (1959) conducted research on dimensions essential for the "universal graph" (the latter was assumed to have a multi-dimensional nature). This study demonstrated that, in addition to the semantically relevant dimensions under certain pathological conditions (oligophrenia, focal brain pathology, etc.), the amount of non-semantic dimensions that are triggered is enormous. This finding indicates that they may be present in any engram structure and that it takes a special aspect of execution to "edit them out" in the on-line processing. Kintsch (1974) states that the semantic net is of a categorical nature. It would be fairly easy to deal with it were that the case. However, Luria and Vinogradova have demonstrated that the categorical relations are only one dimension of the "universal graph."

Actually, Osgood, in his studies of "semantic differential," also revealed the fact that the metrics of the "universal

graph" can in no way be restricted to conceptual relations between items.

Among other studies of the metrics, or as some authors, e.g. Bernstein (1966), Tabory (1965) prefer to call it, topology of the "universal graph" (since both notions are more or less metaphoric in this case, there is no point in discussing which one is more appropriate), one can also mention the studies of Brown and McNeil on the "tip of the tongue" phenomenon (1966), as well as those on associative meaning by Deese (1962). Collins and Quillan (1969, 1972) used the notion of "semantic space" in a sense very close to our "universal graph."

Thus, both the existence of the "universal graph" of representation and its having a certain metrics (or topology) has been postulated by many authors. However, the studies of the "universal graph" and its structure have dealt, as a rule, with words. In a way, it has been implicitly postulated that "word" is the unit of the universal semantic graph. It is a fairly arbitrary approach, and it ignores the fact that the words are those linguistic units which probably do not correspond very naturally to the units of human experience. It can be suggested that similar graph-type relations exist among the units of events which, converted into linguistic terms, would rather correspond to whole propositions. This graph would be much larger, and for this reason the "dangers" of slipping along irrelevant directions would increase in the absence of adequate "editing process."

Thus, the role of the control functions increases enormously in the reproduction coherent material. It becomes the function of execution in the mnestic process to selectively maintain one particular context and "edit-out" many irrelevant ones that are elicited by single items. This level of the process is different from what is traditionally called retrieval; it is an editing function over all the retrievable engrams for which a given item may serve as an address.

In its own turn, this process can function only if a schematic representation of the given context--narration--exists in memory. It would be of a special interest to determine what level of generality is required for such a scheme to efficiently operate over the "universal graph," and this point will be the concern of the subsequent chapter. Thus far, it is sufficient to assume that such a scheme is indeed necessary to provide a criterion for the executional aspects of the process connected with "editing-out" the retrieved traces. But in order to facilitate selective retrieval, the scheme has to be formed first. Hence, the requirements for the cognitive aspects are definitely increased.

The above-outlined nature of coherent material reproduction also makes of the latter a very good subject matter for studying those aspects of memory which have been postulated by a number of scientists, who have suggested that the process of ekforia is reconstruction of material following its

"disassembled" representation in memory, rather than reproduction of an engram which is semantically isomorphic with the original material (Norman, 1970; Kintsch, 1970; Shiffrin, 1970; Feugenbaum, 1970).

The above review prompts three issues to be assessed:

(a) demonstration by neuropsychological means of the mulit-leveled nature of the engram;

(b) demonstration of the reality of restrictive interactions between the levels of representation (control function) as an aspect of memory processing distinctly different from storage and retrieval;

(c) specification of the "intermediate" levels of the hierarchically organized engram.

These three issues will be the subject matter of the subsequent presentation.

CHAPTER 3

THE RATIONALE FOR SELECTION OF NEUROPSYCHOLOGICAL POPULATIONS

3a. Memory Disorders Following Diencephalic Lesions

While modality-specific memory deficits which follow certain parts of the cortex lesions are, in a sense, an extension of the corresponding cognitive defects, lesions of the diencephalic areas of the brain lead first of all to the memory deficits as such. The latter are of global, modality-nonspecific nature. Most probably, it is due to the activating functions of diencephalic systems, which activation is necessary for normal memory processes. The area under discussion (Papez circuit) includes both hippocampi; medial parts of mammillary bodies, anterior nuclei of the thalamus, and the connections between these structures. Some researchers treat the hypophisis as a part of this system.

Deficits of memory for current or recent events is specific to the damages of these areas, while memory for "old," remote events may be preserved. In most expressed cases it may take the form of Korsakoff syndrome. The latter, following hyppocampal lesions, was described by Korsakoff (1890), Bechterev (1907), and by modern authors: Scovill (1951), Penfield (1958), Milner (1959), Pribram (1969), Luria (1974),

Kyaschenko (1973), Popova (1964, 1966).

There may be various types of memory deficits following Papez-circuit lesions. Kyaschenko (1973) suggests the following classifiction of them"

(a) "Pure" memory deficits, which take the form of deep amnesia for current events, with intact "old" memory, intact intellect, voluntary attention and motivation. This picture can be observed in bilateral hyppocampal lesions.

To some extent, the mechanisms of this type of deficits are explained in the data of Adey (1970) and Vinogradova (1965). It was demonstrated that up to 60% of hyppocampal neurons react not to the modality-specified parameters of the stimulus, but to its changes. This argues for the hyppocampi's involvement in the coding and the storage of the stimuli traces.

(b) A very moderate variant of this syndrome occurs in hyphophisal lesions.

(c) A severe amnestic syndrome combined with the patient's disorientation and confabulations, is observed when the lesions affect walls of the third ventricle, thus damaging the signal circulation in the Papez circuit. These generalized deficits following the higher stem lesions find some explanation in the data of Moruzzi and Magoun (1949), Jasper (1957) and Lindsey (1960), who have demonstrated that this part of the brain is involved in the maintaining of the optimal tonus of cortex.

There is, however, one basic feature which is common to all the groups described: primary, modality-nonspecific memory deficits.

Two considerations concerning the patients with diencephalic brain lesions are crucial for the present study.

First, according to Luria (1963), intellectual functions, capability for planning, execution and control over their behavior remains intact in patients with the Papez-circuit lesions (to the extent that the level of awareness is undamaged).

The second consideration is that the memory deficits observed in these cases, are due to retrieval problems rather than to those of storage. One possible explanation for forgetting (both as a normal and abnormal phenomenon) is to attribute it to interference between the trace systems (Smiznov, 1948; Underwood, 1957; Postman, 1969; and Norman, 1969). Luria (1974) and Kyaschenko (1973) have demonstrated that this explanation can also account for modality-nonspecific memory disorders of the discussed origin.

If these two assumptions are true, the Papez-circuit memory deficits may provide a fairly direct model for studying hierarchic properties of memory processing from a semantic point of view.

It is not a new notion that meaningful material is encoded according to the "laws of thought" (Buller, 1943). An extraction of the "general idea," of given material takes place, which thereafter serves as the basis for its recon-

struction. The notion of the level of "general idea" requires further elaboration. However, before proceeding further, a direct model of dissociation between the ability to reproduce the precise content of a given material as opposed to its general schematic "idea," is desirable.

If the assumption is true that the memory disorders in the Papez-circuit population are not associated with the severe loss of cognitive and planning abilities, then these patients have all the prerequisites in order to narrate whatever material they have in storage.

If, on the other hand, their memory problems are due to retrieval, while storage itself is fairly intact, then it would seem plausible to assume that these patients have the original material (the full content of a story) available for cognitive operations for at least some time--probably long enough to extract the scheme.

Once extracted, the scheme would become a much more compact pattern than that of the full representation of the original content. If this holds true, then the scheme-representation would become less vulnerable to subsequent interference by other engrams, thus becoming more retrievable than the full-content representation.

The hypothesis to be explored, then, is the following: one could expect sharp dissociation between the retrievability of the full content, and its narration, in Papez-circuit population.

Provided that the fact of this dissociation is established, it will serve as additional evidence--a clinical one--that memory encoding is, indeed, of hierarchic nature.

My only goal in studying diencephalic lesions is to provide such a demonstration. If the hierarchic nature of the engram is demonstrated, a closer examination of the nature of the levels involved and the interaction between them will be needed as well.

An attempt to provide these elaborations will be made by studying different clinical populations, which, in a sense, are complementary to the Papez-circuit group from the point of view of their functional deficits.

3b. Memory Disorders Following Prefrontal Lesions

The lesions of prefrontal areas of the brain lead to extremely massive disorders of behavior. These areas, while not directly involved in regulating motor processes, are connected with the sequential organization and control of all types of activities. For this reason, the lesions of these areas lead to a broad range of deficits in many forms of activities, rather than to any specific behavioral damage.

In the intellectual sphere, these deficits take the form of an inability to outline a preliminary plan of approaching a certain problem with its subsequent step-by-step realization. Instead, an erratic manipulation of separate operations takes place. At the same time, factual knowledge and separate formal operations (mathematical, constructive, etc.) remain more or less intact.

The cognitive sphere suffers to the extent that the given cognitive task requires processing that lies beyond the automatic skills or simple registration of perceptual events. Thus, a prefrontal patient is unable to analyze a picture with disguised content, or to arrange a sequence of pictures reflecting a story. Speech itself remains intact (there is no indication of any type of aphasia) although spontaneity and the purpose-orientation of verbal behavior may suffer.

Motor movements continue basically intact, but are still affected when the patient faces a complex motor problem that

deals with the re-coding of the visual field or the production of non-periodic motor sequences.

The patient's personality suffers in a very crude way. Lack of programmed behavior leads to the cessation of stable motives and goals. The patient becomes completely dependent on the "immediate moment." In the most severe cases, it takes the form of "field behavior." One can speak about the "lack of personality," rather than about the "change of personality." The patient's lack of critical attitude to his deficits, irrelevancy, and the paucity of emotional reactions constitute another aspect of the patient's impoverished personality.

In the most extreme cases, the above-described deficits of programming and control affect the most basic behavioral levels. In these cases, perseverations are observed in the patient's actions, and there is inertia in shifting from one elementary operation to another. A lack of voluntary activity is characteristic to all of these patients and takes the form of severe aspontaneity.

Memory deficits in frontal patients have been a matter of long debate. The supposition that the frontal lobes contain "mechanisms of memory" has been an important theory for many years. The argument in favor of this hypothesis relied on the fact that after the removal of the frontal lobes, animals were unable to fulfill delayed responses, while the ability for immediate responses remained intact (Jackobsen, 1935).

However, Malmo (1942), Pribram (1961), Weizkrantz (1958), and Konorski (1961) have demonstrated that, in addition to the above phenomena, the experimental animals displayed distractability towards irrelevant on-going stimuli and that the balance of excitation and inhibition of the behavioral stereotypes proved to be severely damaged. If the flow of on-going irrelevant stimulation was reduced, or the excitability of the nervous system was diminished pharmacologically, then the "mnestic" deficits in the experimental animals disappeared. These data led to a reconsideration of the view the the frontal lobes were "the containers of memory."

A similar debate took place in connection with human studies. The experiments of Luria (1962, 1963, 1966, 1974) and Tsvetkova (1966) have demonstrated that in prefrontal lesions the very structure of mnestic activity suffers, rather than the elementary storage and retrieval. The mnestic processes lose their purpose-oriented, hierarchically organized nature. In a sense, the memory deficits following prefrontal lesions of the brain provide a picture that is complementary to that observed in diencephalic patients.

What is known about frontal patients, should lead one to expect that just the executional aspects, i.e. those associated with controlled reconstruction of material, suffer most in these patients. Thus, one can expect that reproduction of coherent material in frontal patients would prove to be a good preparation for studying the traditionally neglected aspects of memory, that is, those which are superimposed

on storage and retrieval and serve the purpose of control.

The hypothesis to be explored suggests that the mnestic deficits in frontal patients are due mainly to an inability to extract the plan of a given discourse and to utilize this plan for selective editing of what is retrievable during reproduction. These aspects of processing are by far more damaged than storage and retrieval proper.

Two aspects of the hypothesis are to be examined:

(a) The reality of the control-function in the memory processing;

(b) The fact of its being an independent source of memory disorders.

In order to establish these two assumptions, it should be demonstrated first that in the pre-frontal patients the reproduction process is severely damaged <u>in spite</u> of the fact that both storage and retrieval are relatively intact.

Thus the study of memory deficits following diencephalic lesions of the brain may prove to be helpful for understanding the hierarchic nature of the engram: and the study of memory deficits following prefrontal lesions may prove to be instrumental in assessing the interaction between the levels-control function.

These two problems will be covered respectively by Experiment 1 and Experiment 2. The difference in utilization of the two groups of patients will not be so clearcut. As will be demonstrated below, additional analysis of the results of

Experiment 2 (prefrontal group) can also provide some insights into the nature of "intermediate" levels of engram hierarchy.

CHAPTER 4

SUBJECT-POPULATION AND EXPERIMENTAL PROCEDURES

4a. Subject Population

Two pathological and one control (normal) groups of subjects were studied.

Group 1: Diencephalic Lesions

Twenty-nine patients were studied, out of which seven had third ventricle tumors, twelve had tumors of mammillary bodies affecting hippocampi and/or hypophysis, six had tumors of the hypophysis. Four other cases (out of which two were tumors and two traumas) affected also the structures adjacent to the Papez-circuit.

Due to the purpose of the study, the focal homogeneity of the group was not as important as "analyzability" of the patients' story reproductions, which could be affected by massive confabulations. For this reason, one of the requirements for the selection of patients was that they have a relatively mild disorientation in space, time, and their conditions. This requirement affected primarily the sampling of the third ventricle cases.

On the other hand, some erroneous production was desirable, and that is why only those hypophisal patients who manifested this were included in the group.

In other words, an attempt was made to sample those situations, when "pure" retrieval problems indeed existed to a significant extent but were not overshadowed by the massive impairment of the level of awareness. Below follows the description of the subject group.

TABLE 1

GROUP 1: DIENCEPHALIC LESIONS

Description of the Subjects

Case #	Type of Lesion
1	Cystic tumor of the 3rd ventricle.. Chemist, 37 years old.
2	As above. Clerk 48 years old.
3	As above, Teacher, 41 years old.
4	As above. Engineer, 56 years old.
5	Tumor of the bottom of the 3rd ventricle. Nurse, 35 years old.
6	As above. Driver. 50 years old.
7	Cyst and tumor of the 3rd ventricle with hyppocampal growth. Designer, 42 years old.
8	Craneopharingeoma affecting mammillary bodies and hypophysis. Worker, 29 years old.
9	As above. Agricultural worker, 43 years old.
10	As above. Musician, 52 years old.
11	As above. Administrator, 37 years old.
12	Craneofaringeoma of the mammillary bodies affecting both hippocampi. Housewife, 40 years old.
13	As above. Clerk, 34 years old.
14	As above. School teacher, 38 years old.
15	Non-specified tumor, localization as above. Worker, 46 years old.
16	As above. Military man, 51 years old.
17	Tumor of mammillary bodies with the left hippocampal growth. Research scientist, 62 years old.

TABLE 1 (cont.)

Case #	Type of Lesion
18	As above (craneofaringeoma). Engineer, 43 years old.
19	Tumor of the mammillar bodies with the right hippocampal growth. Worker, 38 years old.
20	Tumor of the posterior areas of corpus callossum affecting the hippocampal area. Retired officer, 60 years old.
21	Adenoma of hypophysis. University lecturer, 58 years old.
22	As above. Housewife, 37 years old.
23	As above. Artist, 42 years old.
24	As above. Clerk, 45 years old.
25	As above. Administrator, 39 years old.
26	Massive adenoma of hypophysis pressing onto the stem and the frontal lobes. Medical doctor, 44 years old.
27	Deep tumor of anterio-medial parts of the left hemisphere. Engineer, 36 years old.
28	Close trauma with insult into the upper stem area. Worker, 38 years old.
29	As above. Student, 19 years old.

TABLE 2

GROUP 2: PREFRONTAL LESIONS

(Fourteen patients were selected using two criteria: (a) lesion of prefrontal areas; (b) the symptom of "interminable" monologue.)

Description of the Subjects

Case #	Type of Lesion
1	Massive left-hemisphere intracerebral tumor occupying the space between the frontal pole, mid-line and the anterior horn of the lateral ventricle. Germs of the corpus callonum distructed. College education, 42 years old.
2	Massive fronto-basal tumor, multiple cysts. Nurse, 38 years old.
3	Interhemispheric tumor along the mid-line (24-32-8 Broca fields) with multiple cysts. Engineer, 34 years old.
4	Resection of the right frontal pole with elimination of arachoendotelioma of the anterior skull groove to the right. Script-writer, 37 years old.
5	Massive arachnodiendotelioma of the olfactory groove going superiorly (size of the tumor 5 x 4 x 4). Military service, 46 years old.
6	Tumor of the anterior horn of the left lateral ventricle up to the left frontal pole; 1.5 years later, another operation: intracerebral tumor-astrocitoma. High-school teacher, 39 years old.
7	Massive extracerebral tumor of the left frontal lobe, anterior border, 1.5 cm from the pole; the tumor was connected with the falks (size of the tumor: 6 x 5 x 3). Driver, 43 years old.

TABLE 2 (cont.)

Case #	Type of Lesion
8	Rupture of the aneurisms of the auterior communicative artery with bilateral spasm of auterior arteries. Journalist, 56 years old.
9	As above. Engineer, 48 years old.
10	As above. Mill-worker, 51 years old.
11	Bilateral trauma of the frontal lobes. Removal of the frictioned frontal bones, resection of both poles. Subsequent plastic surgery. Social worker, 38 years old.
12	As above. Military man, 21 years old.
13	As above. Construction-worker, 32 years old.
14	As above. Graduate student, 24 years old.

TABLE 3

GROUP 3: CONTROL GROUP (NORMAL SUBJECTS)

(Six subjects were used as a control group)

Description of the Subjects

Case #	Anamnestic data
1	Graduate student, male, 27 years old.
2	Graduate student, female, 30 years old.
3	Graduate student, male, 24 years old.
4	Researcher, male, 28 years old.
5	Graduate student, female, 30 years old.
6	Researcher, male, 35 years old.

4b. Experimental Materials, Procedures and Data Analysis

Six stories were used (see Appendix 1), out of which three were one-concentric (Stories 1, 2, 6) and three were more-than-one-concentric (Stories 3, 4, 5).

Experimental procedures were different for the two pathological groups.

4b.1 Experiment 1: Diencephalic Group

Procedure:

Condition 1A: Each patient was presented with one of the one-concentric stories (stories 1, 2, 6) with instructions to reproduce it immediately.

Condition 1B: If the patient performed under condition 1A adequately, then in 1 - 2 days he was presented with one of more-than-one-concentric stories (stories 3, 4, 5) with the same instructions as in Condition 1A. (By adequate reproduction we mean that no more than one minor omission or distortion of the original content was committed.)

Condition 2A: If the patient performed under condition 1B adequately, then in 1 - 2 days he was presented with a second one-concentric story, with instructions to reproduce it after a 2-minute interval, which was either empty or filled with arithmetic calculations (heterogeneous interference).

Condition 2B: If the patient performed under condition 2B adequately, then in 1 - 2 days he was presented with a second more-than-one-concentric story with the same instructions as in 2A.

