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ENCODING STRATEGIES AND RECOGNITION OF FACES BY
ALCOHOLIC KORSAKOFFS AND OTHER BRAIN-DAMAGED PATIENTS

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by

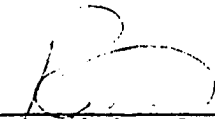
CAROL BIBER

A dissertation submitted to the Graduate Faculty
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This manuscript has been read and accepted for the Graduate Faculty in Experimental Cognition in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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ABSTRACT

The present study assessed whether the alcoholic Korsakoffs' impairment in the recognition of unfamiliar faces is related to a failure in stimulus analysis. Patients with alcoholic Korsakoff's syndrome, Huntington's Disease and right hemisphere damage were administered a face recognition task under three experimental conditions that presumably induced different levels of stimulus analysis. The recognition scores of the Korsakoff patients, but not those of the other patient groups, improved significantly following a "high level" orientation task requiring the subjects to judge the likeability of the to-be-remembered faces. Under baseline conditions (i.e., no orientation task), normal controls appeared spontaneously to encode faces in a manner induced by the "high level" task, whereas the Korsakoff patients, left to their own devices, employed strategies consistent with the "low level" orientation task (judgment of nose size). Although these findings seem to support the limited encoding hypothesis, explanations stressing the role of affective-motivational factors cannot be dismissed.

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INTRODUCTION

A number of theories have been advanced over the past decade to explain organic amnesia (e.g., Milner, 1971; Warrington & Weiskrantz, 1977; Butters & Cermak, 1974; Huppert & Piercy, 1976; Kinsbourne & Wood, 1975). None has, however, been able completely to explain all of the data coming from research on disorders of memory. A number of psychological processes, each highly complex in itself--attention, perception, motivation, to name just a few--contribute to normal memory functioning and a breakdown in any one or several of these processes may result in memory dysfunction (Oscar-Berman, 1980). In some recent studies, manipulation of test conditions and careful analysis of subjects' behavior, aimed at identifying the deficits that actually contribute to impaired memory test performance, have suggested that breakdowns in different processes may contribute to poor memory test performance in different amnesic groups (Mattis et al., 1978; Butters & Cermak, 1980). In the present study, by manipulating encoding conditions at stimulus presentation, an attempt was made to draw some distinctions between the deficits underlying impaired performance on a test of facial recognition in alcoholic Korsakoffs and two other brain-injured groups.

Butters and Cermak have emphasized the role of faulty, i.e., incomplete, analysis of incoming stimuli in accounting for alcoholic Korsakoff subjects' profound inability to acquire new information (Butters & Cermak, 1974, 1975, 1976, 1980). Such a relationship was initially suggested and subsequently supported in a series of verbal

learning and dichotic listening studies. Alcoholic Korsakoffs were shown to be capable, although slower than normals, of carrying out semantic analyses of words when such analyses were specifically required (Cermak, Reale & Baker, 1978). However, under spontaneous encoding conditions, they repeatedly appeared to rely on a more "superficial", e.g., phonemic, level of stimulus analysis (Butters & Cermak, 1974; Cermak & Moreines, 1976; Cermak, Naus & Reale, 1976).

Several studies now provide evidence that Korsakoffs' impaired encoding of verbal material may represent just one example of a more general tendency not to extract all relevant information from complex stimuli. Glosser et al. (1976) demonstrated that these individuals are restricted, compared to normal controls, in the number of features they can abstract from dichotically-presented digits. An analogous phenomenon was demonstrated by Oscar-Berman and Samuels (1977) on a visual discrimination task. They required subjects to formulate hypotheses regarding which stimulus dimensions (color, size, form or position) were relevant at each of a series of choice points. Transfer trials were then administered to determine which dimensions had been utilized. Korsakoffs' impaired performance on this task was shown to be related to their tendency to base discriminations on only a limited number of relevant stimulus features. Inattention to multiple stimulus dimensions has also been hypothesized to contribute to Korsakoffs' demonstrated impairments on such visuoperceptive tasks as retention of random geometric forms (Cermak, Reale & DeLuca, 1977), digit-symbol substitution (Glosser, Butters & Kaplan, 1977), and embedded figures (Kapur & Butters, 1977).

Dricker et al. (1978) were, to my knowledge, the first to attempt

a systematic study of whether Korsakoffs' difficulties on visuoperceptual tasks are attributable to an encoding deficit. They reasoned that if Korsakoffs have a general limitation in the depth to which they encode nonverbal stimuli, then it might be possible to demonstrate that they limit their analyses to superficial features. To test this assumption, they turned to Carey and Diamond's work (1977) on the developmental course of facial recognition. Carey and Diamond had demonstrated that eight and ten year old children, in attempting to match faces, are fooled by changes in paraphernalia presumably because they base identification on such salient features of the stimuli. According to Carey and Diamond, older (12 and 14 year old) children are able to match faces despite such alterations in appearance because for them, as for adults, identification is tied to a "configurational" analysis of the eyes-nose-mouth relationship. Dricker et al.'s predictions were confirmed by the finding that both alcoholic Korsakoffs and right brain-damaged patients behave the way young children do on Carey and Diamond's matching of faces to sample test. They concluded that the performance of alcoholic Korsakoffs might represent one instance of a more general deficiency in information processing while the suggested deficit for right brain-damaged patients might be limited to the analysis of visuo-spatial material.

Although a number of studies have suggested a connection between Korsakoffs' incomplete analyses and their poor retention of stimuli, the nature of the relationship between these two variables has been unclear. That is, the question has remained of whether limited encoding actually contributes directly to impaired memory test performance. One way of examining this question is to manipulate the kind of processing

subjects carry out at stimulus presentation and then to see if these manipulations influence memory test performance. The "levels of processing" model of human memory (Cermak, 1972; Craik & Lockhart, 1972) provides a useful framework for this kind of analysis. This model focusses on the relationship between the way information is processed and how it is retained. Encoding characteristics and persistence of the trace are, in fact, regarded as kind of byproducts of the type of processing which takes place. The term "depth" is used to connote a continuum of processing ranging from "shallow sensory analyses requiring little attention to deeper semantic processes through which the stimulus is identified, interpreted and enriched by associations with stored knowledge (Craik, 1977)." "Deeper," more elaborate (and what I shall refer to as "high level"), as opposed to "superficial" (what I shall refer to as "low level") analysis, is expected to result in stronger, more enduring and/or more retrievable memory traces. A number of studies with normal subjects using both verbal and visual-spatial stimuli have now been described in which orienting tasks designed to induce different "levels" of analysis led to predictable differences in subsequent retention (Craik & Tulving, 1975; Bower & Karlin, 1974; Warrington & Ackroyd, 1975; Winograd, 1976; Patterson & Baddely, 1977; Blaney & Winograd, 1978; Smith & Winograd, 1978).

Two studies have now been reported in which orienting paradigms were used in attempts to clarify the nature of the relationship between AKs' faulty encoding and their impaired retention of words (Cermak & Reale, 1978; McDowall, 1979). In both studies, while alcoholic controls overall recalled more words than AKs, both groups recalled significantly more words following semantic than nonsemantic orienting tasks. In one

of these studies, which was reported by McDowall, a free study condition was introduced as a measure of recall following spontaneous encoding. With inclusion of the free study condition, different patterns emerged for the two groups. Alcoholic controls performed equivalently following free study and semantic instructions. It appeared that the nonsemantic task interfered with their normally effective spontaneous processing of words. Korsakoffs' recall following free study was, however, equivalent to that following the nonsemantic task and was significantly more impaired than their recall subsequent to the semantic task. These results suggested that, in the absence of encoding instructions, Korsakoffs typically encode words in a manner equivalent to the processing induced in them by the nonsemantic task. The differential improvement seen for Korsakoffs, compared to controls, between the free study and semantic conditions appeared to provide strong support for the limited encoding hypothesis.

The present study constituted an attempt to develop a nonverbal analog of the McDowall (1979) experiment. An orienting paradigm was utilized. The major aim was to see if a direct relationship could be established between the Korsakoffs' faulty processing of faces and their impaired ability to retain this material. In keeping with the limited encoding hypothesis and in light of McDowall's findings, the following predictions were made. While controls were expected, overall, to perform better than Korsakoffs on this test, both groups were expected to show significantly better recognition following the task selected to induce "high level" than following the task selected to induce "low level" encoding. Also, because under the free study, i.e., spontaneous, encoding condition the Korsakoffs were expected to carry out "low level"

and the normal controls "high level" analyses of faces, it was predicted that the Korsakoffs would recognize significantly more faces following "high level" than following free study instructions relative to controls.

A number of studies with normal subjects using facial stimuli have now tested the applicability of the levels of processing model to memory for complex visual stimuli (Bower & Karlin, 1974; Warrington & Ackroyd, 1975; Winograd, 1976; Patterson & Baddely, 1977; Blaney & Winograd, 1978; Smith & Winograd, 1978). Although little justification, independent of test results, has been offered for particular orienting tasks being selected to induce "high" or "low level" encoding, these studies have consistently found improved recognition of previously unfamiliar faces following global-evaluative judgments (e.g., Is this person honest?) as opposed to those based on specific stimulus features (e.g., Does this person have curly hair?). Carey (1978), based on a number of studies which examined facial processing in different age groups and in brain-damaged as well as in normal subjects, has distinguished two types of facial processing. One, associated with relatively good recognition, does not become operative until about ten years of age. In this mode, faces are processed as configurations with reference to some abstract, upright representation in memory. The second type, seen in young children (Carey & Diamond, 1977), as well as in right posterior brain-lesioned patients and alcoholic Korsakoffs (Dricker et al., 1978) presumably involves treating faces in a piecemeal manner, with identification based on ideosyncratic features. This latter type of processing, according to Carey (1978), is associated with relatively poor recognition. These two modes of processing, "configurational" and "piecemeal," appear not to be inconsistent with the encoding character-

istics assumed, in the literature, to be induced, respectively, by global-evaluative judgments and judgments of ideosyncratic physical features.

In the present study, for the "high level" task, subjects were asked to judge the likeability of individuals pictures. The "low level" task required subjects to judge size of nose. Faces were rated for these qualities on four-point scales. These ratings as well as the time required to make them were recorded by the examiner. It was hoped that these task demands would promote more considered judgments than, for example, binary decisions and that the measures, in turn, could provide a means of comparing subjects' behavior on these tasks across groups. A third, free study, condition, intended as a measure of stimulus retention subsequent to spontaneous encoding, was included for comparison with the other two conditions.

The stimuli used in this study were selected to exclude salient differentiating features of dress and hairdo. As noted above, Korsakoffs, like young children, are "fooled" by changes in paraphernalia on a matching of faces to sample task (Dricker et al., 1978). Young children and older adults, although helped by global-evaluative orienting tasks, do poorly on tests of facial recognition relative to young adults (Blaney & Winograd, 1978; Smith & Winograd, 1978). A point not considered in any of these papers is that a major factor in the poor performance of all these groups may be a tendency not to resist a "pull" to salient perceptual features of stimuli. That is, these subjects may be more or less capable of carrying out "configurational" analyses of faces but perhaps tend to focus on outstanding features when they are available. The Carey and Diamond (1977) and the Dricker et al., (1978)

studies, as well as the studies which investigated levels of processing and retention of faces in young children and the aged, all used stimuli which included a number of such potentially distracting features. It was believed that elimination of such differentiating details of hairdo and dress might help subjects focus on those attributes of facial stimuli considered to be veridical for "configurational" analysis.

Two subject groups, right hemisphere-damaged (RH) and Huntington's disease (HD) patients, in addition to normal controls and alcoholic Korsakoffs, participated in the present study. There were two reasons for inclusion of the RH patients. First, they have well-known impairments in processing complex visual stimuli, including faces (Yin, 1970; Benton & Van Allen, 1968; DeRenzi, Faglioni & Spinnler, 1968). Dricker et al. (1978) found that right brain-damaged patients and AKs were similarly impaired in their ability to recognize faces and that both groups, in attempting to match them, tended to focus on irrelevant features of paraphernalia and hairdo. While both right hemisphere and AK subjects were characterized as being "deficient in the depth of their perceptual encoding," it was questioned whether such similarities in test results might not represent different underlying deficits in the two groups. Dricker et al. suggested that deficits in perceptual encoding might follow either cortical (as in the case of right hemisphere patients) or subcortical (as in the case of AKs) brain lesions. They stated "For the alcoholic Korsakoffs, this deficit in perceptual encoding is only a single exemplar of a general deficiency in the depth of the patients' verbal and nonverbal information processing while for the right hemisphere patients the encoding problem may be limited to the visual modality." Carey has suggested that there is a "processor in the

right posterior hemisphere that is differentially involved in the encoding and recognition of upright unfamiliar faces (1978)." If this is correct, then it may be that RH patients lack the cerebral substratum for effective, i.e., "configurational," processing of facial stimuli. In this case, variations in encoding instructions at stimulus input would not be expected to alter their subsequent ability to recognize faces. It was predicted that their performance would, on this basis, be distinguishable from that of the AKs in the present study.