Condition 3: If the patient performed under condition 2B adequately, then in 1 - 2 days he was presented with a third more-than-one-concentric story, which he was instructed to reproduce immediately. Following this he was presented with a third one-concentric story (without subsequent reproduction) but, then, the instructions were to reproduce the previous story (non-selective homogeneous interference).

Those patients who performed under condition 3 adequately were subjected to the "selective homogeneous interference condition," which will be described separately.

Once a patient failed one of the above conditions, he was not subjected to subsequent ones.

Only those reproductions were analyzed which corresponded to the "failed" condition for each patient.

Data Analysis:

In each of the reproductions analyzed, the presence of the "key statement" was determined (it is given for each story in Appendix 1).

If the key statement was absent, the patient was asked about the "moral" of the story. If the "key statement" was present either in the patient's reproduction or in his answer

to the question about the "moral" it was assumed that the disassociation between the levels of encoding was observed.

The rationale for this kind of experimental design is the following: In order to be able to analyze the semantic aspects of the story reproduction, an optimal level of interference should be found for each case that would counterbalance the severity of processing deficits as resulting from the lesion. (The more severe the lesion, the "milder" the level of experimental disturbance.) In this way, the memory deficits in all the patients can be brought to a common base-line, that of "a minimal observable deficit." This would ensure that the deficits are manifest, but yet not quite complicated by contaminations, intrusions, etc., that their analysis becomes too complicated. The point of our interest is not the inter-lesion differences, (which, in fact, is the variable that we want to eliminate by this design), but rather the extraction of the features of normal memory processing (the latter being assumed to be invariant across the subjects).

Our hypothesis is that a dissociation between the "general idea" level and the level of precise content would be observed in a substantial number of cases under the first failed condition.

4b.2 Experiment 2: Prefrontal Group

Procedure:

(A) Monitored Condition: The patients were presented

stories 1 - 5 (see Appendix 1) each on a different day with instructions to listen to the story carefully. Then the patients were requested to answer questions about the story. These questions were of a non-prompting nature, such as: "Whom was the story about?", "What happened first?"; "What happened next?" The purpose of the questions was to restrict the patient's monologue. Each subsequent question followed immediately after the answer for the previous one had been obtained in order to preclude the patient from developing his own monologue. The experiment stopped immediately upon the patient's answer to the last question posed, or immediately upon the patient's beginning to introduce the events that were not part of the story.

(B) Non-Monitored Condition: The patient heard the same story once again with the instructions to reproduce it.

Data Analysis:

In order to analyze the subject's recall, a description of the content of the original stories had to be introduced against which the content of the subject's monologue could be matched.

It would be natural to proceed from those attempts in linguistics that were designed for description of normal written texts. However, one immediately finds that the most elaborate (from the point of view of their inambiguity) designs are hardly applicable to the description of long

texts or monologues. We mean here descriptions in terms of "basic primitives," such as the ones designed by Shaumyan (1961, 1965), Melchuk and Zholkovsky (1965, 1967, 1972), Katz and Fodor (1963). The text descriptions derived in this way would be extremely lengthy and hardly observable for the purpose of registering the monologue. Those designs which describe a simple statement in terms of a group of propositions, such as Osgood's "kernel assertions" (1963) or Kintsch's text-base propositions (1974), seem to be much more relevant to our purpose.

The stories were broken down into elementary chunks of information (1 or 2 place propositions). An event was considered as being mentioned in the reproduction regardless of the lexical and grammatical form of its expression. Small, excessive elaborations on events not present in the story were not treated as failures, provided that they did not carry the monologue away from the original content. Elaborations permitted consisted of simple adjectives and adverbs, or the patient's remarks which did not introduce new events.

About eight sentences of the monologue following the last relevant statement were analyzed for reproductions under the non-monitored condition. The narrations of these monologues are given in the last columns of the tables in Appendix 2. Once the text is described as a sequence of propositions, it is fairly easy to decide whether or not any single one of them was encountered in the subject's monologue. Needless

to say, for some groups of propositions, there is compulsory sequential ordering (those referring to the sequence of events), while the sequential arrangement of others is arbitrary, and any sequence of their encountering by a subject would be considered as correct (e.g. the phrase "A dog was crossing a bridge over the river at night"-- "It was night."; "The dog was crossing the bridge."; "The bridge was over the river." This particular ordering "kernal assertions" is arbitrary and can be replaced by any other one).

An interesting method of describing a subject's monologue was suggested by Laffal (1961): each word in the monologue was assigned to a category, thus allowing judgment about the content of the discourse, rather than its verbalizing. A similar idea was applied in the description below, although applied to propositions rather than to words. Thus, a proposition, "A lion wanted to eat up a mouse." is assigned to the class, "A lion wanted to hurt a mouse."

Since a possibility existed that a proposition encountered by the patient might consist of a correct predicate and an incorrect term or terms, or vice versa, these two complimentary constituents of a proposition are separated: the terms are in brackets. A comment about each distortion of any of the two constituents by a subject is mentioned in the tables that are presented in Appendix 2.

The way of "chunking" a phrase into "kernal assertions" which we employ is not quite consistent. For example: the

phrase, "A lion wanted to eat up a mouse," can hardly be treated as a single proposition. Rather, it should be rendered as "a lion came to a desire."; "The desire was to eat up a mouse."

While Osgood is very careful about chunking into "elementary" proposition, Kintsch does not consider it to be an essential issue, and his chunking is closer to "natural proposition." So is the one employed in this study.

The hypothesis to be tested was that there should be significant difference in the quality of reproduction between the monitored and non-monitored conditions.

The data obtained in Experiment 2 were also employed for further analysis of the nature of the level of the text-representation. This analysis will be described separately in the chapter entitled "Results."

4b.3 Control Procedure and Baseline Results (Normal Subjects)

Normal subjects were put through condition 3, as described for Experiment 1. The difference was that, while condition 3 presupposes only one homogeneous interference pair, the normal subjects had to undergo all three possible pairs. In each of the pairs, the first story was more-than-one-concentric, the second story was one-concentric (e.g., stories 3 - 1. 4 - 2, 5 - 6).

After having listened to each pair, the subject had to reproduce both stories in sequence. This was another complication as compared to Condition 3.

This procedure covered, in effect, all the procedures employed in Experiment 1, and the non-monitored condition of Experiment 2. Thus, "passing" under this condition would serve as adequate, if not excessive, evidence for the subjects' ability to pass any of the procedures employed in the study.

Below follows the table representing the quality of the story reproduction in the units of events for each story (story 6 is omitted in the table, since it was used only for the diencephalic group, for which no quantitative analysis in the units of events had been done.

TABLE 4

QUALITY OF THE STORY REPRODUCTION BY THE NORMAL SUBJECTS IN UNITS OF EVENTS

Case #	Proportion of Events Conveyed				
	Story 1 (6 events)	Story 2 (8 events)	Story 3 (14 events)	Story 4 (18 events)	Story 5 (11 events)
1	1	1	0.93	1	1
2	1	1	1	1	0.91
3	1	1	1	1	1
4	1	1	0.93	0.945	1
5	1	1	1	0.89	1
6	1	0.88	0.86	0.89	0.91
Average:					
	1	0.98	0.95	0.95	0.97

All the stories were reproduced under this excessive condition close to 100%-level. The only deficits observed were those of omissions, which never affected the "key statements" of the stories.

CHAPTER 5

RESULTS

5a. Experiment 1 (Diencephalic Group)

5a.1 Dissociation Between the Levels of Respresentation

Below is the distribution of the subjects across the failed conditions, and the distribution of the cases where the dissociation between the levels of representation was observed.

TABLE 5

SUBJECT DISTRIBUTION ACROSS

THE CONDITIONS FAILED

(DIENCEPHALIC GROUP)

Condition Failed	Cases' # #	Total Amount of Cases	Amount of Cases With the Dissociation Observed
1A	5	1	1
1B	1,2,28	3	2
2A	3,4,7,12,15	5	2
2B	6,8,9,10,13,16,29	7	4
3	11,14,17,18,19,26,27	7	3
TOTAL		23	12

Six cases (20-25) passed all the conditions.

The cases in which the above dissociation occurred constitute about a half of all the observations made (12 out of 23). This means, that it cannot be stated that the dissociation between the levels of representation is a common feature of the memory disturbances of the patients with the Papez-circuit lesions. However, the number of cases in which the dissociation was observed was clearly non-negligible, thus providing a clinical population (a certain sub-group of the Papez-circuit lesions) which can serve as a model of dissociation between the levels of representation of a discourse: a certain higher-order level (that of general idea) is available for retrieval, while the level of exact content of the discourse is not.

The cases in which this dissociation was observed are evenly distributed within each of the five conditions (in each case about a half of those "failed" at the given condition). This means that the dissociation phenomenon cannot be attributed to a certain particular condition.

The distribution of the "failures" across the conditions of increasing complexity supports the findings of Kyaschenko (1973). Indeed, all the patients with discrete lesions of hypophysis passed all the conditons (cases 21 - 25). On the other hand, none of the patients with the third ventricle lesions and vascular insults of the upper stem, reached condition 3.

However, the point of interest in the present study, is semantic analysis of "failures," rather than their "localization."

Twenty-three subjects failed under one of the conditions which comprised the material of 23 stories. From these 23 stories, 12 stories clearly demonstrated the dissociation between the levels of precise content versus the knowledge of its "general idea." The latter could be demonstrated either by the presence of the "key statement" in the patient's reproduction, or through his telling the "moral" of the story. Below are some examples of this dissociation:

Story: "A Hen and the Golden Eggs" (Case 5, cond. 1A)
"The story was about gold...Someone wanted to kill a human being for gold...Don't remember!"

Moral: "A greedy one won't get anything, anyway."

Story: "An Ant and A Pigeon" (Case 28, cond. 1B)
"Good for good, evil for evil...Someone got stuck in the forest...Whom was it about?... About the kind and the cruel...about a horse, a bear, a fox, a rabbit...Rabbits came down, and a bear, and a horse..."

While in the first example, the knowledge of the "essence of the story" is not apparent from the reproduction itself, and only becomes apparent when asked about the "moral," in the second example, the "key statement" of the story is in

the reproduction itself, ("good for good, evil for evil"), although it is not present in the actual events as conveyed. These are two alternative forms of the dissociaton between the levels, but they demonstrate basically one and the same phenomenon: the availability of a certain higher, generalized level of encoding, with the access to the engram of the full content being lost (or the inability to reconstruct it).

It should be noted that in the second example (with a two-concentric story) neither of the two parts was conveyed to any adequate extent. Nevertheless, the key statement covers both of them.

A partial knowledge of the "general idea" (i.e., the presence in the reproduction of a "key statement" referring to one concenter) can be observed even when the actual reproduction is so low that the two concenters of the same story contaminate each other.

Story: "A Lion and A Mouse" (Case 2, cond. 1B)
"A lion was sleeping. A mouse ran into his messed up place, gnawed everything and released the lion."

Condition 2A reveals the same dissociaton, which can take the following two forms:

Story: "A Hen and The Golden Eggs" (Case 7, cond. 2A
"A man had a hen who was laying golden eggs. The man wanted to get more golden eggs, and he

...started to alternate day and night, that is, to make it more. He was doing an artificial day and an artificial night...Something like that. I would not bet on it...The hen died, and he did not get any gold."

Here again, the idea that a man wanted more gold from the hen, but did not get it, is explicitly present. However, the most fantastic intrusions are included which distort the actual content of the story.

Below is an example where both the story reproduction and the moral reveal the knowledge of the "general idea" of the story, in the absence of adequate reproduction.

Story: "An Ox and a Frog" (Case 15, cond. 2A)
"An ox was walking around. Nearby, a frog was trying to do harm, until she kicked the bucket... Without having adequate means, don't try to accomplish something."

Here are some examples of condition 2B:

Story: "A Lion and a Mouse" (Case 10, cond. 2B)
"A hunter was going and saw a lion...then a mouse..."

Moral: "Mutual help: one saved the other, then vice versa.

Story: "An Ant and a Pigeon" (Case 9. cond. 2B)
"An ant was doing his own thing...A pigeon was

passing by, holding something in her beak... and she lost it. The ant was running further on. The pigeon sat down. The ant got to her from behind, they pulled together...and flew to their own place."

Moral: "Even a small one can help a big one. The pigeon helped the ant, and the ant helped the pigeon."

While the previous story included intrusions, here is an example of a reproduction which consisted of a "framework" of the story in a pure form. However, it cannot be accepted as an adequate reproduction, since the details are missing.

Story: "A Daw and the Pigeons" (Case 16, cond. 2B)
"A daw went to the pigeons and learned that one can do very well there, but they did not accept her...she was black, while one must be white there...She went back but was not accepted either."

Moral: "Don't break into a strange community with your own customs."

Although the design of the experiment was intended to eliminate contaminations between the stories (only one story a day was presented under condition 1 and 2), it was not entirely successful. Below is an example of contaminations between two stories that were presented separately and

several days apart.

Story: "An Ant and a Pigeon" (Case 29, cond. 2B)
"An ant and a bird...The ant gnawed a hole through which the bird escaped."

Story: "A Lion and a Mouse" was presented to the patient under condition 1B, and its traces apparently interfered ("gnawed the hole"). However, the "key statement" for a single concenter is present here, in spite of the fact that none of the concenters are conveyed adequately.

In condition 3, contaminations become inevitable. It complicates the analysis of the reproduction. However, in many cases the dissociation between the levels of representation is still apparent.

Here is an example of the story, "An Ant and a Pigeon," after the story "A Hen and the Golden Eggs" (Case 14, cond. 3).

"The hunter wanted to get gold out of the pigeon and started to drown and rinse him. But the pigeon crawled away along the branch that another pigeon threw him and ran away."

Here both the contamination with the previous story, and contamination between the concenters of the actual story occurred. However, the "key idea" of a single concenter is present, although none of the concenters are conveyed adequately.

It is even possible that the "general idea" of the whole story is conveyed when none of the concenters is conveyed appropriately.

Story: "A Daw and the Pigeons" (following "A Stupid Dog") (Case 19, cond. 3)
"A daw wanted to get a cheese...but she started to sing songs and lost it...The dogs chased her away."

Moral: "When you cheat, you're going to lose, anyway."

Here both the previous story contaminates with the actual one and with a popular story, "A Crow and a Fox," which comprises similar elements" a bird and a cheese.

Although contaminations are frequent, they do not necessarily appear under these conditions. The following example illustrates this:

Story: "A Lion and a Mouse," (following "An Ox and a Frog") (Case 17, cond. 3)
"A lion was walking around the edge of the forest, and someone began to bother him. The lion was very angry...These were butterflies..."

Moral: "Once someone helped you, remember it forever."

Below are some examples of the story-reproductions, which, although containing proper fragments of the original story, were not judged to reveal the presence of the "general idea" level of representation.

Story: "A Hen and the Golden Eggs" (Case 4, cond. 2A)
"A hen was climbing up with the golden eggs, but it was hard. She was climbing and climbing, with breaks. Still, she climbed out."

Here, a contamination occurred with the story, "An Ant and a Pigeon," which the patient had heard before under condition 1B.

Story: "An Ant and a Pigeon" (Case 6, cond. 2B)
"An ant and a pigeon. When the hunter saw a pigeon...no, the pigeon was flying and the ant was sitting at the shore, and the ant asked the pigeon for help. He gave her his paws, but the pigeon bit the ant's paws away."

5a.2 Other Types of Limitations on Reproduction Distortions: Additional Observations

The level of the "general idea"--the highest one in the hierarchy of respresentations--is most probably associated with the predicative structure of the discourse, rather than with its nominative components. Indeed, this level remains the most intact in the memory deficits following the Papez-circuit lesions.

Although the exact knowledge of the predicates involved in the discourse may be lost, the knowledge of the semantic class to which they belong is present in many Papez-circuit patients--at least in those who demonstrated the above dissociation.

It is a question of interest whether or not the same phenomenon holds for the nominative components of the stories. In other words, in the situation when the knowledge of the genuine personages of the story is unavailable, do the substitutions still belong to the same semantic category as the original personages?

Indeed, apart from the stories where contaminations occurred with another story, there was not a single instance when an animal-personage was substituted for a human personage, or vice versa. Even within the animal category the replacements were quite restricted: when the precise name of the beast was lost, it was replaced by a name of another mammal, but not a bird. It holds true for both the stories where the above dissociation was observed, and where it was not observed.

Below are some examples of the situation where the above dissociation was observed:

Story: "An Ant and A Pigeon" (Case 28, cond. 1B)
"Good for good, evil for evil...Someone got stuck in the forest...Whom was it about?..About the kind and the cruel...about a horse, a bear, a fox, a rabbit...Rabbits came down, and a bear, and a horse...."

In effect, the patient gives a "descriptive definition" of the class to which the heroes belong--that of animals.

Story: "An Ant and a Pigeon" (Case 29, cond. 2B)
"An ant and a bird...The ant gnawed a hole

through which the bird escaped."

Here, an explicit naming of the semantic class occurs--"a bird" instead of "a pigeon."

Similar observations were made with the story-reproductions where no dissociation between the levels took place.

Story: "A Stupid Dog" (Case 12, cond. 2A)
"Someone jumped into the river...Not a hen, and not a duck...It was a wolf or a dog..."

Again, a "description of the class" is given--animals as opposed to birds.

Substitutions are also restricted by semantic classes. Thus, "a pigeon" is replaced by "a sparrow" (Case 11, cond. 3); "a mouse" by "a rat" (Case 13, cond. 2B); "a hunter" by "a policeman" (Case 26, cond. 3).

Thus, the errors connected with the nominative aspect of the texts (personages) are also restricted in Papez-circuit patients by the semantic class to which these personages originally belong.

Observations have been made which may indicate that the relations in the story (predicative aspect) and the personages (nominative aspect) are not the only dimensions of the text whose distortions are restricted by some kind of narrative representation.

This latter phenomenon does not deal with semantic aspects of the discourse, but rather with the representation

of its structural (or compositional) aspects. When a subject must reproduce a story with a two-concentric structure ("A Lion and A Mouse," "An Ant and a Pigeon"), then, sometimes the doubling of a certain element (acting personage) is observed in reproduction. When this doubling occurs, both the nominative and the predicative aspects of the story are usually distorted.

Below is an example of such "doubling."

Story: "An Ant and a Pigeon" (following "A Lion and a Mouse" (Case 25, "selective interference" cond., which will be described below)
"A pigeon was going...and came to the river. And a bear came and wanted to eat the pigeon up. Then a second bear came. And they a te the pigeon up."

This phenomenon may indicate an "alienated" knowledge of some structural properties of the original text, which cannot be properly reconstructed because of the lack of retrievable information about more semantic aspects of the discourse.

There are, however, other possible explanations for this phenomenon. One may suggest that, once having mentioned a character, the patient fails to remember this fact and introduces it a second time. Or possibly that the phenomenon has a perseveratory nature. However, it would, then, be hard

to explain those cases (and they prevail) when "doubling" does not have consecutive form and the patient speaks about two objects from the very beginning.