The second reason for inclusion of the RH group was that the tendency of individuals who suffer from chronic alcohol abuse to manifest difficulty predominantly on tasks designed to assess visuospatial as opposed to verbal abilities has led a number of investigators to hypothesize that the neuropsychological deficits of alcoholics are similar to those of right hemisphere patients (see Wilkinson & Carlen's review, in press). If such were the case, the effects of orienting tasks in the present study were expected to be similar in the AK and RH groups. The validity of the "right hemisphere hypothesis" has, however, been brought into question. Radiological and neuropathological examinations of the brains of chronic alcoholics have revealed subcortical lesions and cortical atrophy (Wilkinson & Carlen, in press), but lateral asymmetries appear not to have been reported. Secondly, as stated by Goodglass and Kaplan (1979), "... inferences concerning lateralization cannot safely be made on the basis of test scores alone; it is necessary to consider the qualitative features of performance." The fact that difficulties in visuospatial problem-solving may not necessarily implicate right or more particularly right posterior hemisphere dysfunction has frequently been overlooked. The types of deficits seen in chronic alcoholics

(Parsons, 1975), and in alcoholic Korsakoffs (e.g., Oscar-Berman, 1980), for example, perseverative tendencies as well as difficulties on conceptual shifting tasks, in the selection of relevant stimulus attributes, and in the formulation of appropriate strategies for problem-solving, are those which have been associated with frontal system dysfunction (Luria, 1966). It was predicted that the AKs would not behave similarly to the RH patients in this study. The RH subjects were expected to be unresponsive to variations in input conditions because they were lacking the neuratomical substratum prerequisite for global analysis of faces (Carey, 1978). However, the "high level" instructions were expected to induce effective, i.e., "configurational" analyses of faces in the AK subjects because the cortical substratum for such processing was believed, in these individuals, to be at least relatively intact.

A group of HD patients was also included. HD is a genetically transmitted disorder associated with progressive atrophy of the basal ganglia and cerebral cortex. Clinical symptoms most commonly include involuntary choretic movements and a progressive dementia. Severe memory problems are prominent, often in early stages of the disease, and are characteristically observed in the context of a general intellectual decline. HDs' overall scores on tests of new learning and of old knowledge are as impaired as those of AKs. However, different patterns emerge for the two groups with analysis of error types and comparison of their performances under different test conditions. For example, on the Peterson and Peterson task (1959), which tests recall following short periods of interpolated activity, AKs tend to make prior list intrusions while HDs omit items (Meudell et al., 1978). Also, AKs but not HDs are sensitive to such manipulations in test conditions as dis-

tributed versus massed practice and variations in similarity of target and distractor material (Butters, Tarlow, Cermak & Sax, 1976). HDs also fail to show normal patterns of improved recall for high versus low imageable words, and following semantic as opposed to nonsemantic encoding tasks (Weingartner et al., 1979). Results of these studies suggest that distinctly different information processing deficits must underly the memory problems in these two groups. AKs show marked sensitivity to PI due largely to their failures to analyze relevant attributes of stimuli. Since HDs appear to perform poorly on memory tests regardless of manipulations in encoding conditions, they may have more severe deficiencies in encoding than AKs, or may be unable either to consolidate or to retrieve new information. It has been suggested, for example, that HDs may lack some of the neuroanatomical structures necessary for consolidation and storage of information (Butters & Cermak, 1980). However, more work will be required before the deficits underlying their amnesia can be understood. It was predicted that the HDs in this study would 1) recognize significantly fewer faces than normal controls and 2) be unresponsive to manipulations in encoding conditions.

In this study, there was of course no way of determining whether subjects in the different groups were actually carrying out the encoding tasks in the same way. However, likeability and size of nose ratings as well as the number of seconds taken to make them (encoding times) were recorded to see if any differences could be discerned in the way the different groups rated faces at input. If differences had been found, they would have had to be interpreted in relation to recognition test performance.

Gaffan (1972) has suggested that AKs have an abnormal sense of familiarity. That is, they appeared to him to be capable of retrieving information but unable to determine whether these items were the targets being sought. There are also reports in the literature of AKs demonstrating that they have acquired new information but denying any awareness of having previously been exposed to it (Kinsbourne & Wood, 1975). Confidence ratings were recorded along with each recognition test response in order to look at a second level of responding; that is, to probe the idea that AKs are somehow less able than normals to judge the correctness of their responses. Another rationale for including confidence ratings was that AKs have been described as apathetic, passive and lacking in initiative (see, for example, Butters & Cermak, 1980). If AKs' confidence ratings were found not to be significantly different from those of normals in this study, this would have suggested that lack of active engagement in the task was not a major factor contributing to impaired learning of new faces.

In sum, specific predictions included: 1) NCs would, overall, recognize more faces than AKs; 2) NCs and AKs would perform significantly better following "high level" than "low level" instructions; 3) AKs would show differential improvement compared to controls between the free study and "high level" conditions; 4) AKs would show no significant difference in overall performance from the RHs and HDs; and 5) neither the RHs nor the HDs would respond differentially to manipulations in encoding conditions.

METHOD

Subjects

Four subject groups (each with nine subjects) participated in the present study: (1) alcoholic Korsakoffs (AKs); (2) patients with brain damage limited to the right hemisphere (RHs); (3) Huntington's disease patients (HDs); and (4) nonalcoholic controls (NCs). Aside from one female in the RH group and three females in the HD group, all subjects were male.

All of the AKs employed in this study were diagnosed and treated at the Boston, Brockton and Bedford VA Medical Centers. All were hospitalized or in nursing homes when tested. They had severe anterograde and retrograde amnesias, as measured by the Wechsler Memory Scale (WMS) and on the basis of clinical assessment, but their general intellectual functioning, as measured by the Wechsler Adult Intelligence Scale (WAIS), was within normal limits (Table 1 gives age, education and WAIS and WMS results for the AKs and other groups).

Etiologies for members of the RH group included seven cerebral-vascular accidents, one hematoma evacuation, and one neoplasm resection. At the time of testing, four were hospitalized and five were living at home. All of the RHs were right handed. Five of the nine had some left-sided paralysis and sensory loss. Five showed some visual neglect for the left side of space. Locus of lesions was confirmed on the basis of neurological examinations as well as CT scan reports.

The HDs had been diagnosed an average of 5.4 years prior to

GROUP	AGE	EDUC	PRORATED WAIS IQ		WECHSLER MEMORY SCALE						
			Verbal ⁺	Perform ⁺⁺	MQ	Info	Orient	MentCont	LogMem	VisRepro	AssocLrn
NCs	55.7	11.9	115.7	117.2	126.0	5.8	5.0	7.8	12.6	9.7	15.0
AKs	55.0	11.1	108.7	104.6	81.3	2.7	3.0	7.3	5.0	3.3	7.9
RHs	61.6	11.5	110.3	88.6	109.0	5.6	4.8	7.1	9.0	4.6	14.8
HDs	49.9	13.7	95.3	85.6	82.3	5.6	4.7	5.2	4.8	3.9	9.0
Signifi- cant Group Differ- ences			1x4**	1x3**	1x2***	1x2***	1x2***		1x2***	1x2***	1x2***
				1x4*	1x4***	2x3***	2x3*		1x4***	1x3**	1x4*
					2x3***	2x4*	2x4*		2x3*	1x4*	2x3***
					3x4*				3x4*		3x4*

Table 1. Standardized test results. +Verbal IQ prorated from Information, Similarities, Digit Span and Vocabulary subtests. ++Performance IQ prorated from Block Design and Object Assembly subtests. Significance levels for group differences are indicated by astericks: *p<.05; **p<.01; ***p<.001.

testing. None was considered to be in terminal stages of the disease process or was institutionalized. All evidenced marked memory impairments and significant intellectual decline (but not advanced dementia), as measured respectively on the WMS and the WAIS. None suffered, on clinical assessment, from a severe psychiatric disability. These individuals were identified for participation in this study by a local chapter of the Committee to Combat Huntington's Disease.

The NCs were matched for age and education with the AKs. They were all non-hospitalized volunteers recruited from newspaper advertisements and were carefully screened for any history of alcohol abuse and evidence of neurological disease prior to being included in the study.

Materials and Procedure

Stimuli were 144 highly homogeneous, three by four inch, black and white reproductions of yearbook photographs of caucasian male Coast Guard Academy seniors. Each picture was pasted on a five by eight inch white index card. All individuals pictured had short hair, were clean-shaven, without eyeglasses, and in uniform. Seventy-two "look-alike" pairs of photographs were initially assembled on the basis of direction of gaze, facial expression, hair coloring and general similarity of appearance. One member of each pair was then randomly assigned as a target (T), the other as a distractor (D). Each of the 72 Ts was then randomly assigned a place in the study set. Exact duplicates of the Ts were randomly paired with Ds and made up a two-choice recognition test. Each item of the recognition test consisted of one T and one D positioned side by side in an 8½ by 11 inch transparent, no-glare sheet protector. The 72 items were assembled for presentation in a three-ring loose leaf notebook. The order of items in the recognition test

was randomly determined, the only constraint being that Ts making up the first 24, the second 24 and third 24 items of the study set appeared, respectively, in the first, second and third parts of the recognition test. This was done to provide some control for duration of interval between initial presentation of an item and its subsequent reappearance on the recognition test.

The study set was divided into nine subsets, eight targets in each. The order of pictures was fixed, i.e., the same for all subjects. Ordering of the three conditions, likeability (L), size of nose (N), and free study (S), was first decided by chance and then this order (L-S-N) of conditions was rotated across the nine subsets. This resulting sequence was once more rotated by thirds to achieve a balanced order of presentation within and across subjects (see Table 2). Three subjects in each group were randomly assigned to each of three sequences.

Subjects in each group receiving sequence	Picture Set		
	I	II	III
1,4,7	L S N	S N L	N L S
2,5,8	S N L	N L S	L S N
3,6,9	N L S	L S N	S N L

Table 2. Sequence in which conditions were presented to subjects in each group (L= likeability judgments; N=size of nose judgments, S=free study).

Subjects were tested individually. Before presentation of the study set (all 72 items), they were instructed as follows: "I am going to show you a series of pictures of people, one at a time. You will see each picture for seven seconds. While looking at some of the

pictures, you will have a task to do. I will tell you what the task is when we get to it. Other pictures you will just look at. However, whether you are required to carry out a task or just look at the pictures, I want you to try to remember all of them because afterwards I am going to give you a test (here, for emphasis, E placed her hand on the book containing the recognition test) to see how many of them you can recognize." Although the instructions were somewhat lengthy, the demands of the situation did not require that subjects hold instructions in mind verbatim. For the L condition, judgments were made on a four-point scale, a printed copy of which was placed before the subject. The four points on the scale were: 1) Very likeable; 2) Likeable; 3) Not likeable; and 4) Not at all likeable. For the N condition, subjects also made judgments on a four-point scale placed before them, which read: 1) Very big nose; 2) Big nose; 3) Small nose; and 4) Very small nose. Free study was allowed for the 24 remaining targets. At the outset of each condition, subjects were told: for L, to judge how likeable they thought the person might be; for N, to judge the size of the person's nose; and, for S, just to look at the person and to try to remember him. Subjects were assured that there were no correct or incorrect judgments.

Immediately following presentation of the 72 items in the study set, the recognition test was introduced to subjects as follows: "You have just looked at a lot of pictures. Now you are going to see two pictures at a time. One will always be a picture you have just seen (E's hand here was placed on the study set pack for emphasis). The other picture will be one that you have never seen before. I want you to tell me which picture looks familiar to you, which one you have seen

before. In addition, I would like you to tell me whether you are sure you saw the picture, probably saw it, or are guessing." A card with these three levels of confidence remained before subjects throughout recognition testing. RHs were continually reminded during recognition testing to examine the face to the left as well as the one to the right before making a decision.

During presentation of the study set, E recorded subject's judgments and his encoding times (in seconds). During recognition testing, in addition to actual responses, confidence ratings were recorded.

Results

Number correct on the recognition test out of the 24 items studied under each of the three orienting conditions (likeability judgments, size of nose judgments, and free study) was first tabulated for each subject (group means are shown in Table 3). These data were initially entered into a three-way ANOVA with repeated measures (3 sequences x 3 conditions x 4 groups) which determined that the sequence in which conditions were presented did not influence performance. That is, there was no main effect for sequence and no interaction between sequence and either of the other variables. Sequence was therefore disregarded in all subsequent analyses.

A two-way ANOVA with repeated measures (3 conditions x 4 groups) yielded main effects for orienting condition ($df=2$, $F=12.288$, $p < .001$) and for diagnostic group ($df=3$, $F=5.847$, $p=.003$). There was also a significant group by condition interaction ($df=6$, $F=2.278$, $p=.047$) (see Figure 1).