Story: "A Lion and a Mouse" (Case 8, cond. 2B)

"A lion was fighting with a tree. A hunter wanted to tighten him up but couldn't make it. Nearby, two lions were wrestling. He came and wanted to smash them. But they got untied."

One can also suggest that it is impossible for the patient to transfer one and the same acting personage from one situation into another--from the first part of the story into the second one. As it is known, some primitive languages (or archaic forms of modern languages) do not have the means of expressing this.

In order to test this possibility, the patients in whom the "doubling phenomen" was observed, were presented with two one-concentric stories, successively, so that the presentation of the second story was not interrupted by a recalling of the first one. In this fashion, a two-concentric sequence was created; the characters did not overlap, so there was no need to transfer the same character from one situation into another. Nevertheless, the "doubling" phenomenon was still observed.

Story: "The Hen and The Golden Eggs" following "A Stupid Dog" (Case 8)

"Two hens...The owner had two hens. He has eaten

them up, for they laid golden eggs."

Thus, the "doubling" phenomenon can be observed only if the subject is presented with a double-concentric text, or if two separate short texts follow immediately and successively. For this reason they might have been perceived as a whole by the patient. These circumstances indicate a non-casual relation between the "doubling" phenomenon and the formal structure of the text.

Therefore, in addition to existence of the representation of the "general idea", there is some evidence for higher-order representation of the categorical class to which the acting heroes belong, and also some representation of the formal structure of the discourse, even when this structure is not realized in the actual reproduction. Although the two latter findings were not studied systematically in this research, the mere evidence for the existence of those phenomena may be of some interest.

Now that two types of semantic restrictions have been established (those connected with the story-personages, and those connected with relations between them), it would be interesting to assess which of these two types of semantic restrictions is the more essential for a successful reconstruction of the original material. In order to test this notion, the sub-group of six subjects who passed all five of the previous conditions were subjected to the condition of "selective interference." It consisted of the following

procedure.

Three pairs of more-than-one concentric stories were devised in such a way that:

(a) One pair had a common "general idea" but different personages: stories "A Lion and a Mouse" and "An Ant and a Pigeon."

(b) In the second pair, sets of personages overlapped, but the "general ideas" were different: stories "An Ant and a Pigeon" and "A Crow and a Fox."

(c) In the third pair, both of the above parameter were different in the two stories: stories "A Lion and a Mouse" and "A Daw and Pigeons."

Note that in the pairs (a) and (b), both the actual relations and the acting personages are different. What is common are, respectively, semantic classes for predicates ("help"--cond. A), and personages ("Birds"--cond. B).

In such a way, an interference was created that selectively obscured the differentiation between the two engrams from the point of view of predicative (cond. A) or nominative aspects (cond. B).

The pairs were presented to the patients with 1 - 2 day intervals in the following order: (c), (b), (a). The instructions were to listen to the first story and to reproduce it immediately; to listen to the second story without reproducing it immediately; and finally, to reproduce the first story.

Out of the six subjects, only one of them had difficulties with condition (c); two patients had contaminations between "a crow" and "a pigeon" in condition (b) while in other respects the reproductions were quite adequate; and five subjects failed under condition (a).

One example was quoted above (Case 25). Below are some more,

Story: "A Lion and a Mouse" after story "An Ant and a Pigeon" (Case 21)

"A lion caught a pigeon...and tried to figure out what to do with him...and something happened."

Moral: "I am not sure."

The same instructions (Case 240:

"A lion wanted to drown the mouse but then pitied him and pulled him out. so, the mouse did not forget it, and when the time came bit the hunter...and the lion ran away."

While in the former case, the predicative structure of the story was ruined and contamination between the two nominative sets occurred, in the latter case the nominative set remained intact, but contaminations occurred between the two predicative structures.

It should be noted that the failures under condition (a) included not only damage to the predicative aspect of the

stories, but also to their nominative aspect. It may indicate that these are not two independent systems of "addresses," but that the "general idea" representation, being predicative in nature, is also essential for retrieving the non-predicative components of the original content.

5b. Experiment 2 (Prefrontal Group)

5b.1 Dissociation Between the Monitored and Non-monitored Conditions of Reproduction.

There is no significant difference between the quality of reproduction under monitored versus non-monitored condition of the first two stories, the short one-concentric ones. However, the picture changes considerably in the longer, more-than-one-concentric stories (stories 3, 4, 5).

Indeed, the proportion of correctly reproduced events (completely correct or within the semantic class) to the total number of events in the stories is considerably larger under the monitored condition than it is under the non-monitored condition. This holds true for all the three stories and for all the patients studied.

Below is the table with these data summarized (see the detailed tables in Appendix 2).

TABLE 6

QUALITY OF THE STORY REPRODUCTION IN UNITS OF EVENTS

(PREFRONTAL GROUP)

Case #	Proportion of the Events Conveyed									
	Story 1 (6 evts)		Story 2 (8 evts)		Story 3 (14 evts)		Story 4 (18 evts)		Story 5 (11 evts)	
	M	N/M	M	N/M	M	N/M	M	N/M	M	N/M
1	1	0.83	0.75	0.75	0.71	0.36	0.61	0.28	0.73	0.18
2	0.83	1	0.88	0.88	0.71	0.43	0.66	0.33	0.73	0.18
3	0.83	0.83	0.88	0.88	0.71	0.43	0.89	0.45	0.73	0.45
4	0.83	0.83	0.75	0.88	0.64	0.36	0.5	0.33	0.82	0.55
5	0.66	0.5	0.75	0.62	0.5	0.43	0.72	0.33	0.45	0.36
6	0.83	0.83	0.75	0.5	0.57	0.43	0.66	0.39	0.64	0.18
7	0.83	0.83	0.88	0.88	0.71	0.36	0.78	0.45	0.82	0.18
8	0.83	1	0.75	0.75	0.64	0.64	0.5	0.22	0.73	0.36
9	1	0.66	0.62	0.5	0.5	0.21	0	0	0.55	0.18
10	0.5	0.50	0.75	0.5	0.36	0.36	0.55	0.17	0.45	0.18
11	1	1	0.88	0.75	0.79	0.43	0.66	0.33	0.55	0.27
12	1	0.83	0.75	0.75	0.64	0.36	0.78	0.45	0.82	0.45
13	1	1	0.88	0.62	0.79	0.36	0.66	0.17	0.64	0.18
14	0.83	0.83	0.62	0.4	0.71	0.36	0.61	0.39	0.73	0.27
Average	0.89	0.83	0.78	0.69	0.64	0.39	0.61	0.31	0.67	0.28

Several conclusions can be drawn from these data as far as the problem of the mnestic deficits is concerned.

1. Reproduction of the stories under the monitored condition is fairly good. It is considerably better than in the cases of true amnesias described in the previous chapter.

2. There is no considerable difference in the quality of reproduction with the increase of the length and complexity of the story under the monitored condition. This is another difference from previously described amnestic patients.

These two facts indicate that both storage and retrieval are relatively intact in prefrontal subjects.

3. In many cases the quality of reproduction under the monitored condition remained high even when the subject was tested after he had completed his absolutely irrelevant monologue. It means that retrievability of the relevant trace system can resist even large homogeneous interference. In true amnestic subjects, this factor damages the quality of reproduction considerably.

4. The quality of reproduction deteriorates enormously under the non-monitored condition. This indicates that there are some aspects of mnestic processes that suffer in prefrontal subjects. These deficits are of a different nature than traditionally studied storage and re-

trieval, and they need special analysis. It will be the concern of the following subchapter.

5b.2 The Problem of Spontaneity in "Prefrontal Monologues." Qualitative Analysis of Verbal Field Behavior

It is clear what monitors the process of a text reproduction in normal subjects: the plan, the narration of the discourse, its engram, and the task to convert this engram into a verbal sequence (communication task).

Presumably, these mechanisms are also evident in diencephalic patients except for the fact that the engram and/or its retrievability is impaired. However, the engram continues to regulate the process to the extent it is intact. This was demonstrated by the error-analysis above: The errors are relevant to the original story. They reveal the subject's ability to efficiently encode the content of the text on a certain level of generality.

However, a peculiar problem arises with the text reproduction by pre-frontal subjects. In response to the instructions to reproduce a short story (non-monitored condition), the subject builds up a lengthy monologue, which sometimes continues 40 - 60 minutes. Beginning with a fragment of the original story, he then starts to deviate from it until there is no resemblance at all between the original story and the content of the patient's monologue. The subject, however, goes on and on. Even when urged by the experimenter to stop, the subject answers: "Not yet,"; "Wait a minute," and

continues to develop his monologue. The inability to terminate the activity once begun can be observed in frontal subjects in many behaviors: writing, drawing, etc. It is inertia "upside down." Often, this inverted inertia goes together with the real inertia. It is very difficult to coax the subject to begin reproduction. In response to the instructions to retell the story, he responds: "I've told it already." ; or "There was nothing in this story." However, once he eventually starts, he cannot terminate the process. This leads one to believe that "real" intertia and the inertia to terminate are two manifestations of one and the same deficit.

The subject's verbal production obviously is not governed by the text engram in the subject's memory, since both the engram of the text and its availability for retrieval is fairly intact, as demonstrated before, while the discrepancy between the patient's monologue and the original story is considerable.

Below are some examples of these monologues.

Story: "A Lion and a Mouse" (Case 13)

The Patient's Monologue	Comment
So, the lion made friends with the mouse	Actual relations are replaced by the most standard ones for initiating a fairy tale, or possibly, narration of the whole story.

The mouse was caught by the lion. He wanted to strangle him but then let him go.	An authentic fragment of the story.
The mouse started dancing around him, singing songs and was released.	Instead of passing over to the next concenter, a redundant development of the previous one continues. The mouse's joy is explicated by "field associates": dancing, singing songs, etc.
After that the mouse was accepted in his house by...lions various animals. After that he was released, so to say he hadn't been captured, it was like if he were captured but he was still free. But after that he was completely released and was walking free.	"Cycling": all the alternative continuations of the plot are exhausted; but inertia of activity does not allow the patient to terminate.
So, he was released by the lion completely, after the lion listened to him, and he was released to all the four directions.	Cycling goes on in a perseveratory way. A field associant is introduced: the experimenter is listening to the subject; the lion is listening to the mouse.
He didn't run away and remained to live in his cave, then the lion caught him once again, in some time... I don't remember it quite exactly. So, he caught him, and released again.	Cycling over and over. Nevertheless, the termination of the process is impossible.
Now the mouse got out of there to his moor (a slang expression for a secure place)... to his railroad station.	Developing a new concenter of field associations. A new field associant is introduced, this time on phonematic basis (moor [prichal]; railroad station [vokzal]).
The mouse goes further and further and tells about his railroad station...	The subject is projecting his own state into the story: "...tells about the railroad."

And there is another mouse and the third one at the station	Cycling again
So the mouse opens the door to this...What's his name? Hullo! Hullo! How are you doing? Okay, more or less ...All set. Glad to find you...	Developing a new concenter of a meeting of two friends.
I have an apartment...and a house...and a room	A stereotypical associative sequence.
The bigger mouse asks the small one: How are you doing? How is it going?	Cycling again.
So, it was all right, I had a lot of friends. They often meet...but the friendship broke apart, so you tell him that I'm sorry for those short rendezvous... Or you don't tell anything.	An imitation of standard conversation between two friends, possibly with projection of the subject's own experiences.
The story ends up by the two friends drinking beer in a railroad pub.	

Another example of the field monologue:

Story: "A Stupid Dog" (Case 13)

The Patient's Monologue	Comment
A dog was going at night over the bridge and saw his own reflection. He decided that it was cheese and jumped into the water. There was no cheese there, it was his own reflection, and he got wet.	A relatively good reproduction.
There was no son there it was just a reflection, and he got wet.	An associant is introduced on a phonematic basis "[sir]; son - [sin].
He dried himself and went home. At home he saw his son and the whole bunch of dogs.	A stereotypical development of the plot ("went home") instead of terminating the process.
So, he decided that there had been no point in jumping into the water, that he only got wet without profit.	Cycling starts.
Well, during the night he dried, and was returned to his house in a dried way.	Cycling. Varying the opposition "wet-dry" and the word, "night" (perseveration).
After this incident he decided that there are all kinds of people, and some of them may be nasty.	Association on the basis of the general meaning of the story, that the dog suffered. Impossibility to develop the line of the plot; in spite of that impossibility to terminate the process.
But the dog did not derive the lesson from the whole thing and remained stubborn.	Varying the topic of fiasco; almost cycling.
After this incident he had to live...on his own...	A lexically stereotypical completion of the phrase (live on his own).

After that he was not allowed...how to say it better...to quit.	Projecting of the subject's own state of inability to terminate the process.
Generally speaking, he was gotten friends...with a lion-cub.	Perseveration of the passive form from the previous sentence (...was gotten friends), which is grammatically inappropriate; a trace of the previous story ("A Lion and a Mouse") gives source to a new concenter of association.
So, the lion-cub decided to feed the dog and brought him to his house and he said "That's why friend, feed him quickly, he has no time."	A new theme develops, influenced by previously mentioned issue: "A house," "to feed" (dog's hunting for the cheese).
So, the lion-cub was requested, where he was from, and so on. He was fed and thanked the host for the dinner....	A standard development of the theme.
...And was let to go wherever he wants.	Perseveration from the previous story--"A Lion and a Mouse."

Experimenter: Did you finish?

Subject: Not yet.

Experimenter: What was the story about?

Subject: How the lion got friends with a dog.

Experimenter: Do you remember the story "A Stupid Dog?"

Subject: Yeah, a dog was going over the bridge...

Experimenter: And what happened?

Subject: Well, he saw his reflection in the water and thought that it was her son, and jumped into the water. But it was just a reflection, so there was no point in jumping there.

There is one obvious factor that damages the subject's verbal behavior--perseverations. However, they cannot account for the "creativity" of the subjects' monologues. At best, perseverations can account for the least productive aspects: repetition of a few verbal cliches. But the subjects' monologues are not all that repetitive. They obviously have some development: new events are introduced and these lead to the inclusion of still newer events, etc. A long chain of events is "invented" by the subjects in the most bizarre combinations.

There is a phenomenon commonly observed in frontal patients which is called "field dependent behavior." As a rule this term is used to describe the frontal patients' tendency to react to every stimulus that occurs in their sensory field instead of accomplishing the behavioral task.

The structure of the frontal monologues under discussion is somewhat reminiscent of this behavior. By "verbal field behavior" we mean any situation in which a subject's verbal activity, instead of following the communication task (reproducing a story, describing a picture, etc.) in a selective way, is distracted by any current stimuli which happen to appear in the subject's physical environment or in the focus of his attention. These stimuli or events then become incorporated into the subject's monologue, causing the discourse to take the most arbitrary directions.

Let us assume that such a phenomenon is not a fantasy, that it can be observed, and that the prefrontal monologues

under discussion are an example of it. In order to support this assumption, it should be demonstrated that the subjects' monologues are really guided by field-associations.

Analysis of prefrontal monologues indeed supports this assumption. At least five types of agents can be singled out as provoking the inclusion of "field associations" into the subject's monologue:

(a) external stimuli (objects in the sensory field, actions of surrounding persons, etc.)

Thus, in reproducing a story "A Daw and Pigeons," subject 14 incorporates into the story a tape-recorder that the experimenter is using.

"Pigeons were well-fed, and the daw envied them. so, she flew to the dove-cote. But the net was too thick, so she couldn't even pull her head through it (points to the net that guards his bed)...So, he flew and flew ...and asked the taping-boy to take the net away... and then she sees a net...and...See, it is thick...and so the net was removed...and the pigeon flew to the... hen (net is setka; hen [na'setka])...and told her that all is taped..."

In other cases, the doctor, or the net, (many patients were guarded by a net in the post-operational ward), or the tape-recorder are introduced into the monologue.

(b) The patient's own condition is assigned to the heroes of the story.

Thus, in reproducing the story "A Daw and Pigeons," subject 13 projects his own verbal exhaustion:

"A daw, or rather a pigeon, or rather a daw learned the daw language, flew to her pigeons and told them that she learned to speak the daw language. She went on speaking, some time passed, and a pigeon asks the daw: 'Where did you learn to speak this way, how could you make it? How long can you talk this way?' And the daw answers that she can talk a year, two, probably three--and that's it...I'm telling you all precisely...They ask the daw, how could you learn to talk this way...So, they ask this daw, how long can you talk? And the daw answers that she can talk a year, two, well, three at most and that's it. A year passes, two, three, the daw gets exhausted, she doesn't know what else to say. A year passes, two, three...<u>the daw's vocabulary gets exhausted</u>..." (long perseveration follows).

In reproducing "A Lion and a Mouse," case 10 reported: "A mouse was running around a sleeping lion. The lion got up and grabbed her...You can't resist a stronger one... He could just blow once, and the mouse would die from fear...What could the mouse do...She can't run away, because the lion runs faster...He could just punch her with his paw and that would be it...So, the mouse asks him...'Why do you want to kill me?'...And the lion says because you don't pay your dues...But how can I pay them?

I am in the hospital...How long are you in the hospital? ...Why did they put you here?...Because something was wrong with my...legs...and with my head...Well, the mouse said, I had an operation...and another operation ...The second mouse asks...Well, do they bring you something here?" (Monologue continues.)

(c) Verbal out-of-the-given-context associations.

These can be on phonematic levels, as in the above quoted reproduction of the story "A Stupid Dog," where the word "sir"--cheese evokes the word "sin"--son, which is introduced into the monologue, or "setka-nasetka" in the above quoted reproduction of "A Daw and Pigeons." Or they can be on a lexical level. Thus, subject 2 reproduces the story "A Daw and Pigeons"in the following way:

"So, the daw flew back to the daws, but they did not accept her either. Then she flew to her...little children-birds...brought them food...to the nest... looked at them...then looked into the mirror...and the girl Daw...and she started dancing around the mirror ...because she was pretty...it was the girl's silk that was pretty...so she looked at her...wedding-dress..." (The monologue continues.)

The daw turns into a girl Daw. In Russian, the word [galka] means the name of a bird and also is a female first name.

These associations can also refer to larger units of the language (but still to the language-items, rather than to items of events), such as idiomatic expressions or verbal cliches. Thus, subject 6, reproduces the story "A Stupid Dog" in the following way:

"The reflection of the moon was in the river. The dog saw the reflection of the moon and jumped into the river to get it...But there was nothing good there... except the moon...the dog started...growling at the moon ...out of despair"("to growl at the moon" is a very common Russian expression with the connotation of despair) ...Then the patient relates a verse by Esenin that starts with the words: "Dogs were quietly barking..."
"...So the dogs were barking and barking again...and that was it..."

Experimenter: Is that all?

Subject: No, they also got into fight... (Perseveration follow.)

(d) Frequent out-of-the-given-content situational associations to the items of the discourse.

Here is an example from "A Lion and a Mouse." (Case 11)

"...Hunter caught the lion...and tied him to the tree... mouse came and untied him...So, the lion is free... Now, the hunter caught the lion again...So, they are in trouble ...they got together once...and another time...there is nothing good...they get together once again...everyone got together...and they discuss how to save the hostage-lion...and the mouse tells them: 'Don't you run away...