Overall group comparisons showed that normal controls recognized more faces than Korsakoffs ($df=16$, $t=3.019$, $p=.009$), right hemisphere patients ($df=16$, $t=2.750$, $p=.015$) and Huntington's patients ($df=16$, $t=3.789$, $p=.002$). No other group comparisons were significant.

Overall comparisons by condition indicated that more faces were recognized following "high level" judgments than subsequent to both size of nose judgments ($df=35$, $t=4.508$, $p < .001$) and free study ($df=35$, $t=2.410$, $p=.022$).

Group	Condition		
	Size of Nose	Free Study	Likeability
Normal Controls	15.444 (2.061)	18.444 (2.061)	19.333 (2.261)
Alcoholic Korsakoffs	13.333 (1.826)	14.667 (1.764)	18.222 (1.474)
Right Hemisphere Patients	14.222 (2.740)	15.111 (3.071)	15.778 (3.705)
Huntington's Disease Patients	14.000 (3.333)	13.556 (2.948)	14.444 (2.499)

Table 3. Mean number of items correctly identified on recognition test out of 24 in each condition by each group. Standard deviations are given in parentheses.

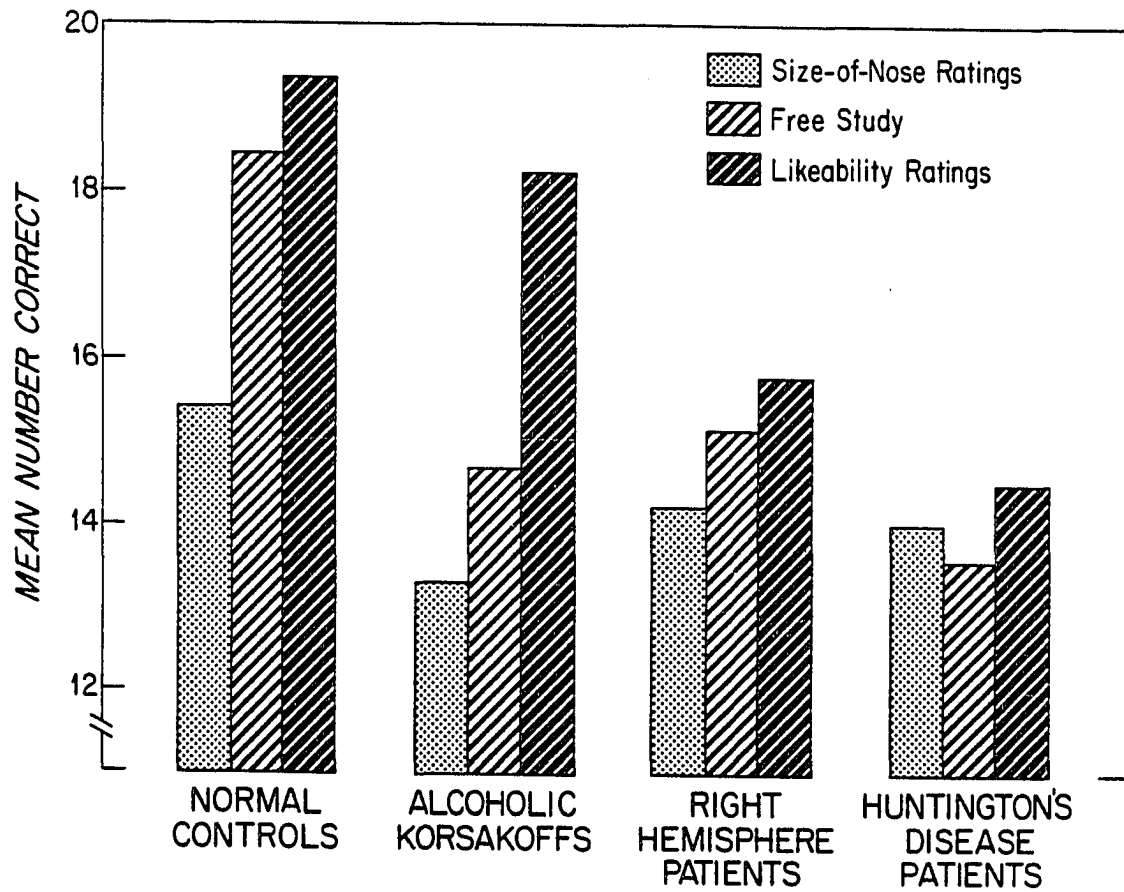


Figure 1. Mean number of items correctly identified on recognition test out of 24 in each condition by each group.

Since all predictions were made between the AKs and each of the other groups, post hoc comparisons (Duncan procedure) were carried out using error terms derived from two-way ANOVAs (2 groups x 3 conditions) between the AKs and NCs, the AKs and the RHs, and between the AKs and the HDs.

When the AKs were compared to the NCs on each of the three conditions, significant differences emerged between the two groups following free study and "low level" instructions ($p < .01$). That is, the NCs recognized significantly more faces than the AKs in both of these conditions. There was, however, no significant difference between AKs and NCs following "high level" instructions. Within group comparisons for the AKs revealed no significant differences between their facial recognition scores following free study and "low level" instructions. However, they recognized significantly more faces following "high level" than following "low level" ($p < .01$) and free study ($p < .01$) instructions. The NCs showed no significant difference between the number of faces recognized following "high level" and free study instructions; however, they recognized significantly more faces in each of these conditions than following "low level" instructions ($p < .01$ in each instance).

The AKs recognized significantly more faces than the RHs following "high level" judgments ($p < .05$). No significant differences emerged between the two groups for either of the other conditions. There were no significant differences in the number of faces recognized by the RHs in any of the three conditions

Following "high level" judgments, the AKs recognized significantly more faces than the HDs ($p < .01$). No significant differences emerged

between these two groups following "low level" or free study instructions. There were no significant differences between any conditions for the HDs.

Likeability and size of nose ratings as well as encoding times were examined to see if differences in the way subjects carried out encoding operations could be ruled out. Mean likeability and size of nose ratings were computed for correctly and for incorrectly recognized items for each subject and, using these data, a 2 x 4 ANOVA (correctness x group) was run separately for each condition (see Table 4). In neither instance were significant main effects or a significant interaction found. Mean encoding times for items that were correctly recognized and for those that were not correctly recognized were also computed for each subject in each condition and after these figures were converted by log transformations they were entered into a three-way ANOVA (correctness x condition x group). Again no significant main effects or interactions were found that might distinguish differences in the way the four groups carried out the encoding tasks.

Mean confidence ratings were also calculated for each subject for correctly and for incorrectly recognized items in each of the three conditions (see Table 5). A three-way ANOVA (correctness x condition x group) yielded a main effect only for correctness ($df=1$, $F=13.410$, $p < .001$) and no interactions were found between any of the factors. This indicated that subjects in all groups expressed greater confidence for those faces on the recognition test that were correctly than for those which were incorrectly selected.

Group	Condition			
	L: Likeability		N: Size of Nose	
	Corr.	Incorr.	Corr.	Incorr.
Normal Controls	2.069 (3.4)	2.279 (3.3)	2.318 (3.4)	2.471 (3.3)
Alcoholic Korsakoffs	2.249 (2.2)	2.271 (2.5)	2.408 (2.1)	2.326 (2.2)
Right Hemisphere Patients	1.967 (2.9)	1.944 (2.8)	2.400 (3.0)	2.411 (2.8)
Huntington's Disease Patients	2.173 (2.9)	2.213 (3.0)	2.411 (2.5)	2.251 (3.2)

Table 4. Mean likeability and size of nose ratings (mean encoding times, in seconds, given in parentheses) for each group for correctly and incorrectly identified items on the recognition test.

Group	Condition					
	N: Size of Nose		S: Free Study		L: Likeability	
	Corr.	Incorr.	Corr.	Incorr.	Corr.	Incorr.
Normal Controls	1.796	1.796	1.604	2.002	1.548	1.835
Alcoholic Korsakoffs	1.882	2.142	1.896	2.104	1.875	2.165
Right Hemisphere Patients	1.664	1.720	1.665	1.794	1.699	1.753
Huntington's Disease Patients	1.821	1.877	1.739	1.910	1.809	1.869

Table 5. Mean confidence ratings for correctly and for incorrectly identified items on the recognition test in each condition by each group. 1 = Sure; 2 = Probably; 3 = Guessing.

DISCUSSION

A major rationale for carrying out the present study was to define further the nature of the relationship between AKs' spontaneous encoding and their retention of unfamiliar faces. Dricker et al. (1978) had demonstrated that AKs are impaired in both their delayed identification and their simultaneous matching to sample of faces. Furthermore, they were able to extend to the visuo-perceptual domain the finding that AKs, under spontaneous encoding conditions, tend not to analyze all relevant features of verbal stimuli. That is, unlike normals, who utilize configurational aspects of faces, AKs appeared to base their analyses on piecemeal or superficial features, e.g., paraphernalia. While McDowall (1979) had shown that AKs' problems in verbal processing directly contribute to their poor performance on tests of verbal learning, the relationship between AKs' limited encoding and poor recognition of faces, for lack of further evidence, could until now only be characterized as correlational.

The results of the present study, in which encoding characteristics during stimulus presentation were experimentally manipulated, provide evidence of a direct relationship between AKs' limited encoding and impaired recognition of faces. Both AK and normal control subjects recognized significantly more faces for which they had been required at input to make likeability (i.e., "high level") judgments than faces for which they had made size of nose ("low level") judgments. Furthermore, the AKs' recognition performance following free study was no

different than it was subsequent to the "low level" task, while NCs' performances following free study and "high level" encoding tasks were equivalent. This suggests that while AKs spontaneously (i.e., in the free study condition) processed faces similarly or equivalently to the way they processed them when required to carry out "low level" encoding, normals spontaneously encoded faces similarly or equivalently to the way they encoded them on the "high level" task. The emergence of the predicted differential improvement for AKs compared to NCs between the free study and "high level" conditions, i.e., AKs were significantly more impaired than NCs following free study but performed comparably to them subsequent to likeability judgments, provides strong support for the limited encoding hypothesis. There was no ceiling effect for normals that might explain this finding, nor could it be accounted for by differences in likeability or size of nose ratings, encoding times, or confidence ratings since no differences emerged between NCs and AKs, or for that matter between any of the groups, on any of these measures.

The relationship between the AK and the NC subjects' performances on the three conditions in this study are highly comparable to McDowall's (1978) results with verbal material. Taken together, McDowall's and the present results imply that AKs do not process either words or faces in a manner effective for subsequent recall/recognition unless they are required to carry out encoding tasks at input specifically designed to induce "high level" analyses.

A recently reported study by Mayes et al. (1980) used a paradigm similar to this one to compare AKs' and normals' abilities to recognize unfamiliar faces following "high," "low" and free study instruc-

tions. While it is impressive that their AK subjects showed marked improvement following the "high level" task, in contrast to the present findings, they failed to show differential improvement for AKs compared to controls between free study and "high level" conditions. However, a close look at their conclusions suggest procedural variants which may account for these differences. 1) Mayes et al. manipulated the performance of AKs and NCs in order to equate the two groups on the free study condition. They did this by testing AKs immediately after exposure to the to-be-remembered items and by introducing an hour's delay between controls' study and testing. With this manipulation, there was no significant difference between amnesics' and controls' performances on any of the three conditions. Both groups showed significant improvement following "high level" (friendliness) judgments and significant decline in performance following "low level" (curliness of hair) judgments. By introducing this delay, Mayes et al. may have created qualitatively different tasks, one involving relatively short-term, the other long-term, storage. Recognition from short-term memory may, for example, be more subject to retroactive interference than recognition from long-term memory. 2) Providing subjects with the same cues at retrieval as at stimulus presentation has been shown to reinforce recall, particularly when both cues are strong, i.e., promote "high level" encoding. This may have had the effect of improving performance on the "low level" and particularly on the "high level" conditions in relation to free study, where no cues were provided. This also might have induced ceiling effects for both groups which may obscure differences between them. 3) The free study condition was presented first to all subjects. It is generally accepted that

heightened sensitivity to PI is a major factor underlying the severe amnesia of AK patients (Warrington & Weiskrantz, 1970, 1973; Cermak & Butters, 1972; Cermak, Butters & Moreines, 1974; Meudel et al., 1978) and failure to balance order of presentation of conditions may have had more of a deleterious effect on the AKs' ability to recognize target faces on the "high" and "low level" conditions relative to free study than was the case for controls.

Numerous studies have argued that the cognitive deficits associated with chronic alcoholism, especially the visuoperceptual deficits, are related to right hemisphere involvement. This proposal received support from the study by Dricker and her colleagues (1978) in which AKs performed like right hemisphere patients on the Carey and Diamond faces. These findings suggest that the perceptual defects manifested by AKs and the perceptual defects manifested by RHs are separable. Unlike AKs, RHs' memory for faces does not improve with "high level" encoding. Instructions to carry out likeability judgments did not affect their recognition test performance. The two groups differ only in the "high level" condition, the AKs recognizing more faces than the RHs. Carey (1978) has proposed that the brain structures subserving configurational analyses of facial stimuli are located in the posterior portion of the right hemisphere. Although the exact location of such structures within the post-Rolandic region of that hemisphere has not been specified, RHs may fail as a group to benefit from "high level" instructions because they lack the neuroanatomical substratum for effective, i.e., configurational processing. The fact that only the AKs perform comparably to NCs following "high level" instructions suggests that their failures to carry out effective analyses of faces under spon-

taneous conditions cannot be attributed, at least primarily, to right hemisphere compromise. Even if AKs show evidence on neuropsychological testing of greater right than left hemisphere dysfunction, an issue which remains unresolved (Parsons, 1975; Wilkinson & Carlen, in press), it cannot account for their problems in perceptual encoding of faces. Whatever right hemisphere structures may be implicated in "configurational" processing of faces, they are at least relatively intact in the AKs and may be engaged with appropriate encoding instructions. AKs' failures in face recognition may reflect a general inability to formulate effective cognitive strategies for problem solving while RHs' failures may reflect a lack of perceptual skills to analyze faces. These findings suggest important differences between the perceptual problems of AKs and those of RHs.

Previous studies have revealed qualitative differences between the performances of AKs and HDs on a number of tasks (Meudell et al., 1978; Butters, Tarlow, Cermak & Sax, 1976; Albert, Butters & Brandt, in press). Results of the present study provide further evidence that different deficits underly the memory disorders of these two groups. HDs were similar to AKs (and RHs) in their overall level of performance. Furthermore, like RHs, but unlike AKs, their ability to recognize faces was not influenced by differences in encoding conditions. HD subjects' failures to respond to manipulations in test conditions are comparable to previous findings on tests of both short- and long-term memory. As noted above, various experimental manipulations of the Peterson and Peterson task, e.g., increasing rehearsal time between stimulus presentation and onset of distractor activity, have been shown to help AKs but not HDs maintain, over relatively long delay intervals, information

they abstract from verbal stimuli (Butters, Tarlow, Cermak & Sax, 1976). Weingartner et al. (1979) showed that HDs are able to carry out semantic encoding tasks, but do not benefit at recall from these analyses. Taken together, these findings suggest that whatever information HDs are able initially to extract from verbal stimuli is not consolidated, cannot be maintained in storage, and/or cannot be retrieved.

It is not known, in the present study, whether the likeability encoding instructions actually induced configurational processing in the HDs. However, no evidence suggests that they were carrying out the task any differently than the other groups since measures taken at stimulus presentation, i.e., likeability ratings, size-of-nose ratings and encoding times, did not differ amongst groups. Although the performance of HDs is indistinguishable from that of RHs in this study, it would be premature to suggest that similar deficits underly impaired recognition of faces in the two groups. It should also be pointed out that while HD patients do have visuo-perceptual defects (Fedio et al., 1979), it is not known to what degree other aspects of their dementia may be contributing to their problems in facial recognition.

An interesting finding of the present study is that, required to make likeability judgments at stimulus presentation, there was no significant difference in the number of faces recognized by the AKs and the NCs. To my knowledge, AKs' performance has not been shown on any one condition of any other test of new learning to come up to the level of controls. (There is one instance in which the level of AKs performance was, however, brought down to the level of controls; see below). This finding may represent an important distinction between encoding characteristics of words and of faces. Kinsbourne and Wood (1975) in

accounting for the amnesic syndrome have emphasized that AKs can retrieve items of information but not the context in which they were presented. In relation to my findings, it seems plausible that words presented for subsequent recall/recognition are much more vulnerable to contextual confusion than faces. Words are always presented against a background of the subject's semantic associational network so that his own store of associations serves as a potential source of contextual confusion with list words. Evidence for this is, in fact, provided by Mattis et al. (1978). They required subjects to recall 20 list words over 12 trials, using a selective reminding paradigm, and inserted yes-no recognition probes after trials four, eight and twelve. There were four lists with the following compositions: 1) real English words from one category; 2) real English words from different categories; 3) nonsense hexagrams, each made up of two CVCs; and 4) Persian words, which were extremely difficult to associate to English words. They found that AKs' ability to distinguish targets from nontargets decreased with increments in the intrinsic semantic organization of the lists. It appeared that items with very low association value gave no advantage to the controls. AKs, as a matter of fact, did slightly but not significantly better on the Persian than on the categorized English words. For the AKs, the authors suggested that repeated exposure to real words may have continued to "trigger" associations to those words in their semantic associational networks to the point where the trace strength of the target words and their nontarget distractors became indistinguishable. It should be noted that this finding is not inconsistent with the limited encoding hypothesis because it appears that

AKs do not encode words to a level which would support such distinctions (Cermak, Butters & Moreines, 1974).

For faces, there is probably nothing comparable to the "semantic associational network" for words. While faces can be encoded on a feature by feature basis (probably involving verbal mediation; e.g., "big eyes," "arched eyebrows"), the fact that many faces share particular features would make it very difficult to remember large numbers of them on this basis, which appears to be the case. However, when faces are more effectively processed, presumably as configurations, which probably involves a largely nonverbal form of mediation, although such processing apparently can be induced by verbal instructions, each face's representation in memory may retain its uniqueness. The probability that faces are encoded as unique entities and not in association with other faces is supported by Bower and Karlin's (1974) finding that normals' ability to recognize faces is not facilitated by presenting them for recognition alongside faces with which they had been paired at input.

If faces are encoded in this manner as unique entities, this may be the basis for humans' prodigious capacity to remember hundreds of faces over many years with apparent ease (Bahrick et al., 1975). It is also noteworthy that faces appear to be learned more easily than other classes of complex visual stimuli (Yin, 1969). Although familiar faces may be confused with other familiar faces in terms of when and where they were learned, if each face's representation in memory is unique, it would be unlikely that a new face would be confused with an old face. It may be that when "high level," presumably configurational analysis was induced in Korsakoff subjects by requiring them to make likeability judgments, that the face was "registered" so to

speak, and once "registered" was neither lost from memory nor was it any more likely than would be the case for normals that any new face would be confused with it.

In conclusion, it was found that AK subjects' recognition of unfamiliar faces was significantly improved, in fact was brought up to the level of normal controls', by the requirement to make likeability judgments about faces at stimulus presentation. Strong support was provided for the limited encoding hypothesis by demonstration of: 1) a direct relationship between AK subjects' limited encoding of facial stimuli under spontaneous conditions and their poor subsequent recognition of these faces; and 2) a differential improvement for AKs' compared to normal controls' recognition test performance between the free study and likeability conditions. Furthermore, since AKs but not RHs recognized significantly more faces following "high level" encoding, it was inferred that different deficits may underly these two groups previously demonstrated problems in the processing of facial stimuli. This finding was not consistent with the "right hemisphere hypothesis" as it has been applied to chronic alcoholics; that is, in light of the present findings, it appears unlikely that AKs' visuoperceptual problems can be attributed, at least primarily, to right hemisphere dysfunction. Rather, general problems in the formulation of cognitive strategies for problem-solving, deficits associated with frontal system dysfunction, were implied. Differences found between the performances of AKs and HDs in this study are similar to those shown in other recent studies; i.e., HDs, unlike AKs, failed to respond differentially to manipulations in encoding conditions. This provides evidence that, in the visuoperceptual as in the verbal

domain, differences exist between the amnesias of these two groups. It was pointed out that absence of differences between the performances of HDs and RHs on this test do not imply similar underlying deficits in these two groups. In addition, it is noteworthy that intergroup differences on the recognition test appeared not to be attributable to differences in how the encoding tasks were carried out since no differences were found in the way the four subject groups either rated the faces or in the time they took to carry out their ratings.

APPENDIX

Theories of Amnesia

In the last decade, a number of hypotheses have been advanced by different groups of researchers to account for the amnesic syndrome. Milner (1968) has been the chief proponent of a consolidation theory of amnesia. The concept of consolidation goes back to the work of Hebb who developed one of the first modern neurological models of memory. Hebb (1949) postulated two ways in which information could be retained in the brain: 1) through continual reverberation of neural circuitry, i.e., by rehearsal; and 2) via some structural change in neural patterning. Interruption of rehearsal could, in the first instance, lead to loss of information. The second process, i.e., structural growth, was presumed to require time to develop and to depend, in part, on continual rehearsal up until the point when the transformation could be completed. The term "consolidation" has been used to refer to this proposed process of transformation. Milner's consolidation theory of amnesia is based largely on her work with H.M., who became severely amnesic following bilateral temporal lobectomy for relief of intractable seizures. H.M.'s ability to hold onto information within his immediate span so long as he could actively rehearse it seemed to fit Hebb's notion of "reverberating traces." Furthermore, H.M.'s inability to retain even simple information once his attention was diverted in the face of interfering activity suggested that he was unable to transform, i.e., to consolidate, the trace.

Evidence favoring the consolidation theory of amnesia includes the following observations. 1) Amnesics are capable of retaining information so long as they can rehearse, but forgetting occurs as soon as rehearsal is interrupted. 2) Despite severe anterograde amnesia, i.e., the inability to learn new information, they are capable of recalling early memories up until, or almost up until, the time of the onset of their memory disorder (i.e., retrograde memories). 3) Individuals undergoing ECT show an amnesia for information learned in the period just prior to treatment; this period of time for which memories are wiped out just prior to ECT, although it has proved to be quite variable in different studies, has been used as a criterion for how long it takes for consolidation to occur. The consolidation theory has proved to be more of a descriptive than a heuristic framework for the analysis of amnesia. It explains that amnesics lose information when they stop rehearsing. However, it does not say anything about why amnesics are so prone to forgetting after short periods of interruption. It also fails to account for why partial information and other forms of cueing may aid amnesics' recall (Baddeley, 1975). That is, if, as consolidation theory suggests, information has not been consolidated, it is not clear why it can be elicited with appropriate cueing.

Warrington and Weiskrantz (1974) rejected Milner's hypothesis since their amnesic group (of mixed etiology) appeared capable of encoding and storing information. They have argued that amnesics have difficulty remembering not because they cannot learn new material but because they are unable to retrieve it. This retrieval difficulty is believed to occur because of excessive interference from, or inability

to inhibit, competing material in memory storage. Warrington and Weiskrantz have provided two major sources of support for their notion that amnesics suffer unduly from such proactive interference. 1) When amnesics were successively presented with two lists of to-be-remembered words, they tended, in trying to recall words from the second list, to produce words from the first (Baddeley & Warrington, 1970). Such prior-list intrusions occurred also on paired associate learning when the same stimulus words on successively presented lists were paired with different responses (Winocur & Weiskrantz, 1976). 2) Material appears to be differentially retrievable depending on how a task is structured (Warrington & Weiskrantz, 1970). Partial information, either in the form of fragmented words or initial letters, provided at retrieval significantly improve amnesics' ability to recall words, presumably by narrowing down the number of items that might interfere with their attempts to retrieve target words.

The retrieval-interference theory has been challenged on several grounds. Piercy (1977) reexamined Baddeley and Warrington's (1970) data and found that when overall number of errors rather than total number of responses were examined, normal controls actually made proportionately more prior list intrusion errors than amnesic subjects. Also, Woods and Piercy (1974) found that normals responded to partial information cues at retrieval in a manner similar to amnesics when memory traces were weakened by imposing a one week, as compared to a one minute, delay between stimulus presentation and testing. These findings undermined the notion that Warrington and Weiskrantz had uncovered a processing deficit that was unique to amnesic subjects. Another difficulty for the retrieval-interference theory has been

pointed out by Butters and Cermak (1980). They state that "Any increased sensitivity in interference, both proactive and retroactive, should be as detrimental for the retrieval of events learned 20 years ago as for events acquired five years ago." The retrieval-interference hypothesis fails to account for findings that alcoholic Korsakoff subjects show a temporal gradient on tests of retrograde amnesia with differential sparing of their most remote memories (Albert et al., 1979).

Huppert and Piercy (1976) also found that their amnesic subjects, in this case alcoholic Korsakoffs, could learn new information (representational pictures). They were capable of distinguishing "familiar," i.e., previously inspected, from "unfamiliar" stimuli; however, they could not distinguish one "familiar" set from another despite the fact that each set had been presented on a separate day. Huppert and Piercy suggested that these subjects' primary defect was an inability to encode and store the context in which items of information had been presented rather than an inability to remember the items themselves.

Mattis et al. (1978) manipulated the degree of intrinsic semantic relatedness of several word lists. When post-Herpes encephalitis subjects failed, on recognition testing, to respond differentially to these manipulations, the authors suggested that for these subjects with presumed hippocampal lesions, as for Milner's subjects with hippocampal removals, consolidation failures might be a major factor. The ability of alcoholic Korsakoff subjects to distinguish targets from non-targets was, however, inversely related to increments in the intrinsic semantic organization of the lists. The authors concluded that, for these subjects, increased vulnerability to interference relates specifically to a disturbance in the relationship between items in their semantic asso-

ciational network and/or an inability to construct efficient programs to access particular items from that network. Mattis et al. thus extended Huppert and Piercy's (1976) notion of "familiarity" to include semantic relatedness as well as context.