(a person with a white coat enters the ward)...the doctor will come...and prescribe what to do'."

While "the doctor" was included into the monologue as a physical object in the subject's visual field, the subsequent statement is, apparently, an introduction of a most common event associated with a doctor.

(e) Memory traces of the subject's previous experiences.

Both the long-term traces of experiences remote in time and relatively recent experiences such as the traces of the experimental materials presented to the patient an hour or two previously can serve as verbal-field behavior stimulators. For this reason, the patient's reproduction sometimes takes the form of contamination of the stories presented to him before, and thus they mistakenly resembly memory deficits in true amnestic patients. Here is an example of such a situation in the report of Subject 9 of "An Ant and a Pigeon."

"A hunter caught a pigeon and wanted to eat him up... So the ant came and bit the lion...and untied his... tail..." (Contamination between this story and "A Lion and a Mouse" heard before.)

Sometimes, in the course of the patient's monologue, at a stage when it already bears no resemblance with the original story, some authentic fragments of the story reappear. But, these fragments act as "field agents"; there is no continuity among them; and they are fragmentarily incorporated into basically irrelevant monologue without being given any priority

comparable with the "field agents" of other types.

Usually, traces of old memories are projected into the monologue, and the patient begins talking about his work, places that he visited, etc.

Thus, at least five different agents of verbal-field behavior affect frontal patients. Only one of them (a) is "localized" in the external field, while the other four in one way or another belong to his inner representation and the last three apparently are "localized" in his long-term semantic space. Were it possible to separate the effect of the latter three types of agents from the former two, it would provide a unique method of analyzing the "metrics" of inner representation of events in the subject's memory. However, it is doubtful whether or not it can be solved. At this point, it is sufficient for our purpose to demonstrate that the analysis of prefrontal monologues allows one to single out "field" agents and, further, that these agents determine the patient's verbal behavior.

So far it has been maintained that the "prefrontal monologues" develop as basically linear sequences. This is true, as far as the communication task is concerned. Monologues, then, are not guided by the plan of the discourse to be reproduced, rather, they are guided by "field associants."

However, these monologues cannot be viewed as linear (in the sense of their being "markovian") from the linguistic point of view. Linguistically, they are quite coherent.

Moreover, the sequence of events encountered in the monologue is not "Markovian" either. This is the difference from the monologues produced by some forms of schizophrenic and psychotic patients, in which one single event in the monologue is hardly coherent or approximate with the successive ones and the monologue, as a whole, lacks any contextuality. In the "prefrontal monologues" one can single out sub-sequents within which the statements made are fairly coherent, in the sense that they form a certain context. Thus, a shift occurs from this context to another one. The level of the monologue at which "Markovian" qualities begin to be observed, is the level of contexts. The patients are unable to "stay" within a certain context, and, as soon as a strong enough "field associant" of any of the types described above emerges, it "shifts" the monologue into a different contextual space. The subject stays within a new contextual space, until a new, strong associant appears, or until the subject has exhausted his repertoire of the most frequent statements belonging to the given contextual space in which case the patient eventually "picks up a field associant that brings him into a new context." It is characteristic, that shifts to a new contextual space are often preceded by perseverations. It can be an indicator of the fact that the context (a set of cliches belonging to the context) is exhausted. As soon as a new context emerges, the perseverations disappear. (Compare these findings with the MacLay and Osgood (1959) results about pauses in spontaneous speech.)

Let us demonstrate, then, "shifts of contexts" as they occurred in the monologue of Subject 14.

Story: "A Hen and Golden Eggs"

The Patient's Monologue	Comment
"A man was living with a hen...or rather the man was the hen's boss. She was producing gold...The man...the boss...wanted more gold at once...So he cut the hen into pieces but no gold...No gold at all... he cuts the hen more, no gold ...the hen remains empty... So he searches again and again...No gold...he searches all around...in all the places.	The genuine story
The search is going on with a tape-recorder...they are looking here and there, nothing new around. they leave the tape-recorder turned on something is twisting there ...what the hell are they recording there...some digits ...0, 2, 3, 0...so, they are recording all these digits ...not very many of them...	Introduction of a field associant (tape-recorder with a turning reels.)
that's why all the other digits were recorded...turned out to be not very many of them either...So, everything was recorded...and I'll tell you what...there were only 5 - 6 digits there...[Experimenter: Did you finish?]...Not yet, I'll finish soon...so, there were only 5 - 6 digits there...	Developing the theme of recording Numbers lead to the introduction of the bus route #5
When they took the bus #5 and go along the Lefortoff Drive...so, you get there and transfer to bus #5 [Experimenter: You better finish!] Not yet! Wait a moment!...So you take bus 5 and get to the Bauman Square ...From the Bauman Square you go further on...further on Here you take off...and again you take bus #5...I'll make it precise...so you take off	New concenter: Subject describes the way to get to the institute where he was enrolled.

...and take bus #5...and you get to cafeteria... number 5 point 6...and you get...sausages...and cucumbers. No beer served there...so you go to a store across the street" (Monologue continues.)

Perseverations. Context of the bus routes exhausted. Digits lead to association with a cafeteria # something. New concenter: a cafeteria.

5c. Experiment 2: Further Analysis of the Data.

5c1. Hypothesis: The "Segment" Level of the Semantic Representation of a Text and Its Place in the Engram Hierarchy.

The hypothesis to be presented is about a level in the hierarchy of representations of an event sequence which level is intermediate between the "single label" ("general idea") level and that of the full content (text-base) representation. It should be noted that the level to be discussed does not have an immediately apparent linguistic equivalent. For the purpose of clarity, it will be named evaluator in the subsequent discussion.

There is no intention in this hypothesis to completely "fill the gap," or even to make a statement that the number of these levels is invariant for all the possible content situations.

The hypothesis will be formulated about "a level" and the plausibility of its existence will be discussed. It is substantially based on the concepts of Morris (1946).

Morris offered the classification of the statements into "designators" - those conveying information; "appraisors" - those expressing evaluation of information, and "prescriptors" - those expressing an action based on the former two.

Although devised by Morris for classifying verbal communications, this clustering is perfectly behavioral in the sense that it can be equally applied to behavioral sequences. It is

also complete in the sense that every behavioral act will fall into one of these categories.

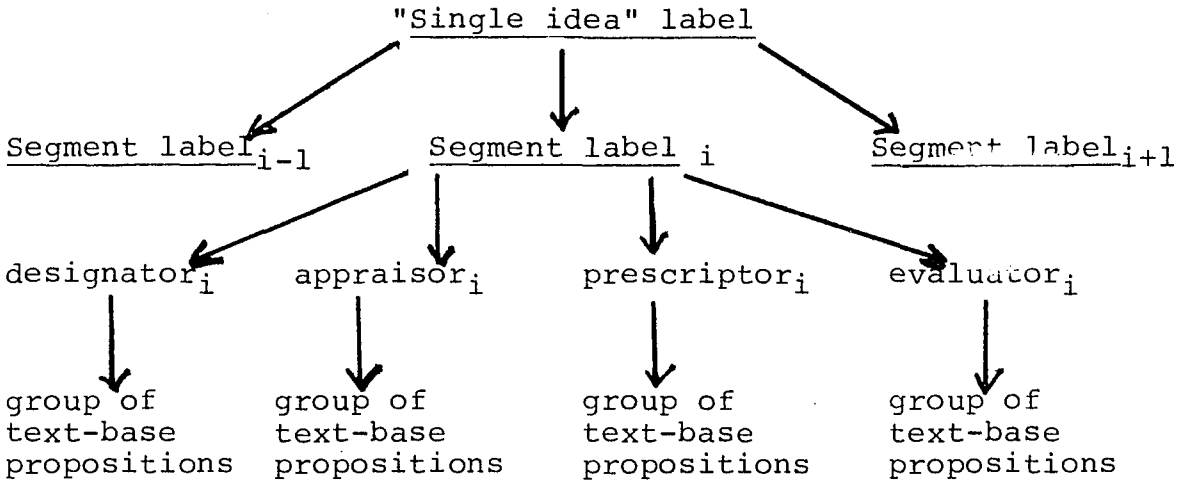
The sequence, (designator) $\rightarrow$ (appraisor) $\rightarrow$ (prescriptor), may serve as a schematic description of virtually every behavioral pattern (a sequence of acts) which has the property of autonomy (self-causality). In order to match this linguistic description to the classic description of an autonomous behavioral pattern, only a second "appraisor" should be added to it - the one expressing the evaluation of the result the "prescriptor." For the purposes of clarity, it will be named "evaluator" in the subsequent discussion. Thus, the resemblance of this scheme to the idea that a "behavioral loop" is an elementary unit of behavior (Bernstein, 1966, Anokin, 1962, Miller, Galauter and Pribram, 1956), will become apparent.

Simple "event-communicating" discourses (and this hypothesis is restricted to them) can be easily segmented into those three (or four) element units each of which can be "labeled" by a single proposition. These labels will be called "segment labels." In the simplest case, they will represent sequentially ordered segments of a full description level (e.g. those in terms of Kintsch's "text-base") but not necessarily, because the same text-base propositions may enter different segments.

An ordered group of the "segment" labels will represent a certain level of de-minimizing the "general idea" single label. On the other hand, every single "segment label" will be a generalization of a three (or four) element unit of the above described nature. Each of the units will be a linguistic

equivalent of the respective state of the behavioral segment. Each of these units will refer to a group of text-base propositions. A Chomsky-type tree of semantic hierarchy will be obtained th this case:

Figure 1. The Hierarchy of the representations of a text.



(embedded in the universal graph)

This model represents a 4-leveled retrieval (or reconstruction) procedure; it also suggests the vertical organization of the process. Postulating that the process consists of 4 levels would be, most probably, a very crude oversimplification; as to the strictly vertical organization of the process, there are different models which account for it (Osgood, 1965), and this aspect of the model will be discussed later one. However, the above aspects of the hypothesis are not central to our goals.

The main aspect of the hypothesis to be considered, here,

is that of the reality of the segment level, as "a level" of the semantic representation of a discourse.

Several features of the suggested semantic representation are to be described. (a) The assignment of a certain proposition to either designator, appraisor, or prescriptor group, is not derivable from the given proposition itself; one and the same proposition may belong to either of the three groups depending on the content of the whole segment. This feature is not a shortcoming of the model, but rather its advantage: it means that the quality of a context - interdependence of single statements is present in the model.

(b) The way of breaking down the discourse into three (or four) unit-segments is not quite fixed. There may be several alternatives for segmenting a given text. Again, it would be naive to try to establish fixed segmentation for a given discourse. It is a cognitive operation done by a listener, and that is why it depends on the listener's interpretation. It was emphasized before that an attempt to find content invariants is not viewed as a relevant one. Thus, the only requirement of the model is that no matter into what concrete chunks a given discourse is broken down, each of them should maintain the above three (or four) unit structure.

This ambiguity is usually connected with the interpretation of "evaluator," since very often the evaluation of the previous action ("prescriptor") leads to a re-doing of it, leaving it up to the language-user whether to treat it as a continuation of the given segment, or as a new event-segment.

This is the reason why it is questionable whether the "evaluator" - statements are parts of the segment under discussion (thus comprising its fourth unit) or whether they are reduced, separate segments.

(c) It has been noted by authors of semantic descriptions on full-content level that the semantic description ought to explicate propositions that are not necessarily present in the verbatim but are implied in the discourse. In the model under discussion, this aspect is present too. Most often, it refers to the "appraisor" part of the segment. In further descriptions, the statements that are implied but not present in the verbatim, will appear in square brackets.

These ambiguities of the model may be relevant to the nature of the real process that it intends to describe: indeed, the model refers to the semantic aspects of derivations, where the degrees of freedom for a language user are larger than when dealing with syntatic aspects of derivation.

(d) Since the segments under discussion reflect units of behavior, an additional means of characterizing them and distinguishing between them would be to indicate whose personage's line of behavior each of them reflects. This will be indicated for each segment in the further descriptions.

One way of testing a "normal" hypothesis for a certain aspect of processing is to find out whether it can account for some pathological phenomena.

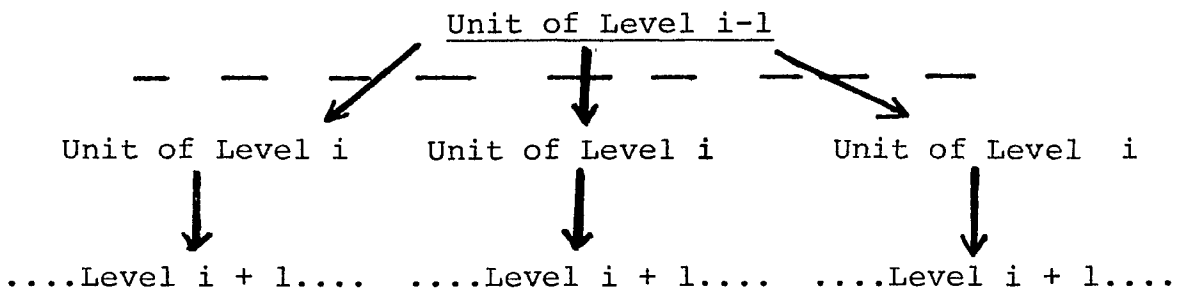
The above hypothesis is of an hierarchic nature; that is why it can be tested best of all on prefrontal patients.

It was demonstrated in the previous chapter, that the storage and retrieval aspects of memory in frontal patients remain much more intact than their ability to reconstruct a given material. This discrepancy may be due to either of two reasons: an inability to organize sequentially the reconstruction process following the narration, or/and an inability to form this scheme beginning with a certain level of generalization.

Whatever model of hierarchic representation for text-content is accepted as a working model (not necessarily the one described above) it would mean having to deal with one (or both) of the two following possibilities: (a) starting with a certain level, the representation is not being formed (in Osgood's terms, "cognitive mixer" works only that far); or (b) the immediately preceeding levels of the hierarchy, although having been formed do not execute sequencing function over the units of representation in the level below them. These possibilities are supported by what is known about frontal patients' performance in problem-solving tasks: they are capable of performing single operations separately, but are unable to integrate them according to the plan of the process (Luria et.al., 1966).

Schematically, the break-down will appear in the following way:

Fig. 2. The Lack of Inter-level Interaction in Frontal Patients.



The representation on the level i becomes a non-integrated set of units, due either to non-existence, or non-efficiency of level i-1. Each of the units of the i level can be successfully de-minimized, but the shift to the other unit of i level does not occur due to either (or both) of the above-mentioned reasons.

The way to test a hierarchic hypothesis involving several levels of representation from the point of view of psychological reality of level i, would be to see whether the following conditions hold for frontal patients:

1) it can be demonstrated that a unit of the i level of representation can be successfully de-minimized by the patient;
2) there is no shift from one i-level unit to another;
3) however, it can be demonstrated that all the units of this level are formed and present in the storage.

In addition, there will also be some more indirect evidence which will be discussed later on.

In order to utilize the patients' production in the above way, the experimental texts themselves (the stories presented to the patients), should first be described in terms of the suggested model. The verbal "labels" will be assigned arbitrarily to the units of the segment level as well as to the segment-unit levels.

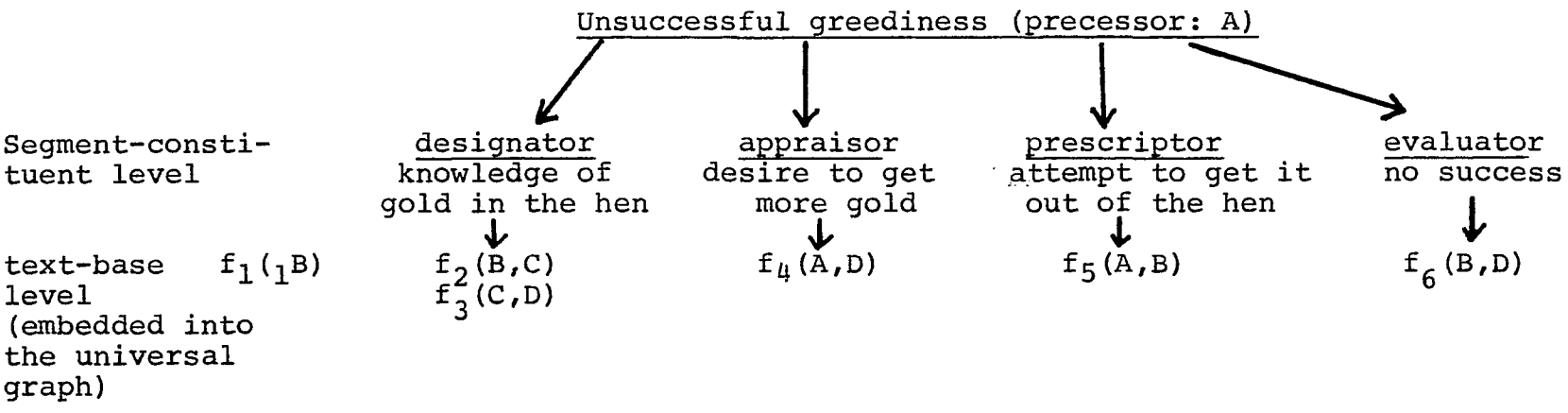
Story 1. A hen and golden eggs.

Terms: man - A; hen - B; eggs - C; gold - D.

Propositions:

1. A man had a hen - $f_1(A,B)$
2. The hen was laying golden eggs - $f_2(B,C)$
3. The eggs were golden - $f_1(C,D)$
4. The man wanted more gold - $f_4(A,D)$
5. The man killed the hen - $f_5(A,B)$
6. The hen had no gold in it - f_6

Figure 3. Description in terms of the model.



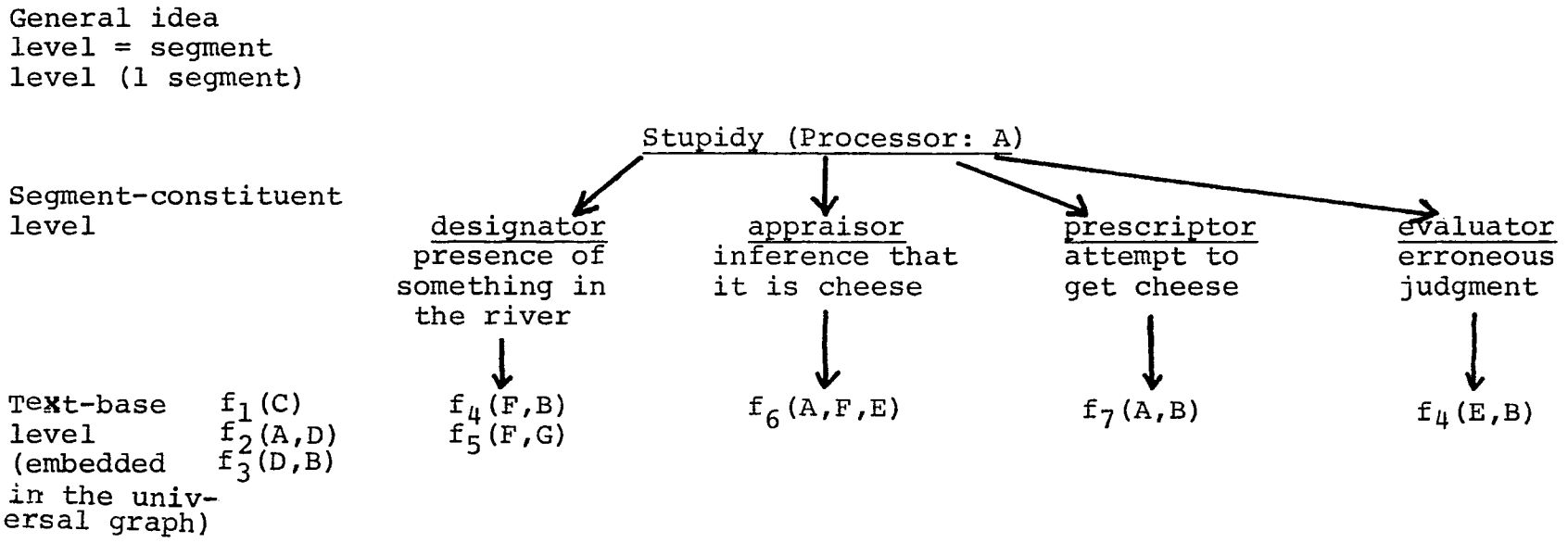
Story 2. A stupid dog.