Kinsbourne and Wood (1975), in accounting for the amnesic syndrome, have emphasized the inability of amnesic subjects to retrieve the context in which items of information have been presented. They have analyzed the amnesic deficit with reference to Tulving's (1972) classification of memory into episodic and semantic components. Episodic memory refers to memory for specific incidents in an individual's personal experience, to unique rather than repeated events. Episodic memories presumably are remembered in relation to the particular context in which they occurred. Semantic memory refers to an individual's fund of "knowledge," i.e., overlearned rules, skills and associations which have come to be independent of the context in which they were acquired. Kinsbourne and Wood have proposed that amnesics show a selective impairment of episodic memory; that is, they are unable to retrieve information about specific events from any period of their lives. Vocabulary, syntax, awareness of social amenities, etc., i.e., semantic memories, presumably are relatively spared in amnesia. Kinsbourne and Wood (1975) also cite examples of amnesics being able to retrieve newly acquired information but not being able to retrieve the context in which it was learned. Winocur and Kinsbourne (1978) reported two experiments in which amnesic subjects' tendency to confuse two word lists (demonstrated previously by Baddeley and Warrington, 1970) could be significantly reduced by increasing the discriminability of the contexts in which each of the two sets of words were presented.

Gaffan (1972) has proposed a familiarity hypothesis of amnesia. Extrapolating primarily from a series of animal experiments, he has suggested that the human amnesic is unable to judge an item's familiarity whether the items to be recognized have been retrieved spontaneously by the subject or presented for recognition by the examiner. This hypothesis conforms to certain clinical observations; i.e., amnesic subjects behave at times as though they remember a particular event but disclaim any prior knowledge of it.

All of the above hypotheses, as well as the limited encoding hypothesis of Butters and Cermak (1974), to be discussed below, have been supported by some findings and seriously challenged by others. Continuing work suggests, however, that none of these theories can fully encompass amnesic performance and that each may, in fact, account for, or shed light on, only one aspect of a set of very complex processes. Oscar-Berman (1980) has recently pointed out that deficits in any of the many psychological processes which go into normal memory functioning, for example, to name just a few, attention, perception, motivation, almost certainly can have deleterious effects on memory. It is noteworthy, in relation to the above, that disorders of memory arise from many different etiologies. The fact that workers in the area have tended to come up with single factor hypotheses to explain amnesia and that, until recently, the organic amnesias have tended to be treated as a unitary disorder, probably, oddly enough, attests to the multiple and complex processes involved. Depending on such factors as the sensitivity of the test instrument to various aspects of performance and whether or not the subject's behavior on the test is qualitatively analyzed to determine the underlying deficits which may be

contributing to impaired performance, the behaviors of patients with different types of amnesic disorders on a particular memory test may be indistinguishable; for example, all may simply appear to be unable to retain new information. With these thoughts in mind, the present study is recognized as having developed out of a particular line of research, that of Butters, Cermak and their colleagues, that has focused on a particular segment of the processing continuum, i.e., the initial encoding operations, that are performed on incoming stimuli in a particular group of amnesic subjects, i.e., individuals suffering from the alcoholic Korsakoff syndrome.

Information Processing Deficits in Alcoholic Korsakoffs

Alcoholic Korsakoffs, as noted above, are renowned for their pronounced anterograde amnesia in the face of relatively well preserved general intellectual functioning. Although they have normal IQs (Talland, 1965), a number of recent studies have also demonstrated subtle information processing deficits. These deficits emerge when tasks are made sufficiently complex, either by increasing the information load or by requiring a higher, i.e., more abstract level of analysis. The exact nature of the relationship between Korsakoffs' impaired processing and their memory problems, i.e., whether it is direct or coincidental, remains open to further exploration.

Verbal information processing deficits

Two groups of researchers (cited above), Mattis et al. (1978) and Butters, Cermak and their associates, investigating alcoholic Korsakoffs' severely impaired verbal memory, have pointed to faulty semantic encoding as a major factor contributing to their increased sensitivity to pro-

active interference.

Mattis et al. presented subjects with four 20-word lists, varied in degree of intrinsic semantic organization. Included were lists composed as follows: 1) categorized-- all real words from the same semantic category; 2) mixed-- each word from a different semantic category; 3) nonsense hexagrams-- each item made up of two CVCs; and 4) Persian words-- extremely difficult to associate to English language words. A selective reminding task was used over twelve recall trials with recognition probes inserted after trials 4, 8 and 12. These investigators found that Korsakoffs could process novel material, i.e., Persian words and nonsense hexagrams, in a manner almost comparable to that of normal controls. Their performance was markedly impaired, however, compared to controls for recognizing targets from the real English word lists, particularly from the more organized, i.e., the categorized list. It appeared that repeated exposure to real words continued to "trigger" associations to those words in the Korsakoff subject's semantic associational network to the point where the trace strength of the target words and their non-target associates became indistinguishable. As noted above, these investigators concluded that their results might reflect a disturbance in their Korsakoff subjects' semantic associational network, an inability to construct efficient programs to access items in that network, or both.

Butters, Cermak and their colleagues have suggested that the failure of Korsakoffs to utilize relevant dimensions of verbal stimuli contributes to their retrieval difficulties. The first clue that faulty information processing at input might contribute to Korsakoffs' memory impairment came when Butters and Cermak (1972) presented Korsakoffs and

normal control subjects with word lists and then required either free recall or cued for recall with categories of which these words were exemplars. Category cues tended to help normals but to interfere with Korsakoffs' retrieval. It appeared that Korsakoff subjects had failed, initially, to analyze the words semantically so that cueing by category ultimately had a disorganizing effect on their attempts at retrieval.

Subsequent studies utilizing verbal stimuli were carried out by this group of investigators and provided further support for the notion that Korsakoffs were not adequately encoding semantic features of words. One study compared the efficacy of category versus rhyme cues at recall (Cermak, Butters & Gerein, 1973a). Another used a false recognition paradigm in which subjects were required to discriminate word repetitions from amongst a distractor set made up of homonyms, associates and synonyms (Cermak, Butters & Gerein, 1973b). A third study required subjects to listen to a series of single words and, while doing so, to detect (in separate conditions): 1) repetitions; 2) rhymes; and 3) words belonging to the same semantic category (Cermak & Moreines, 1976). Results from these studies consistently revealed a tendency on the part of Korsakoffs to favor acoustic as opposed to semantic analyses of individual words.

Other studies have investigated factors which might contribute to Korsakoffs' faulty semantic processing. Cermak, Butters and Moreines (1974), using Posner's reaction time technique, assessed Korsakoffs' ability to make physical and name matches between letters of the alphabet. Posner and Mitchell (1970) had shown that normals can more rapidly detect physical identity (e.g., AA) than physical dissimilarity (e.g., Aa or AB) and, saying that two letters have the same name (e.g., Aa)

required a further increment in encoding time. Cermak et al. (1974) found that Korsakoffs were significantly slow at these tasks compared to alcoholic controls and suggested that, even at this rudimentary level of verbal encoding, impaired performance might contribute to Korsakoffs' semantic encoding deficit.

Cermak, Reale and Baker (1978) compared Korsakoffs' and alcoholic controls' rates of retrieval from semantic memory. Korsakoffs' ability to remember newly experienced, i.e., "episodic" events has, in numerous studies, been shown to be defective. However, because they appear to use language correctly, it had been assumed that their memory for general principles, associations and rules of language (i.e., their "semantic memory") was intact. The first three in this series of five experiments investigated: 1) verbal reaction time; 2) reading-decision time; and 3) semantic search time, i.e., the time required to produce an exemplar given the category name and the first letter of the target noun (e.g., fruit - A). With the increasing conceptual nature of these three tasks, a progressive although non-significant deterioration in performance emerged for the Korsakoff compared to the control subjects. The next experiment in this series was more conceptually demanding. Here, subjects were required to retrieve an exemplar given the category name and, now, an adjective defining the target (e.g., fruit - red). Korsakoffs' performance now showed a significant decrement compared to controls. The findings on experiments 3 and 4 appeared to Cermak et al. to fit in well with Collins and Loftus' (1975) division of semantic memory into "conceptual" and "lexical" stores, as well as with Butters' and Cermak's various findings that Korsakoffs favor acoustic over semantic processing of words. "Conceptual" memory is defined as being

organized on the basis of semantic similarities of words, and the "lexicon" as being organized according to phonemic and orthographic similarity. This demonstration of Korsakoffs' slowed reaction time in searching their "conceptual" stores might help to explain their apparently low level of processing and subsequent poor performance on a number of tasks requiring comparison of a given item with items which must be accessed from "conceptual" semantic memory.

Cermak, Butters and Moreines (1974), in the study described below, again demonstrated a deficit in Korsakoffs' ability to carry out semantic analyses and also made a first direct approach to the problem of whether such impoverished analysis bears a relationship to their abnormal vulnerability to proactive interference. This study borrowed Wickens' (1970) "release from proactive inhibition" paradigm. Using a modification of the Brown-Peterson distractor technique, Wickens demonstrated that normal subjects' memory performance progressively deteriorated if they were repeatedly presented with material from one class of information. However, if after several trials of such build-up of proactive inhibition he switched to another class of information, their performance showed a rebound. According to Wickens (1970), subjects show this "release" from the build-up of proactive inhibition only if they encode stimuli at the level at which the shift occurs. Cermak, Butters and Moreines (1974), using this technique, found that Korsakoffs "released" with shifts between digits and letters. However, unlike normals, they showed no "release" between words from different taxonomic categories. They appeared then not to be analyzing words at a level sufficient to make them semantically distinguishable from one another. This finding was interpreted as establishing a more direct

link between Korsakoffs' impaired semantic encoding and their increased vulnerability to proactive inhibition.

Nonverbal information processing deficits

Several studies, outlined above, have demonstrated Korsakoff's impaired encoding of significant, i.e., semantic attributes of words as well as possible related deficits in the processing of verbal stimuli at more elementary stages. The following studies suggest that faulty processing at initial input, including restriction in the number of relevant dimensions attended to, might also contribute to poor memory performance in nonverbal modalities.

Oscar-Berman has investigated Korsakoffs' extra-amnestic cognitive capabilities. Two early studies focussed on initial stages of information-processing. In one, Oscar-Berman and Gade (unpublished, described in Oscar-Berman, 1978) measured skin conductance of five subject groups in response to intermittent, unpredictable (every 30 to 90 seconds) loud buzzer sounds. Korsakoff subjects showed decreased sensitivity to incoming stimulation. They and the Huntington patients had significantly reduced orienting responses and slower rates of habituation than anterior aphasics, Parkinson patients and normal controls. In the second study, Oscar-Berman (1973) first established individual thresholds for tachistoscopic presentation of words as well as for nonsense figures (Vanderplas & Garvin, 1959). Using these thresholds, critical ISIs, i.e., the length of interstimulus interval required to escape the backward masking effect, were then determined. Korsakoffs were significantly impaired on both these measures compared to normals (long-term alcoholics here, as on a number of other tasks, performed at an intermediate level). Oscar-Berman (1978) interpreted these re-

sults as indicating, in information processing terms, that Korsakoffs' iconic memory was deficient.

Oscar-Berman (1973) found, on a two-choice visual discrimination task where stimuli differed along four dimensions (color, size, shape and position) that Korsakoffs tended to focus on only one, at most two of those dimensions (usually color first, then size) and to perseverate responses on their preferred dimensions following negative reinforcement. This "lose-stay" behavior was manifested even when information necessary to make a decision was constantly available. Struck by these as well as other findings (e.g., Glosser et al., 1977, see below) which appeared to reflect a restriction in the number of relevant stimulus dimensions Korsakoffs can process at one time, Oscar-Berman and Samuels (1977) undertook a further study. For each problem, subjects were first asked to guess which of two stimuli, differing along dimensions of 1) color, 2) form, 3) size, and 4) position, was correct and were negatively or positively reinforced on the basis of a predetermined schedule. Four transfer trials, each utilizing only one stimulus dimension, were then presented, one at a time, in order to assess which dimension(s) had been utilized in the training trial. The entire procedure was carried out under two conditions: 1) standard, memory; and 2) memory aid, where on each problem the training stimulus was left exposed during all transfer trials with an arrow pointing to the correct choice. All subjects improved significantly with memory aids; however, here, as on the standard condition, both Korsakoffs and aphasics were significantly impaired in comparison to controls. Moreover, Korsakoffs were the only group (in either condition) to perform better on their preferred dimensions (as determined by a pretest). Korsakoffs were also unique in

making significantly more errors on the last two as compared to the first two transfer trials, not only on the standard condition, but with memory aids, i.e., where all information necessary for a correct solution was constantly available. Oscar-Berman and Samuels (1977) interpreted this latter finding as representing an instance of increased sensitivity to proactive interference and as possible relating to what Talland has called Korsakoffs' "premature closure of activation," i.e., their tendency to respond prematurely, prior to receiving and/or retrieving all of the relevant information necessary for problem solution.