Terms: dog - A; river - B; night - C; bridge - D; cheese - E; reflection - F; moon - G

Propositions:

1. It was night $f_1(c)$
2. The dog was crossing a bridge $f_2(A,D)$
3. The bridge was over a river $f_3(D,B)$
4. Reflection was in the river $f_4(F,B)$
5. Reflection was that of the moon $f_5(F,G)$
6. The dog thought that the reflection was cheese $f_6(A,F,E)$
7. The dog jumped into the river $f_7(A,B)$
8. There was no cheese in the river $f_4(E,B)$

Figure 4. Description in terms of the model



Story 3. An ant and a pigeon

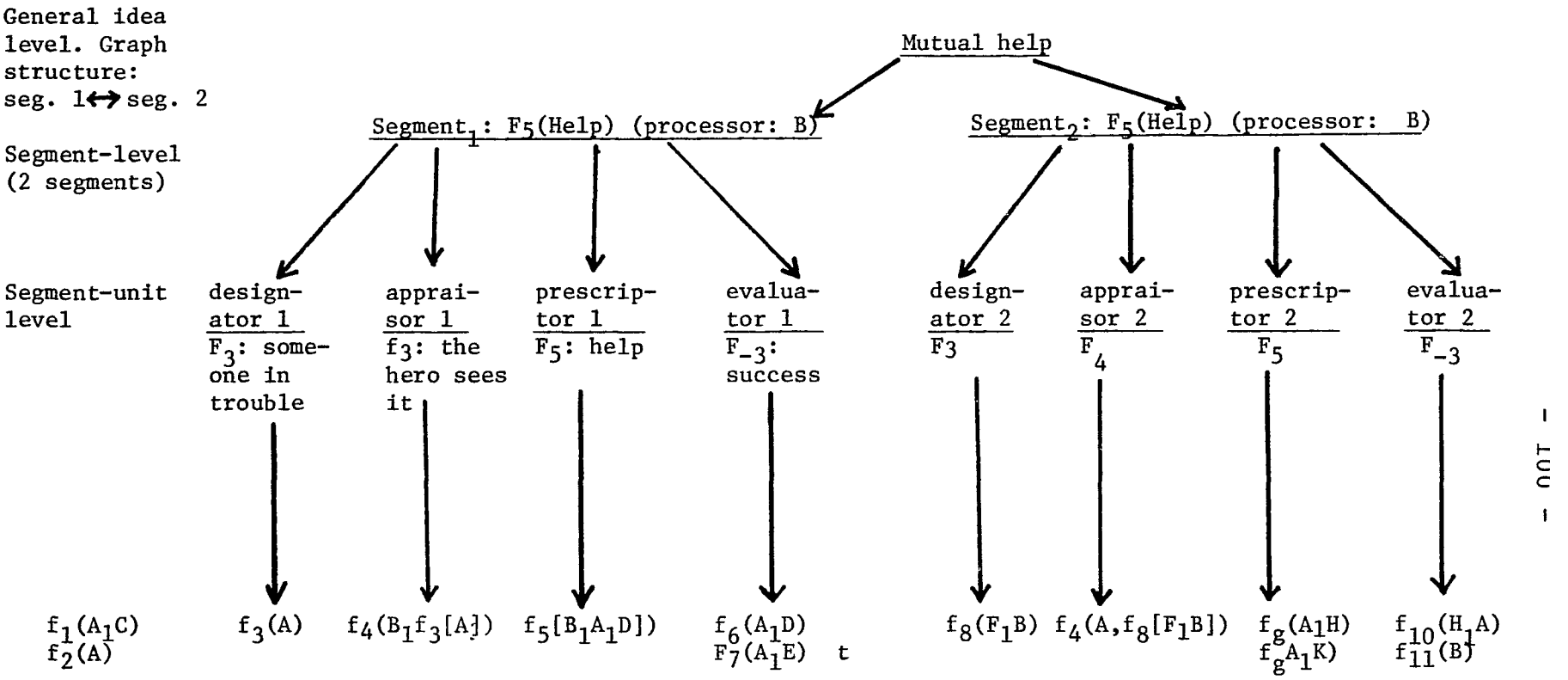
Terms: man - A;, pigeon - B; river - C; branch - D; hawk - E; hunter - H; hands - K.

Propositions:

1. An ant was at river - $f_1(A,C)$
2. The ant was drinking - $f_2(A)$
3. The ant started to drown - $f_3(A) \in F_3$(someone in trouble)
4. The piegeon saw the ant drowing - $f_4(B,f_3[A] \in f_4(B,f_3)$ (sees someone in trouble)
5. The pigeon threw the ant a branch- $f_5(B,A,D) \in F_5$ (help)
6. The ant used the branch - $\left.\begin{matrix} f_6(A,D) \\ f_7(A,E) \end{matrix}\right\} \in F_{-3}$ (someone out of trouble)
7. The ant got to the bank - $f_7(A,B)$
8. Time passed - t
9. The hunter caught the pigeon - $f_8(H,B) \in F_3$.
10. The ant saw it - $f_4(A,f_8[H,B])$.
11. The ant bit the hunter - $f_9(A,H) \in F_5$
12. The bite was on the hand - $f_9(A,K)$
13. The hunter released the hands - $f_{10}(H,A)$
14. The pigeon flew away - $f_{11}(B)$.

$\Big\} \in F_{-3}$

Figure 5. Description in terms of the model.



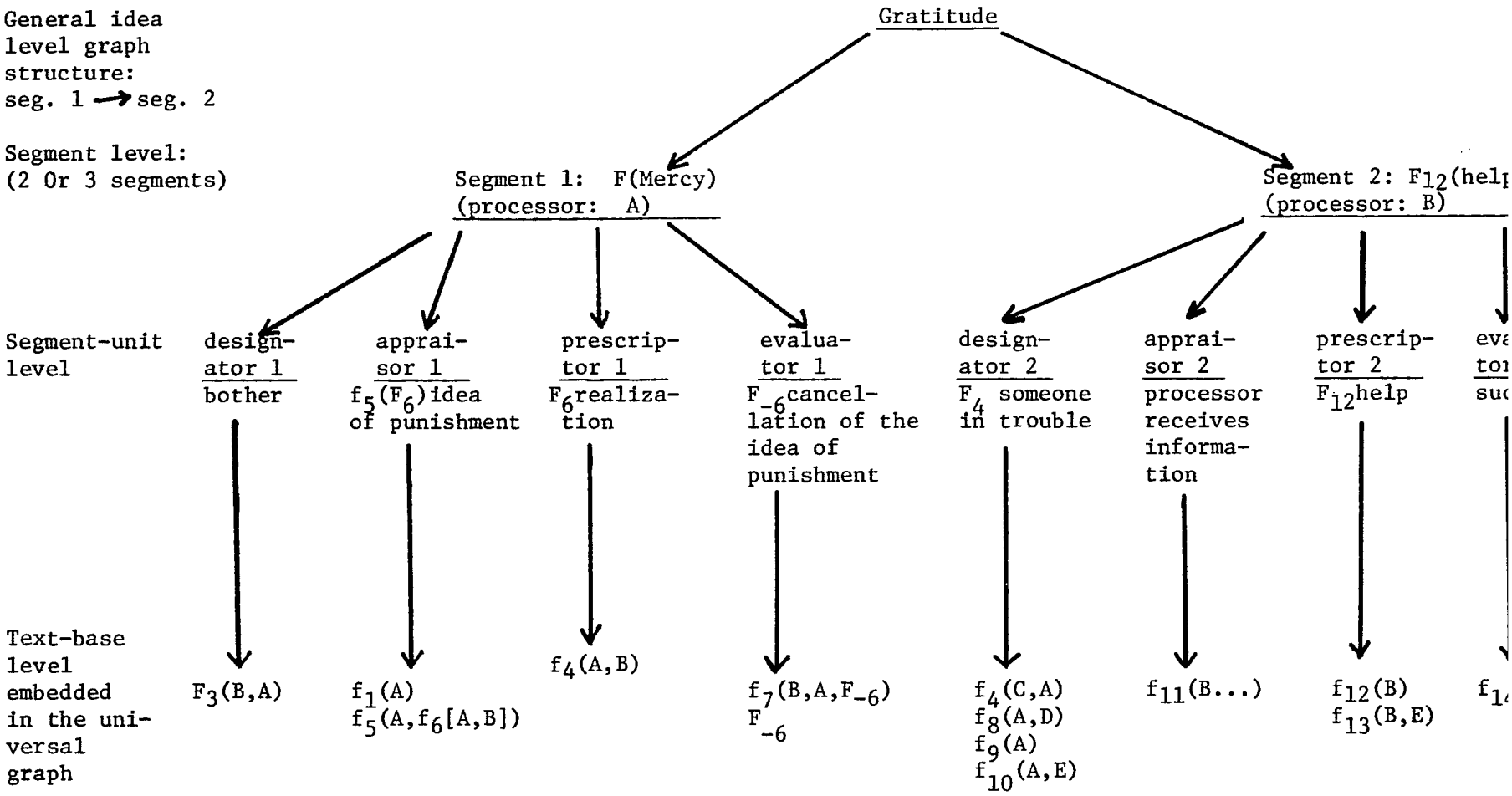
Story 4. A lion and a mouse

Terms: Lion - A mouse - B; hunter - C; tree - D; ropes - D.

Propositions:

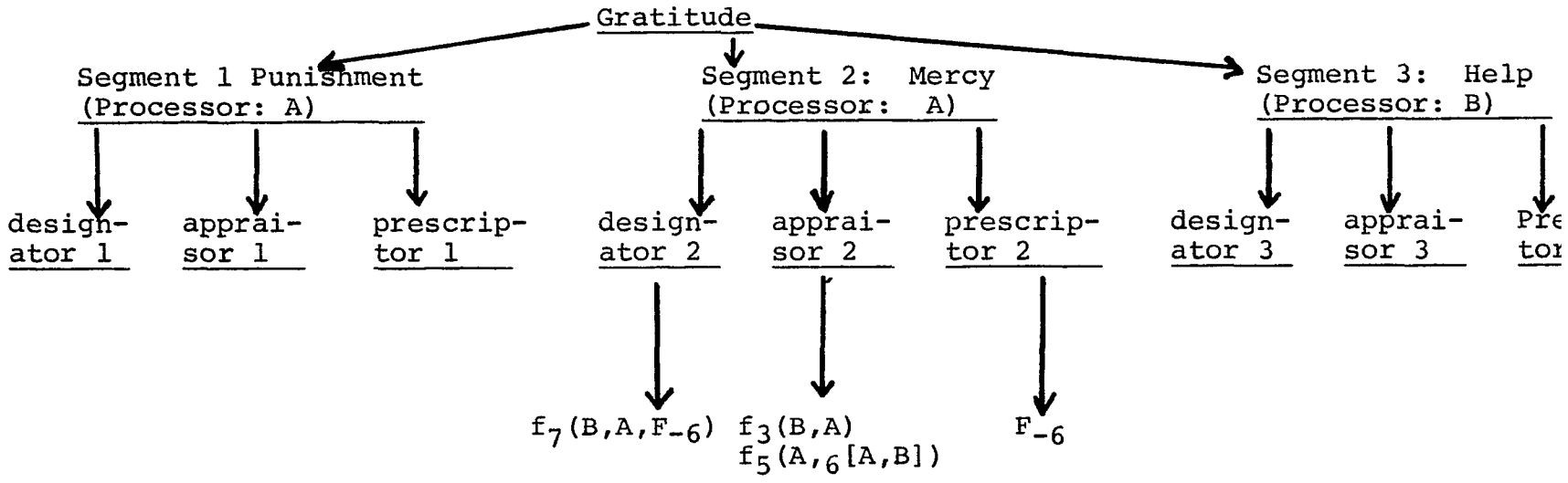
1. A lion was sleeping - $f_1(A)$
2. A mouse was moving - $f_2(B)$
3. Movement was running - $f_3 \in f_2$
4. Movement was around lion - $f_3(B,A)$
5. The lion woke up - $f_2(A)$
6. The lion caught the mouse - $f_4(A,B) \in F_4$(trouble)
7. The lion wanted to eat up the mouse - $f_5(A, f_6[A,B])$; $f_6 \in F_6$(punishment
8. The mouse asked for mercy - $f_7(B,A, F_{-6})$
9. The lion let the mouse go - F_{-6}(mercy)$\in \mathcal{F}_{-6}$(good attitude); $F_{-6}(A,B) \in F_-$
10. Time passed - t.
11. A hunter caught the lion - $f_4(C,A) \in F_4$
12. The lion was placed against the tree - $f_8(A,D)$
13. The lion was tied - $f_g(A)$
14. He was tied with ropes - $f_{10}(A,E)$
15. The mouse learned about it - $f_{11}(B, f_4, f_8, f_9, f_{10})$
16. The mouse came - $f_{12}(B)$
17. The mouse gnawed the ropes - $f_{13}(B,E,$ $\Big\}$ $\in F_{12}$(help) $\in \mathcal{F}_{-6}$(good attitude)
18. The lion was free - $f_{14}(A) \in F_{-4}$

Figure 6. Description in terms of the model.



This story is an example of ambiguity as to the evaluator-unit.
Indeed, in segment 1, the evaluator can equally be interpreted as a reduced separate segment. In this case the scheme will take the following form:

Figure 6_1



Story 5. A daw and pigeons

Terms: Pigeons - A; daw - B; daws - C; dye - D; white - E; cry of a daw - F

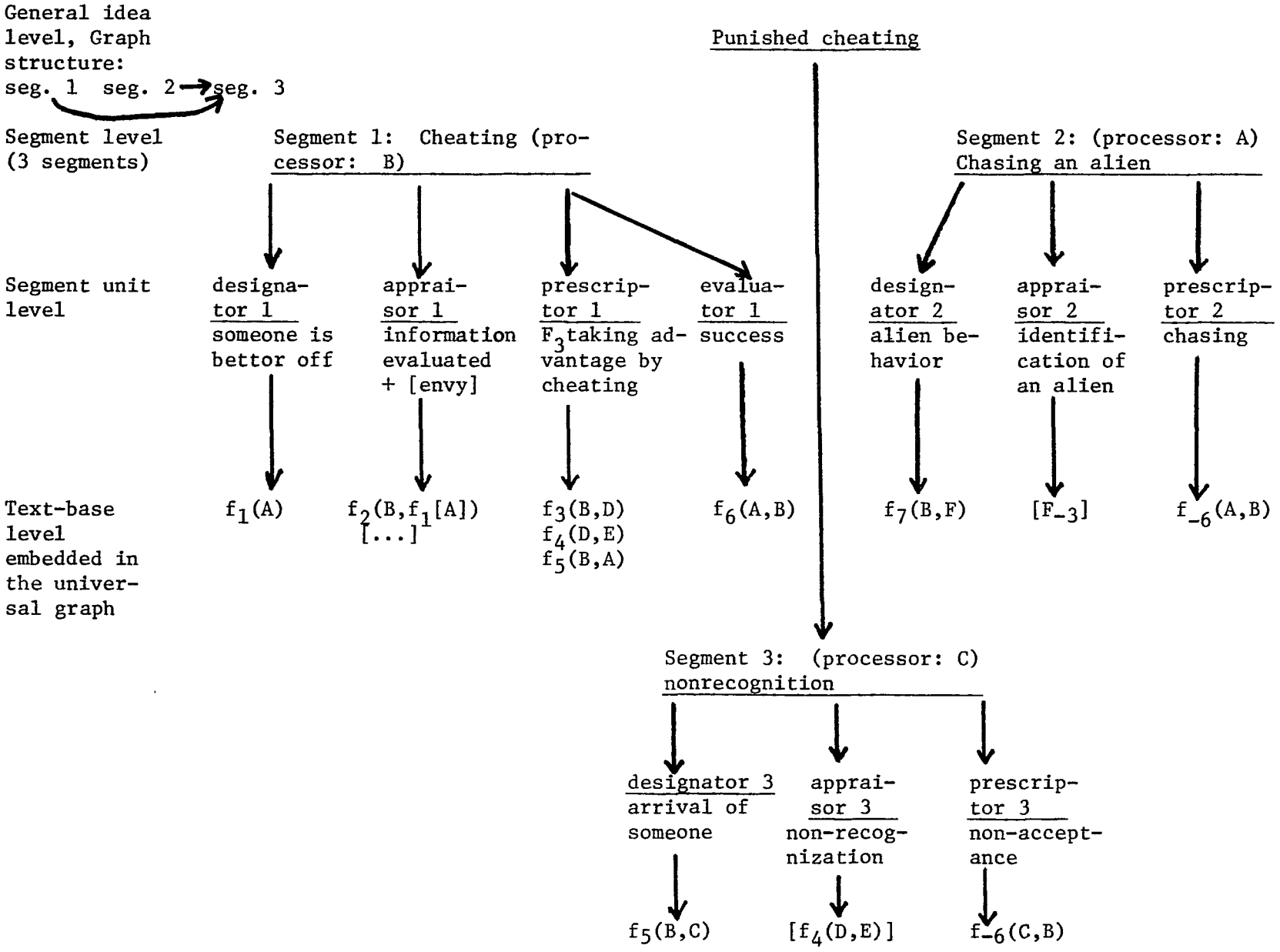
Propositions:

1. Pigeons were fed well - $f_1(A)$
2. A daw learned about it - $f_2(B, f, [A])$
3. The daw dyed itself - $f_3(D,E)$
4. The dye was white - $f_4(D,E)$
5. The daw flew to the pigeons - $f_5(B,A)$

$\in F_3$(cheating)

6. The pigeons accepted the daw - $f_6(A,B)$
7. Time passed - t.
8. The daw cried in a daw way - $f_7(B,F)$
9. The pigeons chased the daw away - $f_{-6}(A,B)$
10. The daw flew to the daws - $f_5(B,C)$
11. The daws did not accept the daw - $f_{-6}(C,G)$.

Figure 7. Description in terms of the model.



Now the requirements for testing the hypothesis can be specified. A peculiarity of the story reproduction by frontal patients under the non-monitored condition is that the monologue can be sub-divided into two parts: a compact group of statements relevant to the original story followed by an irrelevant monologue. The border between these two parts is clearly marked. This is the difference from the story reproduction by the Papez- circuit patients in whom intrusions are usually intermixed with the fragments of original story.

The hypothesis would suggest that this difference is due to the frontal patients' inability to shift from one segment of representation to another, in spite of the fact that all the segments are encoded in the engram. Each segment can be successfully de-minimized, but because of the impairment of the level of representation built "above" the segment-level, that of the "general idea," the shift from one segment to another does not occur in frontal patients.

Thus, in order to test the hypothesis, the following requirements should be met:

a) the initial (relevant) part of the non-monitored monologue is a compact representation of a single segment (any segment) of the given story, as described in terms of the model.

b) no text-base propositions referring to any of other segments appear in the subsequent monologue as a compact group.

In other words, the combination of these two requirements

means that a "label" of a single segment serves as an initiating cue for the monologue; this segment becomes de-minimized, but the shift to the following label does not occur, and the subsequent monologue develops as a sequence of field-associations for the successfully de-minimized segment. It would be sufficient evidence for the fact that the memory representation of the text indeed breaks down the whole content into the above-discussed segments.

In order to demonstrate that the higher-order level of "the general idea" is necessary to organize the sequential execution of the groups referring to the "segment-level," the third condition should be met: that all the segments have been stored.

For this purpose, it will be sufficient to demonstrate that:

c) under the monitored condition, the patient mentions all the segments in the story (irrespective of the order). The criterion for this will be the presence of the "prescriptor" parts of all the segments in the monologue. The reason for selecting the prescriptor-propositions as an indication of the presence or absence of the given segment in the reproduction is that the "prescriptor" propositions are the closest ones to what may be considered the "segment-label."

5c2. The Reality of the "Segment" Level.

In order to evaluate the hypothesis, one should determine what the chance-level of meeting the given requirement is. Two situations will be evaluated separately: the joint event

of meeting the requirements (a) and (b) (due to the fact that these requirements are applied to one and the same material, that is, non-monitored monologues); the joint event of meeting the requirements (a) and (b) and (c).

It will be assumed that the chance level for each situation is 0.5. This is obviously a very excessive requirement, since the situation of joint events (a) and (b) is fairly specific. However, this requirement was assumed because it is difficult to specify the array of possible alternative events as opposed to the (a) and (b) one, and assign to them a priori probabilities of "chance" appearance, (in other words, to decide whether these events are elementary ones). Thus the "chance level" should be selected in such a way that, provided that the "chance-appearance" hypothesis is rejected, it will stand against any conceivable alternative event.

Under these assumptions, the results will appear as follows:

Story #	N of monologues satisfying the requirement (a) & (b)	Probability of $x \geqslant N$ in a sample of 14 according to the "chance-hypothesis"
1	14	0.0006
2	14	0.0006
3	11	0.035
4	10	0.097 (0.043 for a sample of 13)
5	13	0.001

In all the cases except Story 4, the number of monologues that satisfy the (a) and (b) requirement is above 0.05-criterion. For Story 4, it does not satisfy this criterion. However, in one case (case 9), there was no production under the non-monitored condition at all, as far as Story 4 was concerned, which makes it an artifact in the sample. The probability of X 10 in a sample of 13 (under 0.5 chance-level assumption) would be 0.043 - above the 0.05 criterion.

There is not much information as far as the "segment-hypothesis" is concerned, in the data about stories 1 and 2, since these two stories consist of one segment each. The data about stories 3, 4, and 5 confirm the hypothesis.

The amount of monologues that meet both (a), (b) and (c) requirements is respectively: 14 (Story 1), 13 (Story 2), 11 (Story 3), 10 (Story 4), 10 (Story 5).

Stories 1-4 meet 0.05 criterion and of these only Stories 3-4 can yield significant information. Story 5 does not meet this criterion but does meet 0.1 criterion.

Note here that the assumption of 0.5 being a "chance level" for the occurrence of the event became still more overstated, since the event became more specific: (a) & (b) & (c) instead of (a) & (b).

It makes sense to establish a "chance-level" for the "dubious" Story 5, which would not make such an unreasonably excessive requirement of the hypothesis that is tested.

Story 5 consists of 3 segments. Thus, three alternative situations are conceivable: all the segments are stored and

retrievable and (one segment is executed); all the segments are stored and retrievable and (two segments are executed); all the segments are stored and retrievable and (three segments are executed). Assuming that each of these events appears with equal probability, the chance-level of the tested hypothesis (the first of the above three conceivable situations) will become 0.33 for a single event.

In this case p of $N \geq 10$, in a sample of 14, under the assumption that the N events are independent "chance" ones, will be 0.037, which is above 0.05-criterion.

There are other indicators of the reality of the "segment" - representation of the text-content in memory.

Under the monitored condition, the only type of reproduction distortion is incorrect order of the compact parts of the story that refer to different segments. There is almost no contamination between the segments, nor are there external intrusions of any length. This also suggests that the segments are represented as separate "wholes."

This is not the case with the Papez-circuit population, where contaminations between the segments are quite common, but in this case genuine deficits of storage and/or retrieval can be assumed.

It has been indicated before, that the difference in performance by frontal patients under the monitored and non-monitored conditions, is not significant for Stories 1 and 2, and is significant for Stories 3, 4 and 5. This is an important argument in favor of the "segment-nature" of the

engram. Indeed, stories 1 and 2 consist of only one segment each, while Stories 3, 4 and 5 - of several segments each.

Since the quantitative estimates of the story reproductions were made in relative units, it was possible to compare the quality of the story - reproduction of different stories under non-monitored conditions. The hypothesis would predict that the quality of reproduction is a function of the number of segments in the stories. (However, it would be naive to think that it is the only factor involved).

Story 2 (the worst reproduced out of two one - segment stories) would be expected to be better reproduced than story 3 (a two-segment story); and - story 3 better than story 5 (a three-segment story). Story 4 is dropped out of the comparison, due to the ambiguity of whether it contains two or three segments which circumstance would make either finding concerning this story uninterpretable.

T-tests of the above pairs were conducted for the non-monitored condition (see table 6, Chapter 5) under criteria 0.05 and 0.01 (critical T-score values are respectively 2.16 and 3.01). Empirical T-score values were found 6.1 (story 2 vs. 3), and 3.1 (story 3 vs. story 5). The expected differences in performance were observed on both critical levels.

This finding is somewhat weakened by the fact that a significant difference was also observed between the performance of story 1 and story 2 (which are not supposed to be different, according to the segment-hypothesis). However, the empirical T-score was 2.24, which is only marginal for 0.05 level and non-passing for 0.01 level.

CHAPTER 6

SUMMARY AND CONCLUSIONS

6a. General Considerations About the Selection of the Brain-Damaged Populations.

The approach utilized in this study involved making inferences about a normal processing from the observation of deranged functioning due to brain-pathology.

The implicit postulate underlying this approach can be formulated in the following way: insult to the brain leads to damage of the normal processing in some particular dimensions, rather than to the emergence of a totally new "abnormal" organization. By utilizing the information about the behavioral consequences of particular types of brain damage one can determine fairly accurately what aspects of processing are the most affected of all in a given brain-damaged population.

A hypothesis about the importance of a given dimension for a certain psychological function in normals can then be tested by checking whether or not this function is impaired in a brain-damaged population, for which the dimension to be tested is known to be the main denominator of behavioral deficits. Moreover, fairly composite models of normal functions can be obtained by sampling brain-damaged groups each of which is suffering from the impairment of one of the processing-dimensions that are hypothetically important for the

normal performance of the function under consideration.

The main principle in sampling brain-damaged population in this study was that of complementalness: a situation was desirable in which every single neuropsychological group was damaged along one dimension of processing with the others remaining intact, and the spectrum of such neuropsychological groups had to be exhaustive in that it had to cover the whole list of dimensions postulated to be importatnt for the normal model.

Thus, two groups were selected: a diencephalic one, where hierarchic properties of behavior are intact, while elementary storage and/or retrieval are impaired; and a prefrontal one, where the latter aspects of processing are relatively intact, while the hierarchic properties of behavior are severely damaged.

It was not by accident that many other possible neuropsychological populations were ignored in this study: those where memory deficits would be hard to determine due to the multidimensional nature of pathology from a behavioral point of view (such as dementia, where both storage/retrieval aspects and hierarchic properties of behavior can be suspected of being impaired); or where memory deficits are impaired due to the processing dimensions that were not within the scope of this study. An aphasic population can be considered as an example of such a situation in which speech comprehension or production deficits would certainly damage verbal memory.

However, the concerns of the present study were modality-free aspects of memory, in other words, those aspects that are independient of the modality of input, and can be considered as inherent in memory per se). For this reason only those types of brain pathology which reveal modality-nonspecific aspects of memory processing could be considered for this study.

6b. Inferences For Semantic Memory.

It was demonstrated that in a non-negligible sub-group of diencephalic lesions, higher-order representation of the events in the discourse is available, while information about the precise character of these events is not. The presence of such dissociation in pathology may serve as evidence that multi-leveled representation of the discourse-content is characteristic of normal memory.

It is natural to associate the higher-order levels of discourse-content representation with its predicative aspects. However, observations were provided to demonstrate that the latter is not the only aspect of the discourse that is "narrated" at higher-order levels. Both the nominative aspect of the discourse and its formal structure also indicate such "narrations."

There are no data available to decide whether these belong to the same higher-order description, in which case the suggested dimensions along which the higher-order narration occurs will appear to be only a convenient fiction for conceptualizing the obtained data. Or, on the other hand, memory representation of a discourse is not a single hierarchic structure, but rather a collection of "partial" hierarchically organized engrams, each of which "narrates" the original content along its own dimension. In this case, a model similar to that of von Neuman (1962), for increasing the reliability of coding information through the use of

several parallel channels can be formulated (Goldberg, 1970, 1974).

Briefly, this model suggests that during the reconstruction process (ekforia), de-minimization of each single partial engram cannot ensure the adequate de-coding of the original content. The latter is achieved through overlap of the classes of possible narrations - each of these classes being sets of equally probable narrations obtained through de-minization of a single partial engram.

Inferences obtained from the observations of memory deficits in diencephalic patients did not lead to any specific statements about the nature of the levels of memory encoding for a text. In order to obtain a more specific insight into the problem, a group of prefrontal patients was studied.

Observations of this pathological population led to the hypothesis which suggested that one of the levels of encoding a "communication of events" is that of breaking it down into "designator-appraisor-prescriptor-(evaluator)" segments. A graph is formed for which the terms are the labels of the segments. Before discussing the plausibility of such a hypothesis in its precise form, the general trend of thought behind it should be outlined once again.

The hypothesis was based on the idea that a "communication of events" is perceived in clusters which are "entities" from a behavioral rather than linguistic point of view. Such a cluster should comply with the idea of the behavioral loop's

being a minimal autonomous unit of behavior. A possible linguistic equivalent of such a cluster was probed in the classification of linguistic events by Morris (1946).

It was demonstrated that the compact chunks relevant to the original material, which frontal patients produce before the "field behavior" starts, are isomorphic to a single segment of the above nature. This means that on a certain level, the coding of the original material in frontal patients occurs in terms of the above segments. However, it is still questionable whether it is also a feature of normal memory, or merely a peculiartiy of frontal patients.

It has been demonstrated that in spite of reproduction deficits, all other segments are stored and retrievable in frontal patients (nonitored condition). If this is true, then, it means that the fact of a single segment production in the non-monitored condition is not due to its being the only part of the material available, but because it is a unit that is "tight enough" to prevent the verbal field intrusions from occurring until the retrieval of this "chunk" is accomplished. The existence of fairly long "tight" chunks in memory already presupposes a certain level of integration. It makes sense to suggest that the segment-level is the upper limit of the encoding integration possible for frontal patients.

Additional evidence in favor of the "normality" of the segment-hypothesis, consists of indications that segmentation is also a feature of diencephalic patients: it is the "doubling Phenomenon" (see this chapter and Goldberg, 1970)

in which the patients reveal the presence of the number of segments in the engram even if their precise content is unavailable to these subjects. The fact that two different types of memory-disturbed populations demonstrate the availability of a certain aspect of original material indicates that the singling out of this aspect is, indeed, a part of the normal memory that remained preserved in them.

Another consideration of a general nature is the following: the segment was devised as a linguistic approximation to the behavioral unit: if the device is a good approximation, it would only make sense that one who receives a communication perceives it in units that are natural for the sequence of events which the communication conveys.

Studying the semantic structure of myths, Bremond (1962) singled out almost literally the same scheme for development of theme: his scheme essentially does not differ from the structure of the above-suggested segment. Provided that mythology is the "Latin" of semiotic studies, this similarity is very encouraging, and indicates that the hypothesis on the nature of our segment is not altogether erroneous.

However, these references are only indirect evidence in favor of the segment-hypothesis, and it needs further examination.

An attempt has also been made to "place" the segment-level in between the known "extreme ends" of the narration hierarchy. For simple texts such as those used in the experiment, the model takes a 4-level form. However, this almost

certainly is an over-simplification when applied to more complex "event-communicating" texts. Probably, in the latter case, similar segments are built over the above described segments, thus forming an n-order hierarchic structure.

A question arises (assuming that the model is acceptable all together) over whether or not the relations between the levels are strictly hierarchic ones all the way through, or whether at some levels the relations between the units are linear, with the higher levels serving as control functions. Within the simple 4-level model, it is fairly clear that the relations between the segment-level and those below are of a vertical nature: otherwise the "clustered" performance of a segment by frontal patients would not be possible and their performance would "fall apart" on lower levels of hierarchy.

However, there is no evidence about the relations between the "general idea" level and the "segment" level.

One might as well suggest, that the interaction between these two higher levels, is of a more linear nature, so that the functions of the "general idea" level do not include initiation of the reconstruction process, but rather, are restricted to control functions.

In any event, the representation at the "segment"-level should not be viewed as just a list of labels. There is a certain organization between them, which would rather prompt the idea of graph. Even in the simple texts used in the above described experiments, there are two 2-segment stories with

different relations between the segments: a symmetric one (story 3) and a cause-consequence asymetric one (story 4). The ability to integrate the segment-labels into the graph, means, in essence, the cognitive operation of formulating the "general idea"-label. From this point of view, the hypothesis attempts to provide immediate constituents out of which the notion of the "general idea" can be derived. (It should be fair to say that in a long discourse it cannot be derived from an immediate sampling of text-base propositions. There should be an hierarchy of approximations of the text-base level of description). It would be interesting to see whether different types of relations between the segments are differentially difficult for memorizing the whole text.

The texts used in the experiment were probably good for hypothesis-derivation due to the fact that the segments were distinguished in time and sequential from one another. However, to test the hypothesis, different kinds of texts would be interesting to use - those in which the same propositions enter different segments. For example: "Peter and Mike were going along the street. They saw a lady who fainted. Peter took her purse and ran away. Mike ran to the telephone to call a doctor."

It would be interesting to see, whether a situation can be found, where only one segment out of two: "helpfulness" and "theft" are memorized, while the other is omitted. In normal studies, it would, however, require much longer and complicated texts.

The assumption that the segment-labels - once they exist at all - are coded in propositional form is also a hypothetical one. It is supported by the "selective interference" technique with diencephalic patients and indicates that interference, when induced at predicates, damages the other parameter of the text more than would be the case in an opposite situation. In this regard, Vygotsky's statement, that inner speech (planning level of overt verbatim) is of a predicative nature (1934) is relevant.

Once the fact of the multi-leveled quality of the engram has been established and a hypothesis was offered concerning the nature of the levels, it became crucial to turn to more executive aspects of the memory processing, that is, the interaction between the levels.

The data obtained with the profrontal population has been instrumental in this purpose.

A situation has been demonstrated, probably unique for focal brain pathology, in which the mnestic process suffers in spite of relatively adequate storage and retrieval. The level of processing that is impaired in this case is of a higher order and deals with the formation of the plan of the discourse and its utilization for the selective editing of the retrievable traces.

It was impossible to obtain clear answers concerning the extent of the deficits of cognitive prerequisites that are necessary for forming a plan, or for the narration of the story by these patients. The data does not give an adequate

basis for deciding whether or not the patients are able to form a scheme, that is, the narration of the discourse to be reproduced. The fact that it was impossible to make patients answer the question about the "moral" of the story is, by itself, an insufficient basis for making negative judgments. The nature of prefrontal patients is such that it is very difficult to make them concentrate on a task, and for this reason any judgment about the absence of certain knowledge should be made with great caution. Even if the narration is present, it may not serve as a plan for organizing the patient's sequential behavior.

Indeed, the presence of a retrievable engram in these patients was demonstrated, and this, in itself, should be quite sufficient for adequate reproduction, if the executional aspects of the process were adequate.

Moreover, the fact of a fairly good reproduction of the stories under the monitored condition can serve as an indicator that prefrontal patients make use of semantic properties of coherent material. An indirect indication of it this usage of semantic properties may be observed in a situation where a non-coherent work sequence is to be memorized: the frontal patients cannot accomplish this task; instead, they give a "plato"-type learning curve where the number of reproduced words does not exceed 5-6 out of 10 (Luria, 1974).

Thus, it is apparent that what is most severely damaged in the prefrontal patients is the selective editing of the retrievable traces and their matching to the scheme of the

material-to-be-reproduced. Indeed, the conditions under which adequate reproduction was possible (monitored condition), are the conditions which restrict the patient's behavior, rather than guide it from the content point of view.

Prefrontal patients can serve as a group complementary to diencephalic patients in whom storage and retrieval are severely damaged, while the formation of a plan and selective control over its realization are relatively intact. Indeed, it was demonstrated, that the errors made by truly mnestic patients are usually within the "contextual borders" relevant to the original text and that these borders are rarely violated. It means that no matter how insufficient the engram of the text-content is, what is available to these patients is being managed to the best of their abilities. On the contrary, in prefrontal patients adequate storage and retrievability of the relevant traces do not serve their purposes.

The existence of a pathological situation when a certain aspect of processing is damaged, while others remain relatively intact, serves as evidence of the "realness" of this aspect in normal processing.

Thus, an experimental model was constructed which could give more direct evidence for the "reality" of the aspect of the memory processing which controls the execution of the plan for a behavioral sequence. This control consists of the selective editing of retrieved memory-traces. This control aspect is different from that of retrieval itself and can be damaged even when the latter remains relatively intact.

Apparently, in the normal process, it constitutes a level that is superimposed over retrieval and ensures the relevance of retrieval to the plan of what should be communicated.