Glosser, Butters and Samuels (1976) employed several versions of a dichotic listening task to determine whether Korsakoffs' tendency to restrict their analyses to one, or at most two, relevant stimulus dimensions could be generalized to the auditory modality. If this were the case, Korsakoffs' verbal encoding deficits might be considered to be one aspect of a more general information processing deficit. For each of six different conditions, subjects heard series of single digits presented simultaneously to each ear. On two simpler tasks, conditions 1 and 2, subjects were required to respond when a target digit occurred 1) in a designated ear, and 2) in either ear. On conditions 3 and 4, subjects were told to respond to the simultaneous presentation of a pair of target digits, occurring 1) in either ear order, and 2) in a specified ear order. Conditions 5 and 6 replicated conditions 3 and 4, but with increased intertrial intervals. Korsakoffs were significantly impaired in comparison to controls only on conditions 3 and 4. Qualitative analysis of error types revealed that, with more complex decision processes, Korsakoffs failed to analyze all incoming information. This was demonstrated by their tendency to produce false positives when one

of two target digits appeared or when both digits were present but ear order was reversed, rather than responding incorrectly to a pair of non-critical digits. Failure to obtain significant differences between Korsakoffs and controls with longer ISIs only suggests that Korsakoffs' information-processing limitations are time dependent since, under these conditions, a ceiling effect occurred for the normal control group.

In sum, the above study provides evidence in the auditory modality, similar to that demonstrated by Oscar-Berman and Samuels (1977) in the visual modality, that alcoholic Korsakoffs are restricted in their ability to analyze multiple relevant stimulus dimensions. Considering their tendency to focus on acoustic analysis of incoming verbal material, the above findings suggest that alcoholic Korsakoffs may have a more general information processing deficit.

Glosser, Butters and Kaplan (1977) investigated that nature of the deficits underlying alcoholic Korsakoff and right hemisphere patients' impaired performance on the Digit Symbol Substitution Task (DSST) of the WAIS. On this subtest, known to be particularly sensitive to brain dysfunction, both psychomotor and learning deficits had previously been shown to contribute to impaired performance, the latter possibly reflecting both poor visuo-spatial processing and impaired memory. In order to differentiate between these factors, several modifications of the Digit-Symbol subtest, varying the visual-spatial processing demands of the task, as well as a verbal paired associate test and the Children's Embedded Figures Test (CEFT) were administered. Results indicated that a psychomotor component contributed to DSST performance of both control (normals and long-term alcoholics) and brain-damaged (Korsakoffs and right hemisphere patients) subjects. For the Korsakoff and right hemi-

sphere patients, however, an additional visual processing component was reflected in a high correlation between their performance on the DSST (in its various versions) and on the CEFT. No significant correlation was, however, found between DSST performance and results on the paired associate learning test. Glosser et al. (1977), questioned whether such impairment in visuo-spatial processing might not reflect different underlying deficits, e.g., in visual scanning, contour processing, or visual-spatial organization, in the two brain-damaged groups. They proposed that Korsakoffs' nonverbal visual memory deficit "may have its origins in the patients' deficient analysis of the stimuli. If the visual engram is degraded by incomplete or inappropriate visual analysis then such an engram may decay more rapidly, regardless of interference conditions, than one that is based on a complete encoding of stimulus features" (p. 65). Performance of long-term alcoholics on visuoperceptual processing time measures fell intermediate to those of Korsakoffs and normal controls.

Kapur and Butters (1977) compared the performances of Korsakoffs, alcoholics and normal control subjects on five tasks: the Digit-Symbol subtest of the WAIS, visual scanning, spatial location learning, embedded figures, and a symbol-digit paired-associate task. They also correlated Digit Symbol scores with results on each of the four other tests. Their stated aim was to assess the contributions of learning, visual scanning and contour analysis to Korsakoffs' well-known deficit performance on Digit-Symbol. Results essentially confirmed Glosser et al's. (1977) findings that both visuoperceptive and learning deficits are contributing factors. Long-term alcoholics performed at a level intermediate to Korsakoffs and controls on tasks involving new learning. Like Korsakoffs,

they were severely impaired on the embedded figures task and showed a significant correlation between results on that task and on Digit Symbol. Visual scanning was not impaired compared to normals in either group.

Cermak, Reale and DeLuca (1977) assessed alcoholic Korsakoffs' and alcoholic controls' ability to retain verbal and nonverbal material in the face, respectively, of verbal and nonverbal distraction and following unfilled delay intervals of 5, 10, 20 and 40 seconds. To-be-remembered stimuli were presented for two seconds, followed by a filled or unfilled delay interval. A second stimulus was then presented and subjects had to indicate whether it was the same as or different from the initial stimulus. Verbal targets consisted of consonant trigrams; nonverbal stimuli were computer-generated black shapes (Vanderplas & Garvin, 1959) which did not readily suggest meaningful objects. The verbal interference task was a "category scan" test in which subjects were required to classify series of nouns into one of four taxonomic categories. Nonverbal interference involved a series of trials where subjects were required to match one of 25 "snowflake" figures with a target "snowflake." Results indicated that, with unfilled delays, Korsakoffs were able to retain verbal material comparably to controls across all intervals tested. However, following verbal distraction, Korsakoffs' performance fell significantly below that of controls at the three longer delay intervals. For nonverbal stimuli, unlike normals, who were able to retain material across all delay intervals in both filled and unfilled conditions, Korsakoffs' performance was immediately and disastrously disrupted. Here, whether delays were unfilled, or filled with similar distractor activity, subjects showed a progressive deterioration over 40 seconds. They were significantly worse than

alcoholic controls at the 20 and 40 second intervals.

It appeared that while Korsakoffs were able to utilize some kind of a rehearsal mechanism, perhaps low level phonemic analysis, which allowed them to maintain verbal material across a 40 second unfilled delay, no comparable rehearsal strategy was available [or spontaneously used] for recirculating non-verbal material, even without interference.

A second experiment was run, but using only the nonverbal targets. Now, however, verbal labels were provided to see if they would aid Korsakoffs' retention of nonverbal material. Two different types of distractors, verbal and nonverbal, in addition to an unfilled delay period, were used to determine whether the verbal labels were being utilized. Korsakoffs' performance, while still overall significantly below that of controls, was much improved via the provision of verbal labels on both the unfilled and nonverbal distractor conditions.

The interpretation that Korsakoffs were able to utilize verbal labels to help them retain nonverbal material is supported by the following: 1) use of verbal mediation represents the only difference between experiments 1 and 2; and 2) verbal distraction, in experiment 2, proved to be most disruptive. Normals did not show improved recognition with provision of verbal labels, perhaps, as suggested by DeLuca et al., because they tend spontaneously to use verbal encoding and/or because their performance was near ceiling on both experiments.

DeLuca et al. (1977) argued that Korsakoffs are impaired in their retention of both verbal and non-verbal materials due to their reliance on inadequate encoding strategies. With regard to nonverbal stimuli, they concluded that Korsakoffs either possess no mechanism for rehearsal, or whatever mechanism they use immediately breaks down in the face of

nonverbal distraction. They suggest that Korsakoffs have no means of recirculating nonverbal material unless verbal labels are supplied.

Vanderplas and Garvin (1959) figures were the only nonverbal stimuli used in the DeLuca et al. (1977) study. It is difficult to compare their effects to those of verbal stimuli since the figures may be relatively much more complex. Normals may also lack a nonverbal mechanism for rehearsing these figures; a second experiment (see above) suggests, in fact, that normals spontaneously use verbal mediation to maintain this type of material. Alternatively, Korsakoffs may be able to encode nonverbal stimuli in a way which is possibly comparable to normals but fail to do so spontaneously. These considerations are important since nonverbal stimuli, i.e., faces, are used in the study proposed here. It is possible that faces are a class of stimuli different from other complex visual stimuli; for example, compared to Vanderplas and Garvin figures, they have rich internal and/or configurational details which appear to lend themselves either to feature-by-feature or to configurational analysis. While Vanderplas and Garvin figures may be encoded by, e.g., attempting to associate them to real objects, the only perceptual cues are outer contours on which right hemisphere patients and individuals whose neuropsychological profiles show similar characteristics, e.g., elderly subjects and alcoholics, including alcoholic Korsakoffs, tend not to focus.

The "Levels of Processing" Model of Memory

Both Cermak and Craik and Lockhart, in 1972, introduced a model of human memory which they believed would, better than, for example, the short term-long-term dichotomy, elucidate data coming from studies

of both normal memory and amnesia. This model, referred to as the "levels of processing" hypothesis, has since served as a framework for a number of experimental paradigms. The following description of this model will clarify why Butters and Cermak have found it to be an heuristic one for their work with Korsakoffs.

Craik and Lockhart (1972), in keeping with visual information processing theory, describe information as passing through various stages of analysis. They use the term "depth" to denote the degree of semantic or cognitive analysis, i.e., "elaboration," carried out by the subject on the stimulus material. Elaboration, or enrichment, refers to the triggering of associations, images, stories, etc. on the basis of the subject's previous experience. Information passes initially through a series of sensory stages where matching and pattern recognition occur. These are followed by "deeper" processing which involves associative and semantic stages of stimulus enrichment. Craik and Lockhart's model is a production model, where the coding characteristics and persistence of the trace are considered to be a byproduct of perceptual processing; the deeper, more elaborate the analysis, the more enduring and stronger the trace. Other determiners of depth of processing would be attention to the stimulus, compatibility with existing cognitive structures and time available for processing. The terms "Type I" and "Type II" processing are used to refer, respectively, to more superficial and deeper levels of analysis. Type I processing involves repetition of a previous analysis, a recirculating of material at a fixed level of analysis; because no further elaboration takes place even with increased study time, a more permanent memory trace would not be formed. An example of Type I processing would be simply repeating

a telephone number or a short list of words over and over again with attention focussed on accoustic features. Type II processing would involve progressive elaboration; here, a more permanent memory trace would be expected to be formed with an increase in study time. The authors point to several incidental verbal learning studies in which the nature of the orienting tasks had led to differences in subsequent retention. They also note that different types of errors will predominate at different stages of analysis, depending on the type of processing which is taking place. For example, until verbal material has reached a "deeper", semantic level of analysis, at which semantic errors would presumably predominate, accoustic interference would take the greatest toll. A number of studies with normal subjects, in both verbal and visual-spatial modalities (some to be discussed below) have tended to support this model.

Studies using verbal material, normal subjects

The following is an example of a verbal list learning study which uses a paradigm compatible with, and produces results consonant with, those predicted by the Craik and Lockhart model (1972).

Johnson and Jenkins (1971) used a paradigm borrowed from Hyde and Jenkins (1969). The latter investigators employed three different orienting tasks during presentation of a list which consisted of randomly ordered, highly associated pairs of words. Their subjects were required either to: 1) rate words for pleasantness; 2) decide whether each word contained the letter "e"; or 3) estimate the number of letters in each word. Significantly more associative clustering and recall resulted under the pleasantness-judging than under the other two conditions. Johnson and Jenkins (1971) raised the possibility that

the more "superficial" tasks might have prompted subjects to treat each word either 1) as an object, or 2) as a group of elements rather than as a whole unit. Their purpose in replicating the study was to disentangle these two possibilities. They therefore selected two orienting tasks, both of which required subjects to treat words as whole units. Their "superficial" task required subjects to write a rhyming word for each word on the list; the "deep" level task entailed writing either an appropriate modifier or noun for each item. Craik and Lockhart (1972) suggested using incidental learning paradigms, reasoning that subjects, given intentional instructions, would spontaneously elaborate the material whatever the orienting task. Johnson and Jenkins compared incidental to intentional learning for each orienting task described above. They also included a fifth, control group which was given intentional instructions but no orienting task (they simply transcribed each word as it was dictated). Following list presentation, all subjects were asked to write as many words as they would freely recall. Results indicated that both the control and the two adjective-noun groups recalled significantly more words as pairs (i.e., did more "clustering") and also recalled more categories of words than either of the two rhyming groups. There were no differences in results between intentional and incidental learning instructions.

Craik and Tulving (1975) carried out a series of ten verbal learning experiments designed to explore the levels of processing framework (Craik & Lockhart, 1972). General design of the studies was as follows. For each word in a list, subjects were asked a question and then saw the word exposed on a tachistoscope for 200 msec for a "yes" or a "no" response. Questions were designed to induce different levels of encoding.