In order to execute a communication task promptly (in our case, to reproduce a story), it is necessary to give up the natural "universal" metrics of the inner representation graph and to select those items that are relevant to the on-going task. Indeed, as mentioned above, each of the events and notions encountered in a given discourse, would not be completely new to the listener. Obviously, most of these events and notions had appeared before in the linguistic or physical experience of the subject. Furthermore, it means that each event has a multiple affiliation in the subject's memory. Most of these "affiliations" are irrelevant to any particular on-going communication task, and, in the process of the execution of the task, they should be "edited out" although apparently they are retrieved together with the necessary engram. For this reason, the metrics of the inner representation should be overcome in order to ensure adequate execution of the task.

The hypothesis accounted for the "memory" deficits in prefrontal patients by suggesting that this does not happen and that sequential behavior becomes a slave to the laws of metrics of inner representation. What does happen is that "verbal field behavior" takes place.

Those associations prevail that, due to the subject's previous experience, are the "strongest"ones for a certain

item of the subject's monologue. In cases of severe damage, such as the ones described, the process takes on even more primitive form in that the patient's memories are not separated from the on-going events in his physical environment and from his current emotional or physiological states.

Comparison with the performance of prefrontal patients in learning a word sequence may be useful. It has been mentioned bofore that with these patients reproduction of a 10-item word list takes a "plato" form. However, this never leads to anything similar to "verbal field behavior" such as the one evoked during the reproduction of the story. Thus, the "field of inner representation" becomes explicated in the subject's verbal behavior only when certain events are encountered by a patient. One can conclude that this field is structured in terms of units of events rather than objects.

The phenomena described are not unique for verbal memory in frontal patients. Interminability was observed in many a variety of behaviors of these patients. The peculiar phenomenon of mixing up different semantic domains, which is reminiscent of "jumping" from one context to another in the reproduction of the story can also be observed in the performance of graphical sequences. In this case it takes the form of "perseverations of activities" (Goldberg, 1973).

Following the logic of thought implicit in this study, the existence of a type of pathology in which a control function can be dissociated from the storage and retrieval aspects of memory, suggests that the former aspect is both real and important in normal memory.

The last consideration to be discussed, here, is that the phenomenon of verbal field behavior provides a unique, natural situation for "wandering" through the graph of inner representation according to its metrics as opposed to the experimentally induced situation in predetermined units - words. The fact that such a phenomenon exists strongly supports the idea of the "realness" of the multi-dimensional "universal graph" as an overall representation of the subject's experience.

6c. Neuropsychological Inferences.

Although differential analysis of memory disorders was not the subject-matter of the present study, several conclusions may be drawn in this regard.

The Diencephalic Group.

The mere fact that higher-order representation of the experimental material is available to these patients indicates that the cognitive operations necessary for forming an hierarchic structure of mnestic activity, remains relatively intact in these patients.

Furthermore, this means that another necessary condition for the formation of this higher-order representation is also present in these patients; that is the intactness of the traces of the experimental material for at least some time.

Together with the fact that the introduction of interference appeared to have been very damaging to the quality of performance, one could suggest that the observed difficulties are due to retrieval deficits rather than to those of storage. However, the results by no means resolve this question: one could argue that, after a sufficient length of time necessary for "narration"-forming, trace-decay still occurs. However, the retrieval hypothesis provides a better explanation for such a major phenomenon, as contaminations.

The distribution of the patients' failures across the experimental conditions used in the study supports Kyaschenko's classification (1973) of non-specific memory deficits resulting

from damage to the Papet-circuit area: the third ventricle lesions (the area most adjacent to the upper stem) affect memory most severely; Papez-circuit lesions proper (mammillary bodies, hippocampi) are next in order; and hypophisar lesions (which do not belong to the Papez-circuit) produce the mildest deficits.

The Prefrontal Group

It would be premature to claim that, in the prefrontal patients studied for this research, storage and retrieval of the stories was absolutely intact. However, it has been demonstrated that storage and retrieval are sufficient to provide the basis for a fairly complete reproduction of the material and that severe damages to the mnestic process in these patients cannot be attributed to either storage or retrieval.

It can be assumed that the above-described editing deficits which take the form of "verbal field behavior" constitute an important factor in all the cases of memory deficits following frontal lesions.

An emphasis on the control-function deficits in the memory processes, as opposed to storage and/or retrieval deficits, may prove to be instrumental in view of the existing controversy on whether or not memory is deficient in frontal patients.

Bibliography

Adey, W.R., "Cerebral structure of information storage." In: E. Stellar, J.M. Sprague (eds)., Progress in Physiological Psychology, v. 3, Academic Press, N.Y., 1970.

Anokhin, P.K., "Acceptor of action as an afferent mechanism of anticipatroy excitation in the conditioned refles." Lecture at the Psychological Society annual meeting. Moscow, 1959. (in Russian).

Anokhin, P.K., Methodological analysis of central problems in the conditioned reflex theory. Academy of Science-Institute of Philosophy Press, Moscow, 1963. (in Russian).

Bartlett, F.C., Remembering. Cambrige Univ. Press, London, 1932.

Bekhterev, V.M., "Brain demonstrations," Annals of the Mental and Nervous Diseases Clinics, S.Pb Press, 1907 (in Russian).

Bernstein, N.A., Organization of Movements, Meditsina Press, Moscow, 1935. (in Russian).

Bernstein, N.A., Essays in Physiology of Movements and Physiology of Activity, Meditsina Press, Moscow, 1966. (in Russian)

Bremond, C., "La logique des possibles narratifs." Communications, 1967, 8, 60-76.

Brown, R., McNeil, D., "The "tip of the tongue" phenomenon." Journal of Verbal Learning and Verbal Behavior, 1966 5, 325-337.

Buller, K., Sprachtheorie. Iena, Fisher, 1943.

Chomsky, N., Syntactic Structures. Mouton. The Haugue, 1957.

Chomsky, N., Aspects of the Theory of Syntax, MIT Press, Cambridge, Mass. 1965.

Collins, A.M., Quillian, M.R., "Retrieval times from semantic memory." Journal of Verbal Learning and Verbal Behavior, 1969, 8, 240-247.

Crothers, E.J., "Memory structure and the recall of discourse." In: J.B. Carroll & R.O. Freedle (eds)., Language Comprehension and the Acquisition of Knowledge. Winston, Washington, D.C., 1972.

Deese, J., "On the structure of associative meaning." Psychological Review, 1962, 69, 161-175.

Feugenbaum, E.A., "Information processing and memory." In: d.a. norman (ed.), Models of Human Memory. Academic Press, N.Y. 1970.

Fodor, J.A., Bever, T.G., "The psychological reality of linguistic segments." Journal of Verbal Learning and Verbal Behavior, 1965, v. 4, 5, 414-420.

Gelfand, I.M., Gurfinkel, V.S., Tsetlin, M.L., "On tactics of regulations in complex systems as related with physiology." In: I.M. Gelfand (ed.), Biological Aspects of Cybrenetics. Meditsing Press, Moscow, 1962. (in Russian).

Gelfand, I.M., Tsetlin, M.L., "On mathematical models of the central nervous system." In: I.M. Gelfand, V.S. Gurfinkel (eds.), Models of Sturctural and Functional Organization of Some Biological Systems. Meditsina Press, Moscow, 1966. (in Russian).

Goldberg, E.A., "Neuropsychological approach to the units of information processing." Novie Issledowania v Psikhologil, 1974, 1, 49-51. (in Russian).

Goldberg, E.A., "Systemic properties of the engram of a discourse." In: A. Luria (ed.), Proceedings of the Fifth NSO Symposium. Moscow Univ. Press, 1970, 31-45. (in Russian).

Goldberg, E.A., "Motor perseverations and the levels of assembling a visual form." In: V.P. Zinchenko (ed.), Biophysics of the Visual System. Vilnius Univ. Press, Vilnius, 1973, 79-94.

Jackobsen, C.F., "Function of frontal association areas in primates." Archives of Neurology and Psychiatry, 1935, 33.

Jasper, H.H.,"Recetn advances in our understanding of ascending activities of the reticular system." In: H.H. Jasper (ed.), Reticular Formation of the Brain. Churchill, London, 1957.

Johnson, R.E., "Recall of Prose as a function of the structural importance of linguistic units." Journal of Verbal Learning and Verbal Behavior. 1970, 9, 12-20.

Katz, J., Fodor, J.A., "The structure of semantic theory." Language, 1963, v. 30, 2, 170-210.

Kintsch, W.,"Models for free recall and recognition." In: D.A. Norman (ed.), Models of Human Memory. Wiley, N.Y., 1974.

Kintsch, W., The Representation of Meaning in Memory. Wiley, N.Y., 1974.

Konozski, J., "Distribution of inhibitory conditioned reflexes after prefrontal lesions in dogs." In: Brain Mechanisms and Learning. Oxford, 1961.

Korsakoff, S.S., Forms of Memory Pathology and Their Diagnosis. Moscow, 1890. (in Russian).

Lindsley, B., "Attention, consciousness, sleep and wakefulness." In: J. Field (ed.), Handbook of Physiology. Sect. Neurophysiol. III, Thomas, Washington, C.D., 1960, 1553-1593.

Lounsbury, F., "Transitional probability, linguistic structure and systems of habit-family heirarchies." In: Psycholinguistics. A Survey of Theory and Research Problems, Bloomington, 1965, 93-101.

Luria, A.R., Higher Cortical Functions in Man and Their Disturbances in Local Brain Lesions. Moscow Univ. Press, Moscow, 1962. Second edition: 1969. (in Russian).

Luria, A.R., Human Brain and Psychological Processes, v. 1, APN Press, Moscow, 1963; v. II, Pedagogika Press, 1970. (in Russian).

Luria, A.R., "Frontal lobes and regulation of behavior." In: A.R. Luria, E.D. Homskaya (eds.), Frontal Lobes and Regulation of Psychological Process. Moscow Univ. Press, Moscow, 1966, 7-37.

Luria, A.R., Neuropsychology of Memory, Pedagogika Press, Moscow, 1974. (in Russian).

Luria, A.R., Pribram, K.H., Homskaya, E.D., "Disturbance of Programmed Actions in a Case of Massive Lesion of the Left Frontal Lobe." Ibid. 554-575. (in Russian).

Luria, A.R., Tsvetkova, L.S., Neuropsychological Analysis of Problem-Solving. Prosveschenie Press, Moscow, 1966. (in Russian).

Luria, A.R., Vinogradova, O.S., "An objective investigation of the dynamics of semantic systems." British Journal of Psychology, 1959, 50, 89-105.

Maclay, H., Osgood, Ch. E., "Hesitation phenomonen in spontaneous English speech." Word, 1959, v. 15, 1, 19-44.

Magoun, H.W., The Waking Brain, Thomas, Springfield, 1958. Second ed.: 1963.

Malmo, R.B., "Interference factors in delayed response in mondkeys." Journal Neurophysiology. 1942, 5.

Melchuk, I.A., "Composition of a working model of a language." Problems of Linguistics, AN Press, Moscow, 1967. (in Russian).

Melchuk, I.A., Zholkovski, A.K., "A possible method and instrument of semantic synthesis." NTI, 1965, 6. (in Russian).

Melchuk, I.A. Zholkovski, A.K., "On semantic synthesis." Problems of Cybernistics, 1967, v. 19. (in Russian).

Melchuk, I.A., "Levels of a discourse representation and general features of the "content-verbatim" model." Proceedings of the AN Institute of Linguistics. Moscow, 1972. (in Russian).

Miller, G.A., "The magic number 7±2." Psychological Review, 1956, 63, 81-97.

Miller, G.A., Galeanter, E., Pribram, K.L., Plans and the Organization of Behavior. Holt, N.Y., 1956.

Milner, B., "The memory defect in filateral hippocampal lesions." Psychiat. Res. Reports of the American Psychiatric Association, 1959, 11, 43-52.

Morris, Ch. W. Signs, Language and Behavior, Prentice Hall, N.Y., 1946.

Morruzzi, G., Magaun, H.W. "Brain stem reticular formation and activating of the EEG." Electroencephal. Clinical Neurophys., 1949, 1, 455-473.

Neuman, J. Probabilistic logics. In: Automata. MIT PRESS, Cambridge, Mass. 1958.

Norman, D.A., Rumelhart, O.E., "A system for perception and memory." In: D.A. Norman (ed.) Models of Human Memory, Academic Press, N.Y., 1970, 21-66.

Osgood, Ch., "Hierarchies of psycholinguistic units." In: Psycholinguistics. A Survey of Theory and Research Problems. Bloomington, 1965, 71-73.

Osgood, Ch., "On understanding and Creating Sentences." American Psychologist, 1963, 18, 12, 735-751.

Penfield, W. and Milner, B., "Memory deficit produced by bilateral lesions of hippocampal zone." Archives of Neurology and Psychiatry. (Chicago), 1958, 74.

Pribram, K.H., "A further analysis of the behavior deficits that follows injury to the primate frontal cortes." Journal of Experimental Neurology, 1961, 3.

Pribram, K.H., "The amnestic syndromes. Disturbances in coding." In: G. Talland, N. Waugh (eds.), The Pathology of Memory. Academic Press, N.Y., 1969.

Popova, L.T., "Memory disturbances in certain local brain lesions." Unpublished dissertation, Moscow Medical INstitute, 1964. (in Russian).

Popova, L.T., Latash, L., "On the role of hyencephalodiencephalic structures in memory." Proceedings of the Symposium on Memory. Puschino, 1966. (in Russian).

Propp, R., Morphology of the fairy-tale. Moscow, 1921. (in Russina).

Scoville, W.B., Milner, B., Loss of recent memory after bilateral hippocampal lesions." Journal of Neurology, Neurosurgery, Psychiatry, 1947, 18, 2-76.

Shaumyan, S.K., "Information-processing and a two-level theory of structural linguistics." Proceedings of the Conference on Automatized Translation and REading of a Text. Moscow, 1961. (In Russian).

Shaumyan, S.K., Structural Linguistics. Nauka Press, MOscow, 1965. (in Russian).

Shaumyan, S.K., Soboleva, P.A., Applicative Generative Model and Transformation Calculus for the Russian Language.

Shiffrin, R.M., "Memory search." In: D.A. Norman (ed.) Models of Human Memory. Academic Press, N.Y., 1970, 373-447.

Smirnow, A.A., Psychology of Memory, Prosveschenie Press, Moscow, 1966. (in Russian).

Tabory, R., "Semantics, generative grammars, and computers." Linguistics, v. 16, 1965.

Vinogradova, O.S., "Dynamic classification of hippocampal neurons' reactions to sensory stimulation. Zhuranl Vishej Nervnoi Deyatel'nosti. 1965, 15. (in Russian).

Vygotsky, L.S., Thought and Language, Sotsekgiz, Moscow, 1934. (in Russian).

Vygotsky, L.S., Development of Higher Psychological Functions.

Weizkrantz, L., Mishkin, M., "Effects of temporal and frontal cortical lesions on auditory discrimination in monkeys." Brain, 1958, 81, 406-414.

Appendix 1.

Texts used in the experiment.

1. A Hen and Golden Eggs. A man had a hen which was laying golden eggs. The man wanted to get more gold and he killed the hen. But there was no gold inside it.

Key statements: a) Failure to get a desirable thing:

or

b) Unsuccessful greediness.

2. A Stupid Dog. A dog was crossing the bridge over a river at night. There was a reflection of the moon on the water. The dog thought that it was cheese and jumped into the water. But there was nothing there.

Key statements: a) Failure to get a desirable thing:

or

b) Stupidity.

3. An Ant and a Pigeon. An ant was drinking from the river, and he started to drown. The pigeon saw it and threw a branch to the ant. The ant got to the bank by walking on the branch. Sometime later, the pigeon was caught by a hunter. The ant saw it. He bit the hunter on the hand. The hunter released his hands and the pigeon flew away.

Key statements: a) Mutual help.

In the case when none of the two concenters was reproduced by the patient correctly, the following key statements were accepted:

a) Mutual help:
or
b) Help

4. A Lion and a Mouse. A lion was sleeping and a mouse was running around him. The lion woke up, caught the mouse and wanted to eat him up. But the mouse asked for mercy, and the lion let him go. Sometime later, the lion was caught by a hunter. He tied the lion against a tree with ropes. The mouse learned about it, came down, gnawed the ropes and freed the lion.

Key statements: a) Gratitude:

or

b) Mutual help.

In the case when no concenter was reproduced by the patient correctly, the following key statements were accepted:

as above:

or

c) Help:

or

d) Mercy.

5. A Daw and Pigeons. A daw learned that pigeons were fed well. The daw dyed itself white and flew to the pigeons. The pigeons accepted the daw. Sometime later, the daw cried in the manner of daws, and the pigeons chased her away. The daw flew back to the daws, but they did not accept her.

Key statements: a) Punished cheating

In the case when no concenter was reproduced by the patient correctly, the following key statements were accepted:

b) Cheating:

or

c) Failure:

or

d) Non-recognition.

6. An Ox and a Frog. A frog saw an ox walking in a field. She envied the ox's size, and decided to become as big. The frog started to breathe in air, until she burst into pieces.

Key statements: a) Unsuccessful envy:

or

b) Stupidity

or

c) Failure.

7. This story was used in the "selective interference" conditions for diencephalic patients, only.

A Crow and a Fox. A crow was sitting on a tree with a cheese in its beak. A fox was passing by and saw it. She flattered the crow's voice and asked her to sing a song. The crow opened the beak and lost the cheese. The fox grabbed the cheese and ran away.

Appendix 2.

Performance by the prefrontal group under the monitored and non-monitored conditions (experiment 2).

TABLE 7 - STORY 1 - A HEN AND GOLDEN EGGS

Monitored Condition

Case	Events in the Discourse						
	(Man) owned (hen)	(Hen) was laying (gold)	(eggs)	(Man) wanted more (gold)	(Man) killed (or cut) (hen)	No (gold) inside (or in the hen) Class: man did not succeed	Further monologue and "moral" if available
1	+	+	+	+	+	+	
2	+	+	+	-	+	+	
3	-	+	+	+	+	+	
4	+	+	+	+	+	+	
5	+	-	+	-	+	Only simple eggs	
6	+	+	+	-	+	+	
7	-	+	+	+	+	+	
8	+	+	+	+	+	-	
9	+	+	+	+	+	+	
10	_	_	+	(eggs)	+	(eggs)	
11	+	+	+	+	+	+	
12	+	+	+	+	+	+	
13	+	+	+	+	+	too little	
14	+	+	-	+	+	+	

TABLE 8 - STORY 1 - A HEN AND GOLDEN EGGS

Non-Monitored Condition

Case	Events in the Discourse						
	(Man) owned (hen)	(Hen) was laying (gold)	(Hen) was laying (eggs)	(Man) wanted more (gold)	(Man) killed (or cut) (hen)	No (gold) inside (or in the hen) Class: man did not succeed	Further monologue and "moral" if available
1	-	+	+	+	+	+	Persevarations
2	+	+	+	+	+	+	Persevarations
3	-	+	+	+	+	+	No way to get gold from a hen.To ge gold one should deal with Chinese peacock.
4	+	+	+	+	+	+	Perseveration...The hen asked for a bedpan.
5	+	-	+	-	+	-	Got many eggs. Yellow inside, but it was not gold.
6	+	+	+	-	+	+	Only small pearls that the hen ate before...the hen ate bread before.. (perseveration)
7	-	+	+	+	+	+	Perseverations
8	+	+	+	+	+	screwed up	Greedy bastards always screw up (moral)
9	-	+	-	+	+	+	Finds golden coin on the floor. No need for hens any more.
10	-	-	+	(eggs)	+	(eggs)	It was a cock. Strange cock with-out a big tail.
11	+	+	+	+	+	+	Perseverations
12	+	+	-	+	squeezed her a little	+	Let the hen go...Started looking ir other hens...perseveration
13	+	+	+	+	+	little	Too little gold in hens (moral) and too little meat...so the man quit l action with the hen...went to get meat.
14	boss	+	-	+	+	+	Perseverations. Search with a tape recorder...travel around Moscow.