Craik and Tulving state at the onset that perhaps the most serious issue for the levels of processing position is the need to establish some independent index of depth. They state that "... there are obvious dangers of circularity present in that any well-remembered event can too easily be labeled deeply processed." One index offered by Craik and Lockhart (1972) was that, other conditions being equal, deeper levels of processing require longer processing times. Craik and Tulving explored this notion and found that, while generally true, it did not hold under all conditions: for example, if a complex, low-level question required a longer reaction time than an easy to answer semantic question, retention was still better for the item encoded semantically. Therefore, Craik and Tulving concluded that it is the quality of the encoding task and not the amount of time required to carry it out which determines trace strength. While the ten studies yielded a number of interesting findings, only some are highlighted below:

1. Intuitively "deeper", e.g., category as opposed to rhyme, questions generally led to longer reaction times;
2. If questions were manipulated to produce longer reaction times for intuitively more superficial questions, memory performance was still better following "deeper" level questions;
3. Intentional instructions have no effect on reaction time or on the relative influence of different levels of processing, but are associated with overall better retention;
4. More complex, elaborative sentence frames produced better recall, but only for positively responded to targets. Also, the effects of complexity and response type were greatly enhanced by reprovision of sentence frames as cues (encoding specificity);

5. With extra encoding time, memory performance still reflected level of encoding question. Craik and Tulving wondered why subjects, under intentional conditions, did not show equal retention across different orienting tasks since they presumably had time to encode stimuli to a deeper level after their response had been recorded and before the onset of the next stimulus. Motivation was shown not to be a factor contributing to this finding.

An important point made in this group of studies, which supports at least a modified version of the Craik and Lockhart (1972) hypothesis, is that items are remembered not as stimuli "out there" acting on the individual; rather subjects appear to remember their own mental activities, what they did during encoding. Craik and Tulving showed that they were able to influence retention on a number of tasks not by altering the stimuli, but by manipulating only the mental activity of the encoder.

Studies using verbal material, amnesic subjects

Cermak and Reale (1978) tested the relationship between alcoholic Korsakoffs' depth of processing and their retention of words. While previous studies had demonstrated a preference by these subjects to adopt a "superficial", i.e., phonemic level of processing (e.g., Cermak, Butters & Moreines, 1974), any connection established between this tendency and their impaired retrieval was only of a correlational nature. Cermak and Reale (1978) believed that if they could show that Korsakoffs recognized significantly more words following a semantic than a phonemic orienting task, they would: 1) establish a direct relationship between Korsakoff's impaired processing and retrieval deficit; and 2) provide preliminary study in which level of orienting task was varied, Cermak

(1976) had failed to show an effect on Korsakoffs' retrieval and speculated that these patients' passive approach to a yes-no recognition task may have adversely influenced results. Therefore, in the study described here, a forced-choice recognition test was employed. Cermak and Reale's (1978) study consisted of three experiments, all modifications of a Craik and Tulving (1975) paradigm. Subjects were alcoholic Korsakoffs and long-term alcoholic controls. In each experiment, they were presented with lists of words, along with orienting tasks designed to elicit either semantic, phonemic or physical encoding. For all three experiments, the form of rhyme ("Does this rhyme with ____?") and case ("Is this in upper/lower case letters?") questions remained constant. However, questions designed to elicit semantic analysis were changed as described below. In experiment I, for guided semantic encoding, subjects were asked if each word fit in a given sentence. While control subjects showed the expected effect, failure to obtain such results with Korsakoffs suggested to the investigators that a less open-ended type of question was needed to boost Korsakoffs' storage and subsequent retrieval. Therefore, in experiment II, two different, more structured kinds of questions were designed in order more actively to stimulate semantic processing of words: 1) category questions, such as, "Is this an animal?" and 2) specific marker questions, e.g., "Does this animal have stripes?" Again, these questions failed to elicit improved recognition only in the Korsakoff subjects. Since controls had responded as expected in the first two experiments, that is, semantic orienting tasks had resulted in significantly better recognition than phonemic tasks, which had in turn a significantly better influence on performance than case questions, experiment III was conducted with only Korsakoffs as

subjects. For this experiment, the list was divided into five equal segments in the belief that Korsakoff subjects might have been overwhelmed by the length of the full list. Each of the three orienting tasks, sentence, rhyme and case, was used with equal frequency within each 12-word segment and subjects were tested immediately following presentation of each segment. A yes-no format was reverted to because of the brevity of each list. Combined results indicated that the three different orienting tasks finally had the same relative effect on Korsakoffs as had been demonstrated with control subjects. Korsakoffs' speed of analysis was equivalent to that of controls, including the fact that analysis was slightly slower with each increment in level of encoding, except in experiment 2. Here Korsakoffs analyzed items significantly more slowly than controls, possibly because of the relatively difficult nature of the semantic task. Cermak and Reale note that this interpretation would fit in with findings of Cermak, Reale and Baker (1978) that Korsakoffs are slower than normals at searching their conceptual semantic memory. Cermak and Reale (1978) interpreted their results as indicating that, at least under some conditions, Korsakoffs' recognition memory for verbal material can be affected by the level to which they process that information at input and that these patients' "anterograde amnesia might stem, in part, from a tendency not to perform semantic analyses of to-be-retained verbal information."

The above study is important to the one proposed here because it showed that induced level of analysis at input could affect Korsakoffs' performance. The question remained, however, whether depth of processing might also be used to influence Korsakoffs' performance on a

nonverbal task.

Studies using nonverbal material, normal subjects

While the levels of processing hypothesis has served primarily as a framework for studies of verbal memory with both normal and amnesic subject groups, several studies have now attempted to extend this model to encompass nonverbal learning. All of these studies have chosen to use photographs of human faces as stimuli.

Bower and Karlin (1974) were the first researchers to attempt to generalize the effects of levels of processing to the nonverbal domain. Faces were used as stimuli to avoid ceiling effects because, as they stated, "... recognition for common pictures is notoriously high." Orienting tasks, selected a priori to represent different levels of processing, included three different kinds of judgments: 1) male or female; 2) more or less honest; and 3) more or less likeable. In a first, incidental learning experiment, 72 yearbook pictures, selected for their uniformity, i.e., lack of salient, unusual features, were presented, one third with each of the three orienting tasks, followed immediately by a yes-no recognition test made up of the study set items with an equal number of new photos mixed in. (Confidence ratings were made with each response.) Findings indicated that subjects were better able to recognize faces for which they had made likeability and honesty judgments than those for which sexual identity had been indicated.

Because subjects took longer to make character than gender judgments in experiment 1, Bower and Karlin questioned whether results might not have reflected time spent judging pictures rather than type of processing per se. Therefore, in experiment 2, subjects were told at the outset that they would be given a memory test afterwards and

were asked to take the full time to study each photograph after completing the initial judgment. As with Craik and Tulving's (1975) findings for a verbal learning task, neither time spent studying stimuli nor intention to learn appeared to influence results. Bower and Karlin concluded that "depth of processing" was the critical variable in subjects' recognition performance.

Bower and Karlin (1974) modeled a third experiment in this series after verbal learning studies carried out by Tulving and Thomson (1971) and Thomson (1972). In those studies the concept of encoding specificity was explored by asking subjects to recognize words presented either in "familiar" or "unfamiliar" contexts. Bower and Karlin now used gender and compatibility judgments as orienting tasks. Photos of human faces were again presented, but now in pairs. On the recognition test, target photos were presented either in the same or in different pairs and mixed in with distractors, and subjects were required to say whether each photo in the pair was "old" or "new." Again, pictures judged for sex were remembered much more poorly than those judged for compatibility. However, no context effects emerged. These findings suggest that "context" has different implications for faces than for words. It may be that faces are encoded individually with reference to some abstract representation (see below) while the spread of associations induced when words are presented "spreads" to encompass both words of a pair (i.e., so that the two semantic fields come to overlap, so to speak). Context for faces may imply simply the kind or level of encoding which was carried out at input for an individual face.

As noted, Bower and Karlin's orienting tasks were selected a priori. To specify, for example, that character judgments elicit a

deeper level of analysis than gender judgments because the former are associated with better subsequent recognition is a somewhat compelling, but nevertheless circular argument. Bower and Karlin speculate about what depth of processing refers to for faces. They raise the following possibilities: 1) character judgments require examination of more features than gender judgments, which can be based on the presence of one or two salient cues. Character judgments are believed to require a more active examination of more facial features for comparison with a "vague prototype" or memory of, for example, an honest person. The recognition memory test would just reflect this difference in number of descriptive features. The authors suggest measuring the number of eye fixations for different kinds of judgments; 2) character judgments might trigger a greater number of unique associations, for example, the face of a friend bearing a resemblance to the target photo.

Warrington and Ackroyd (1975) compared the effects of "relevant" and "nonrelevant" orienting tasks on normal adults' (aged 50-70) recognition memory for words and faces. For the "relevant" task, subjects were required to judge the "pleasantness" of each word or face. The "nonrelevant" verbal task required saying whether each word was red or green (the authors do not specify whether the verbal stimuli were actually printed in red and green); for faces, they had to say whether the person pictured was tall or short. A standard learning condition was also included for each class of material. A two-choice forced recognition test followed inspection of each study set. For both classes of stimuli, the "relevant" orienting task was found to effect significant improvement in recognition. No differences were found in recognition performance following "irrelevant" orienting tasks and

standard instructions, suggesting that these subjects were spontaneously encoding at more superficial levels. This finding may or may not be relevant to the age of the subjects tested.

Winograd (1976) also explored facial recognition in normals following different orienting tasks. He required subjects (college students) to make nine different kinds of binary judgments, three involving physical features, three character traits and three having to do with the occupation of the individual pictured. He found that recognition was poorest when subjects were asked to decide about the bigness of a person's nose or the straightness of the hair. Recognition was significantly better following trait and role judgments as well as for a decision as to the "heaviness" of the individual pictured. Winograd, noting Craik and Tulving's (1975) findings that recognition memory for words is better following positive than negative responses to orienting questions, was also interested in learning if this particular result could be expanded to include nonverbal stimuli. However, examination of his data for comparison of recognition accuracy following "yes" or "no" judgments yielded no differences. Winograd speculated that, of the three "physical" judgments, the one resulting in better subsequent recognition, i.e., the heaviness of the person pictured, might have elicited "more global or holistic assessment of a face ... [since] ... heaviness is, after all, an attribute of the whole person" (p. 421). Winograd suggests that this interpretation is similar to that of Bower and Karlin (1974) since it assumes that the more features examined (here, in making a "holistic" judgment), the better the recognition. Winograd, like Bower and Karlin, suggests that number of eye fixations in making different kinds of judgments should be sampled.

Winograd's assumptions with regard to "depth of processing" are weak. His use of pictures from a casting directory is questionable since they must have contained a number of salient features, for example, of dress and hairdo. The study provides no way of determining whether or not, for example, trait and role judgments were based on such features.

Patterson and Baddeley (1977) studied the effect of level of processing and several other variables on normal adults' (whose ages are not given) facial recognition. Relevant to the study herein proposed is their choice of orienting tasks. For "deep" level encoding, subjects made four personality judgments for each stimulus. The "superficial" task required subjects to make binary judgments about size of nose, thickness of lips, distance between eyes, and shape of face. This latter task was selected to help differentiate between type of judgment (i.e., character or physical) and parts of face examined in making a judgment, as a means of delineating the factors which influence facial recognition. Bower and Karlin (1974) had suggested: 1) that "deep" level character judgments require "comparison to an ideosyncratic set of vague prototypes or criteria, regarding the patterning of features such as distance between the eyes, size of eyes, size of pupils, curvature of mouth, thickness of lips, and so on" (p. 756); and 2) that "superficial" (i.e., gender) judgments could be based on one or two salient features. They further suggested that what might account, ultimately, for differences in recognition were the number of features utilized in arriving at judgments. Patterson and Baddeley's (1978) results showed that facial recognition was significantly better following personality judgments, even though, for the "superficial" level task, subjects were required to focus not only on a number of different facial

features, but the one presumed to be veridical for making "deep" level judgments. These results suggest that in making "deeper" level judgments, subjects either do not focus on the eyes, nose and mouth, or that they process these features differently than they do in making "superficial" judgments. Perhaps, as Carey and Diamond (1977) suggest, only "deeper" level judgments are made with reference to an abstract, upright, canonical representation in memory. In any case, recognition of faces appears to be enhanced by processing which somehow goes beyond direct judgments and comparisons of actual physical features, even if these features are the ones considered essential for "deep" level encoding.

Smith and Winograd (1978) used a levels of processing paradigm to compare the performance of older (50-80) and younger (18-25) adults on a facial recognition task. Faces were used: 1) because older adults reportedly show worse memory than younger adults on episodic tasks and faces are particularly episodic in nature, e.g., compared to verbal stimuli; and 2) to extend verbal learning findings to a nonverbal modality. Recognition of unfamiliar faces was tested following friendliness (presumed "deep" level) and size of nose (presumed "superficial" level) judgments, as well as subsequent to standard instructions. Smith and Winograd found that while older adults overall recognized significantly fewer faces, both groups showed comparable, significant improvement following the elaborative as opposed to the non-elaborative encoding task. These results failed to support Eysenck's (1974) "processing-deficit" hypothesis, based on his findings that, given a "deeper" level encoding task, older adults show relatively poorer verbal recall than younger adults. Neither did they support Rohwer's (1976) "compensation"

hypothesis which would expect opposite results to those obtained by Eysenck (1974) based on the prediction that a task which requires elaborative processing would help older subjects compensate for their normally less effective encoding of stimuli. Since Smith and Winograd's (1978) and Eysenck's (1974) studies used both different types of stimuli (faces versus words) and different retention measures (recognition versus recall), explanations for their discrepant results require further research. However, Smith and Winograd's (1978) findings represent another instance (Bower & Karlin, 1974; Winograd, 1976; Warrington & Ackroyd, 1975) in which manipulation of encoding task and presumably of level of processing is shown to influence ability to recognize unfamiliar faces.