TABLE 9 - STORY 2 - A STUPID DOG

Monitored Condition

Case	Events in the discourse								
	It was (night)	Dog was crossing (river)	Dog was on (Bridge)	(Reflection) was in (river) (or water)	It was reflection of (moon)	Dog thought that reflection was (cheese) class: made a mistake	Dog jumped into (river) (or water)	There was no (cheese) class: dog did not succeed	Further monologue and "mora when avai able
1	-	+	-	+	+	+	+	Got Nothing	
2	-	+	+	+	+	+	+	+	
3	+	+	-	+	+	+	+	+	
4	+	+	-	+	-	+	+	+	
5	+	-	-	+	+	+	+	+	
6	+	-	-	+	+	+	+	nothing good	
7	+	-	+	+	+	+	+	+	
8	-	+	-	+	+	+	+	+	
9	+	+	+	+	-	-	-	+	
10	-	+	-	+	+	+	+	+	
11	+	+	+	+	+	+	+	-	
12	-	+	-	+	+	+	+	+	
13	+	+	+	+	of her own	+	+	+	
14	+	+	-	moon in the river	-	+	+	+	

TABLE 10 - STORY 2 - A STUPID DOG

Non-Monitored Condition

Case	Events in the Discourse								
	It was (night)	Dog was crossing (river)	Dog was on (Bridge)	(Reflection) was in (river) (or water)	It was reflection of (moon)	Dog thought that reflection was (cheese) class: made a mistake	Dog jumped into (river) (or water)	There was no (cheese) class: dog did not succeed	Further monologue and "mora when avai able
1	-	+	-	+	+	+	+	+	Perseverat
2	-	+	+	+	+	+	+	+	Went to th puppies tc look for t hidden che
3	+	+	-	+	+	+	+	+	Started ru ning on th shore tuni up; (persevera
4	+	+	-	+	+	+	+	+	Perseverat could not out of the water anym
5	-	-	-	+	+	+	+	+	Those who not speak not get ar thing
6	-	-	-	+	+	-	+ to get the reflection	nothing good	Dog howls the moon.. Perseverat Senin's ve follows

(....cont'd)

TABLE 10 - STORY 2 - A STUPID DOG - (Cont'd)

Non-Monitored Condition

Case	Events of the Discourse								
	It was (night)	Dog was crossing (river)	Dog was on (Bridge)	(Reflection) was in (river) (or water)	It was reflection of (moon)	Dog thought that reflection was (cheese) class: made a mistake	Dog jumped into (river) (or water)	There was no (cheese) class: dog did not succeed	Further monologue and "moral when available
7	+	-	+	+	+	+	+	+	Perseverat Took the r flection. Tried to b it, broke tooth...we to the doc
8	-	—	—	-	+	+	+	+	———
9	+	+	+	+	-	-	-	-	Wanted to something about the flection. thing came it. Perse tion.
10	-	+	-	+	(cheese)	-	+	+	Jumped out there. Wa was too co to look fo cheese.
11	+	+	-	+	+	+	+	-	Perseverat
12	-	+	-	+	+	+	+	+	Perseverat (jumps aga and again)

(...cont'd)

TABLE 10 - STORY 2 A STUPID DOG - (Cont'd)

Non-Monitored Condition

Case	Events of the Discourse								
	It was (night	Dog was crossing (river)	Dog was on (Bridge)	(Reflection) was in (river) (or water)	It was reflection of (moon)	Dog thought that reflection was (cheese) class: made a mistake	Dog jumped into (river) (or water)	There was no (cheese) class: dog did not succeed	Further monologue and "moral when available
13	+	-	+	+	of her own	+	+	no son	Perseverat Got wet, d up, went h Met a frie
14	+	+	-	moon in the river	-	+	+	no moon	Perseverat No stars. dog is loc for mother give him s

TABLE 11- STORY 3 - AN ANT AND A PIGEON

Monitored Condition

ase	Events in the Discourse					
(Ant) was at (river)	(Ant) was drinking water	Ant started to drown class: got in trouble	(Pigeon) saw (Ann) drowning	(Pigeon) threw Ant (branch) class: helped the ant	(Ant) used (branch)	Ant got to the (bank)
-	-	+	+	+	+	+
+	+	+	+	+	-	+
+	-	+	+	+	+	+
+	+	+	-	+	-	+
-	+	+	-	(rope)	-	+
-	-	+	+	+	-	stayed alive
-	+	+	-	+	-	+
+	-	+	-	+	-	+
+	-	+	-	helped	-	-
-	-	-	-	-	-	-
-	-	+	+	+	+	+
+	-	+	+	pulled him out	-	+
+	-	+	+	gave him a paw	-	+
+	+	+	-	+	-	+

TABLE 41- STORY 3 - AN ANT AND A PIGEON
(con't)

Monitored Condition

vents in the Discourse

A few days) or some time) assed	(Hunter) caught (pigeon) class: pigeon in trouble	(Ant) saw it	(Ant)bit hunter class: ant helped pigeon	The bite was in (hand)	(Hunter) released (hands) class: let pigeon go	Pigeon flew away class: escaped	Further monologue an "moral" when availab
-	+	-	+	+	+	+	
-	+	-	+	+	-	+	
-	+	-	+	-	+	+	
-	(man)	-	(man)	+	-	+	
-	+	-	took piegon	-	-	they flew away	
+	+	-	+	-	+	+	
-	+	+	+	+	+	+	
-	+	+	+	+	-	+	
-	+	-	+	-	+	+	
-	+	-	+	+	+	+	
-	a guy	+	+	+	cried of pain +	+	
-	+	-	+	-	+	+	
+	+	we'll make it	+	-	let him go	+	
-	+	+	+	-	class	+	

TABLE 12- STORY 3 - AN ANT AND A PIGEON

Non-Monitored Condition

Case	Events in the Discourse						
	(Ant) was at (river)	(Ant) was drinking water	Ant started to drown class: got in trouble	(Pigeon) saw (Ann) drowning	(Pigeon) threw Ant (branch) class: helped the ant	(Ant) used (branch)	Ant got to the (bank)
1	-	-	+	+	+	+	+
2	+	+	+	+	+	+	+
3	-	-	+	-	+	-	+
4	+	+	+	-	(bush)	-	+
5	-	+	+	+	throws a rope	(rope)	+
6	-	-	-	-	-	-	-
7	-	-	-	-	-	-	-
8	+	-	-	-	+	-	+
9	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-
11	-	-	-	-	-	-	-
12	+	-	+	+	pulled him out	-	+
13	-	-	-	-	-	-	-
	+	+	+	-	+	-	+

TABLE 12- STORY 3 - AN ANT AND A PIGEON
(con't)

Non-Monitored Condition

Events in the Discourse

(A few days) (or some time) passed	(Hunter) caught (pigeon) class: pigeon in trouble	(Ant) saw it	(Ant)bit hunter class: ant helped pigeon	The bite was on (hand)	(Hunter) released (hands) class: let pigeon go	Pigeon flew away class: escaped	Further monologue an "moral" when availab
-	-	-	-	-	-	-	Perseveration...climb higher and higher to the top..how to get down.
-	-	-	-	-	-	-	Pigeon brought him to his place, gave pills Perseveration
-	-	-	(brutally) +	-	+	+	Pigeon took the ant and they flew away... to better places. Perseveration. To the south...It was winter to Canary Islands
-	-	-	-	-	-	-	Perseverations
-	-	-	-	-	-	-	Victory. Now the forestbeasts will bit people everywhere.
-	+	+	+	+	+	+	Perseveration
-	+	+	+	+	-	+	Perseveration
+	+	+	+	+	-	+	Mutual accord is what what is desired(moral
-	-	-	+	-	+	+	Even a small one can punish a big one (moral)
-	+	-	+	+	+	+	----------
-	A guy got pigeon for feathers	+	+	+	cried of pain	+	Flies around..teases people. They throw hi food
-	-	-	-	-	-	-	How come you can't swim...Where is all your training...
-	+	Don't worry we'll make it	+	-	class	+	Perseveration. Says to the ant: Now we are buddies (moral) kissed each other... how long are you here have a drink
-	-	-	-	-	-	-	Perseveration... started looking for the star..started rai ing...got into the b

TABLE 13- STORY 4 - A LION AND A MOUSE

Monitored Condition

;e	Events in the Discourse									
	(Lion) was sleeping	(Mouse) was moving	Movement was running	Movement was around (lion) class: mouse bothered lion	(Lion) woke up	(Lion) caught mouse	(Lion) wanted to eat mouse up class: hurt mouse	(Mouse) asked for mercy	(Lion) let her go class: was good to the mouse	(A few days) (or some time) passed
	+	-	-	Shouting around lion	+	-	+	-	+	-
2	-	-	-	-	+	+	+	+	+	-
3	+	+	+	+	+	+	+	+	+	-
4	+	+	+	+	-	+	-	-	+	-
5	+	+	+	+	+	+	+	-	+	-
6	-	+	+	+	-	+	-	+	+	-
7	+	+	+	+	-	+	+	-	+	-
8	+	+	+	+	+	+	+	+	+	-
9	-	-	-	-	-	-	-	-	-	-
0	+	walking	-	+	-	+	+	+	+	+
1	+	-	-	was nasty	+	+	+	-	+	-
2	+	+	+	+	+	+	+	-	+	-
3	-	+	+	+	+	-	strangle	-	+	+
4	+	+	+	+	-	+	-	-	+	-

TABLE 13 - STORY 4 - A LION AND A MOUSE

Monitored Condition (cont)

Case	Events in the Discourse								
	Hunter) caught (lion) class: lion in trouble	(Lion) was placed against (tree)	He was tied	(Rope) was used	(Mouse) learned about it	(Mouse) came	(Mouse) gnawed (ropes) class: helped lion	(Lion) was free class: escaped	Further monologue and "Moral" when available
1	+	-	+	+	-	+	+	+	
2	+	+	+	+	-	+	+	+	
3	+	-	+	+	+	+	+	+	
4	(fire-men)	-	-	-	-	-	exting-uished fire	+	
5	Bear wanted to eat lion	-	-	-	+	+	chased the bear	+	
6	order-ly	-	+	+	-	+	+	+	
7	-	+	+	+	+	+	+	+	
8	-	-	-	-	-	-	-	-	
9	-	-	-	-	-	-	-	-	Contamination with "An an and a Pigeon"
10	+	-	+	-	-	-	-	-	They let him go (contamination with the first par
11	+	+	+	-	+	+	untied	-	
12	(man)	+	+	-	-	+	+	+	
13	+	-	+	+	-	+	+	-	
14	+	-	+	+	+	-	+	-	

TABLE 14 - STORY 4 - A LION AND A MOUSE

Non-Monitored Condition

ase	Events in the Discourse									
	(Lion) was sleeping	(Mouse) was moving	Movement was running	Movement was around (lion) class: mouse bothered lion	(Lion) woke up	(Lion) caught (mouse)	(Lion) wanted to eat mouse up class: hurt mouse	(Mouse) asked for mercy	(Lion) let her go class: was good to the mouse	(A few (days) (or some time) passed
1	+	-	-	shouting around lion	+	-	+	-	was too lazy	-
2	-	-	-	-	+	+	+	-	-	-
3	-	-	-	-	-	-	-	-	-	-
4	+	+	+	+	-	+	put her under arrest	-	-	-
5	+	+	+	+	+	+	-	-	-	-
6	-	-	-	-	-	-	-	-	-	-
7	+	-	-	-	-	-	-	-	-	-
8	-	-	-	betrayed lion	-	-	+	-	rehabilitated mouse	-
9	-	-	-	-	-	-	-	-	-	-
0	-	-	-	-	-	-	-	-	-	-
1	-	-	-	-	-	-	-	-	-	-
2	+	+	+	+	+	grabbed	+	asks why he wants to kill her	-	-
3	-	-	-	-	-	+	strangle	-	+	-
4	-	-	-	-	-	-	-	-	-	-

TABLE -14 - STORY 4 - A LION AND A MOUSE

Non-Monitored Condition (cont)

Events in the Discourse

(Hunter) caught (lion) class: lion in trouble	(Lion) was placed against (tree)	He was tied	(Rope) was used	(Mouse) learned about it	(Mouse) came	(Mouse) gnawed (ropes) class: helped lion	(Lion) was free class: escaped	Further monologue and "moral" when available
-	-	-	-	-	-	-	-	went back to sleep. Next time will catch. Perseverati
+	+	+	-	-	-	-	-	Preseveration. The lion scolds the mouse.
(Pari-seans)	Column of a theatre	+	+	+	+	chased Pari-seans	+	Walk around Paris. Description of the city. Get into plane, back to Moscow.
-	-	-	-	-	-	-	-	Firemen ride around extinguishing fires
-	-	-	-	-	-	-	-	Ate her up. Lion and a mouse are like ice and fire. Lion hate noise...still was hungry...ate a fox
(order-ly)	+	+	-	+	+	+	+	Lion runs away to the 1st floor..turns the lights on.. puts down curtains... Perseveration
-	+	+	+	+	+	+	+	Preseverations
-	-	-	-	-	-	was de-voted to lion since	-	Newspaper cliches. Long rhetorics
-	-	-	-	-	-	-	-	Contamination with "An ant and a Pigeon"
+	-	+	+	-	-	-	-	Then let him go (contanima-tion with the first concente Long perseveration
+	+	+	-	-	+	untied	+	Perseveration...Discussion how to save the lion...docto will prescribe what to do
-	-	-	-	-	-	-	-	Mouse does not pay dues... Mouse is in a hospital, has operations. Moral: you can' resist a stronger one. Lion became friends with a mous
-	-	-	-	-	-	-	-	Mouse dance Mouse meets an other mouse...talks..drink at a bar. Moral: Lion got friends with a mouse
+	(bed)	+	+	+	+	(net)	-	Lion went to his family... Congratulations..Persevera-tion...Lion went to his friends.

TABLE 15 - STORY 5 - A DAW AND PIGEONS

Monitored Condition

Case	Events in the Discourse							
	(Pigeons) were fed well	(Daw) learned about it	(Daw) dyed itself class: pretended a pigeon class: cheated pigeons	The color of dye was (white)	(Daw) flew to pigeons (or dove-cote)	(Pigeons) accepted (daw) or explica-tion: thought he was a pigeon	(Some time) passed	(Daw c in daw class: disclo himsel
1	+	+	+	-	+	-	-	+
2	-	-	+	+	+	started eating with them	-	+
3	-	wanted to live with pigeons	+	nice anylin color	+	+	-	+
4	+	+	+	+	+	+	-	-
5	+	+	-	-	+	+	-	-
6	-	+	+	+	+	+	-	+
7	+	+	+	+	+	-	-	dye (o
8	+	+	+	-	+	+	-	ate much
9	-	-	-	-	+	+	+	-
10	-	-	+	-	+	-	+	-
11	-	-	+	-	+	+	-	-
12	+	+	+	+	+	+	+	+
13	-	-	learned the Daw language	-	+	+	-	unders he is a pige
14	+	envied him	-	-	+	+	-	+

TABLE 15 - STORY 5 - A DAW AND PIGEONS

Monitored Condition (Cont.)

	Events in the discourse			
	(Pigeons) chased (daw) away (or explication:) understood that he was not a pigeon	(Daw) flew to (daws) or flew back to his folks)	(Daws) did not accept him (or explication: did not want traitor: explication: did not recognize him)	Further monologue and "moral" when a able
1	+	+	+	
2	+	+	+	
3	+	+	-	
4	+	+	+	
5	+	-	-	
6	+	-	-	
7	+	+	+	
8	+	-	+	
9	+	+	+	
10	+	-	+	
11	learned that he is sneaky	+	+	
12	+	-	-	
13	+	+	no one accepted the daw	
14	+	+	+	

TABLE 16 - STORY 5 - A DAW AND PIGEONS

Non-Monitored Condition

Case	Events in the Discourse							
	(Pigeons) were fed well	(Daw) learned about it	(Daw) dyed itself class: pretended a pigeon class: cheated pigeons	The color of dye was (white)	(Daw) flew to pigeons (or dove-cote)	(Pigeons) accepted (daw) or explica-tion: thought he was a pigeon	(Some time) passed	(Daw c in daw class: close himsel
1	-	-	-	-	-	-	-	+
2	-	-	-	-	-	-	-	-
3	-	-	+	+	+	+	-	-
4	+	+	+	+	+	+	-	-
5	+	+	-	-	+	+	-	-
6	-	-	-	-	-	-	-	+
7	-	-	-	-	-	-	-	-
8	+	+	+	-	+	-	-	-
9	-	-	-	-	-	-	-	-
10	-	-	-	-	-	-	-	-
11	-	-	dyed in sneaky way	-	+	+	-	-
12	-	-	-	-	+	-	-	+
13	-	-	learned the daw language	-	+	-	-	-
14	+	envied him	-	-	+	-	-	-

TABLE 6 - STORY 5 - A DAW AND PIGEONS

Non-Monitered Condition (Cont.)

Events in the discourse

	(Pigeons) chased (daw) away (or explication:) understood that he was not a pigeon	(Daw) flew to (daws) or flew back to his folks)	(Daws) did not accept him (or explication: did not want traitor: explication: did not recognize him)	Further monologue and "moral" when a able
1	+	-	-	No food today...The wife did not come, d not bring oranges. Perseveration about
2	-	+	+	Flew to his children...Became a girl Daw front of her mirror.
3	after the honeymoon +	-	-	No trouble. Daw traveled around the wor (enumeration) looking for fun.
4	-	-	-	Perseveration...Build nests together. D are girls, pigeons are males.
5	-	-	-	Perseveration
6	+	-	-	Perseverations...Daw decided to live alo Never became black again...Never cried a Only sang songs
7	-	+	+	Perseverations (comes again, chase him again, etc.)
8	-	-	-	There was plenty of food, because people take care of pigeons and forgot about daws (moral)
9	-	+	+	The daw asked the lion for help, to puni them (contamination with another story)
10	-	+	+	Never come again...You are not a bird an more.Asks to be allowed in...No success
11	-	-	-	Takes a grain, looks for water...Drinks water (Perseveration)
12	+	+	+	Daw got upset...Her mood went down...up. down...up(perseveration)...37°C
13	-	-	-	Tells them that he speaks the daw langua can speak one-two years. Then gets ex- hausted.
14	-	-	-	The net was very thick. Asked the "tapin boy" to take it away...Talked to a hen.