Blaney and Winograd (1978) studied the effect of tasks designed to elicit different levels of encoding on childrens' recognition of unfamiliar faces for three different age groups (6, 8 and 10 years). Significant effects were found for age (overall performance improved with increasing age) and for condition ("niceness" judgments facilitated recognition compared to both size-of-nose judgments and standard instructions). As with Smith and Winograd's (1978) findings with adult subjects, there was no interaction between encoding task and age. Blaney and Winograd noted that these two sets of findings "... suggest that memory for faces is developmentally sensitive across the life span. As with word recall, memory for faces increases to maturity and later declines with age. At all ages it can be improved with appropriate encoding strategies" (p. 442). Blaney and Winograd suggest that memory for faces is a function of the number of features encoded, an ability which is facilitated both with increasing age and by particular encoding tasks.

An overview of the aforementioned papers on levels of processing and face recognition in normal subjects suggests that type of orienting task has a strong influence which overrides the effects of a number of other variables. Despite group differences in face recognition, performance for all groups improved following presumed "deeper" level tasks. Studies differed in number and type of stimuli (for example, homogeneity in terms of sex, or salient features of paraphernalia); exposure time; interval between inspection and testing; form of recognition test (yes-no versus forced-choice); proportion of distractors to targets; form of presentation (group versus individual, slides versus prints, etc.); age and sex of subjects; number of facial features required for examination in "low" level encoding tasks. However, none of these variables interacted with orienting task, at least in any obvious way. Subjects, overall, showed poorer facial recognition on tasks requiring direct analysis of physical features; better recognition was shown subsequent to judgments which probably required comparison between an endogenously-generated set of criteria or abstract representation and some transformed representation of the stimulus. Most investigators suggested that "deeper" level tasks ultimately had their salubrious effect on recognition by requiring inspection of a greater number of, and more pertinent, facial features. Patterson and Baddeley's (1977) results, however, weakened this argument by suggesting that it is the nature of the task and not the number or type of features examined which influences recognition.

Introduction of a standard condition (i.e., free inspection of stimuli) always resulted in no significant difference between performance subsequent to this condition and that following "superficial"

level encoding tasks. It appeared, then, that left to their own devices all groups of subjects tended spontaneously to encode faces at more "superficial" levels. However, it is noteworthy that all studies which included a standard condition used pictures which apparently included a number of salient features of hairdo and paraphernalia (i.e., from theater magazines and casting directories). As such, these stimuli might have exerted a "pull" to process these more obvious features which, as will be discussed later, would not be in keeping with a "deeper level" of processing.

Issues in the Encoding of Facial Stimuli

A major problem in studies utilizing a "levels of processing" type of model is the "depth" issue itself. Eysenck (1978) has stated the problem as follows: "In view of the vagueness with which depth is defined there is the danger of using retention test performance to provide information about the depth of processing, and then using the putative depth of processing to 'explain' the retention-test performance, a self-defeating exercise in circularity" (p. 159). This problem is especially troublesome in nonverbal studies, where facial stimuli appear exclusively to have been used. Little justification has been provided for selection of orienting tasks. However, there are now a number of studies which have investigated different aspects of facial processing and recognition. Taken together, they may help provide some clearer notion of what might be regarded as different "levels" of processing vis-a-vis facial stimuli:

1. Developmental studies (Carey & Diamond, 1977) have pointed to two different styles of processing human faces. Younger children appear

to carry out piecemeal, feature by feature analyses of faces. From approximately age ten, faces appeared to be treated as configurations, possibly being compared to some abstract canonical representation in memory. The latter manner of encoding faces is considered to be more effective both for direct matching and for recognition. This is consonant with the notion that a sufficiently abstract representation of a face is resistant to such changes as aging, weight loss and gain, and new hairdos. Younger children, on the other hand, are fooled in their attempts at facial recognition by similarities in details of dress and hairdo.

2. Facial recognition appears to be linked to the integrity of the right posterior portion of the brain (Warrington & James, 1967; Benton & Van Allen, 1968; De Renzi, Faglioni & Spinnler, 1968; Yin, 1970). Individuals with right hemisphere damage have difficulty on facial recognition and matching tasks if changes in paraphernalia, lighting or orientation are introduced (Benton & Van Allen, 1968).

3. Normal adults generally show a left visual field advantage for face recognition and matching on tachistoscopic presentation (Rizzolatti, Umiltà & Berlucchi, 1971; Hilliard, 1973; Leehey, et al., 1978). This advantage is lost at extremely short exposure times when preliminary levels of information processing are foremost (Ellis & Sheperd, 1975). However, a left visual field advantage is demonstrated with more elaborative processing; this occurs with longer exposure times, when a memory component is introduced or, even with very short exposure times, when the icon is masked so that only the products of more complex analysis are available, or when a caricature must be compared with a photograph (Moskovitch et al., 1976).

4. Yin's (1969, 1970) paradigm has been used with different subject groups, and connections have been made between laterality, type of processing, and ability to recognize faces. Yin (1970), see below, demonstrated a dissociation in the ability of normal adults to recognize upright and inverted faces. This dissociation was not, however, demonstrated for other classes of stimuli. Yin also demonstrated that patients with right posterior brain lesions were as good as normal adults at recognizing inverted faces but significantly more impaired at recognizing upright faces.

5. Carey, Diamond and Woods (in press, referred to in Carey, 1978) showed that six and eight year old children who (on the basis of Carey & Diamond's (1977) work) behave like right posterior patients (Dricker et al., 1978) in their ability to recognize faces, i.e., appear to process them in a piecemeal fashion, are equal to older children and normal adults at recognizing inverted faces, but significantly poorer at recognizing upright faces.

6. Leehey (1976) showed that children demonstrate a left visual field advantage for faces on tachistoscopic presentation at the same age as they begin to show the adult advantage for upright faces.

7. Ross and Turkewitz (preprint) separated adults into those showing a left and those showing a right visual field advantage for facial matching on tachistoscopic presentation. They then presented both groups with a Yin-type paradigm. Individuals with a left visual field (i.e., right hemisphere) advantage for faces were reported to show a marked advantage for upright over inverted faces, unlike individuals with a right visual field (left hemisphere) advantage for faces, who appeared to treat faces more like other classes of stimuli on the

task (i.e., showed reduced advantage for faces in the upright orientation).

Taken together, the above findings suggest that more elaborative levels of processing: 1) are lateralized to the right hemisphere (Moscovitch et al., 1976); 2) require the integrity of the right (possibly posterior) hemisphere of the brain (Yin, 1970); 3) are associated with better facial recognition (Warrington & Ackroyd, 1975; Bower & Karlin, 1974, etc.); 4) involve treating faces as configurations with reference to an abstract, canonical, upright representation in memory (Carey, 1978). Less elaborative processing of faces: 1) is associated with poorer recognition; 2) involves treating faces in a piecemeal fashion; 3) does not appear to require the specialized capabilities of the right (posterior) hemisphere.

Several studies, described earlier, suggest that Korsakoffs are impaired in their encoding of visual stimuli at both elementary and more advanced stages of information processing. Although Cermak, Reale and DeLuca (1977) showed that exogenously introduced verbal mediation improves Korsakoffs' recognition of computer-generated abstract shapes, Dricker et al. (1978) were the first to attempt a systematic study of whether Korsakoffs' visuoperceptive deficits are attributable to impairment in depth of nonverbal encoding. Before describing that study, however, I would like to turn to several related studies.

Yin (1969, 1970) compared recognition of upright and inverted faces to recognition of other complex, frequently viewed, generally mono-oriented objects presented in both of these orientations. In one (1969) study, using normal subjects, he found a significantly greater discrepancy between the ability to recognize upright as opposed

to inverted faces than he did between these two orientations with other classes of objects (chairs and houses). In addition, analysis of individual differences amongst subjects revealed an interesting effect which emerged only for faces. That is, there was a negative correlation between the ability to recognize upright and inverted faces. Yin, on the basis of these findings, suggested that upright faces were somehow processed differently and in such a way that made them easier to recognize than other visual stimuli. In a subsequent study (1970), Yin confirmed De Renzi and Spinnler's (1966) finding that right posterior-lesioned patients are selectively impaired for face recognition. Furthermore, comparing these subjects to both normal controls and to patient groups with other unilateral focal brain damage, he found that the right posterior group was worst for recognition of upright faces and least impaired for recognition of inverted faces. These differences were significant in both directions. Yin concluded that there must be some characteristics which are unique to upright faces, possibly relating to faces as social objects and that patients with right posterior brain damage are somehow unable to appreciate whatever these special attributes are.

Yin's (1970) results suggested to two other researchers that right posterior patients' selective difficulty with upright faces gave evidence that faces might be processed in two different ways: 1) as special configurations, with distinctive spatial relations amongst features, best represented in an upright orientation; 2) piecemeal, in terms of isolated, individual features, more like other kinds of visual stimuli might be processed and, also like other stimuli, less tied to an upright orientation (Carey & Diamond, 1977). In other words, Yin's

(1970) right posterior patients appeared to be processing faces in a piecemeal fashion, similar to the way in which normals process other classes of objects, and failed to show a unique advantage, similar to that shown by other subjects, for recognizing upright faces. Carey and Diamond (1977) first used Yin's (1969, 1970) paradigm to discover whether their two hypothesized ways of representing faces might distinguish children in different age groups. Results showed that children from six to ten performed comparably to normal adults on recognition of inverted faces; however, at age ten the normal adult advantage for upright faces emerged. Before that time, children behaved more like right posterior-lesioned patients; i.e., they showed a relatively small advantage for upright faces, one which was not significantly different from their ability to recognize upright as opposed to inverted houses.

Carey and Diamond (1977) then attempted to determine if six and eight year olds' disadvantage with upright faces related to a tendency to represent faces in terms of isolated features. In this second experiment, children were shown a series of study photographs of individual faces. Immediately after seeing each study photo, two test photos were displayed and the child had to say which of the two individuals pictured he had just seen. Paraphernalia (e.g., clothing, eyeglasses, hairdos) and expression were manipulated to provide four types of problems. In problem types I and II ("paraphernalia-to-fool"), only the person in the non-target test photo was attired similarly to the person in the study photo; in type I problems ("paraphernalia-to-fool, expression equal") all three expressions were the same; in type II problems ("paraphernalia-to-fool, expression to help"), expression in the study and the target photo matched. For problem types III and IV

("expression-to-fool"), only the non-target photo matched study photo in expression. On type III ("expression-to-fool, paraphernalia equal") paraphernalia was the same in all three photos; in type IV ("expression-to-fool, paraphernalia to help") problems, paraphernalia on target and study photos matched. Younger (6 and 8 year old) children were "fooled" by similarities in paraphernalia but not by expression. Carey and Diamond interpreted this finding as indicating that young children base facial identities on superficial salient features, for example, of paraphernalia, rather than on an analysis of the relationship between facial features. By age ten, however, children appeared able to analyze faces in a way which led to correct identification. Carey and Diamond suggest that older (compared to younger) children were not merely using a better piecemeal analysis, i.e., knew which facial features to analyze, because such features are visible on inverted as well as upright faces and would have been expected to lead to better performance by ten year olds on inverted faces in the first experiment. Rather, Carey and Diamond (1977) state that "these two experiments taken together imply that the properties that replace paraphernalia as clues to identity by age ten are configurational aspects of faces, aspects that can be encoded best from upright faces."

Facial Recognition in the Patient Groups:
Alcoholic Korsakoffs and Right
Hemisphere Damaged Patients

Dricker et al. (1978) reasoned that if Korsakoffs had a general limitation in the depth to which they encoded nonverbal as well as verbal stimuli, then they might be shown, like young children, to limit their analyses of faces to more superficial features. A series

of facial recognition and matching tasks were used to test this prediction. Other subject groups included: 1) right hemisphere patients, since they had been shown in a number of studies to be impaired in their ability to recognize unfamiliar faces; 2) alcoholic controls, who frequently perform at a level intermediate to Korsakoffs and normal controls on information-processing tasks; and 3) normal controls. Subjects were first presented with two tasks borrowed from Milner (1968). In the first "delayed-identification" task, subjects studied an array of twelve faces and following an unfilled delay of 90 seconds were required to identify them in an array of 25 faces. In a second, "immediate-identification" task, each of twelve photos of faces was matched, one at a time, to its identity in an array of 25 photographs. Korsakoffs and right hemisphere patients were impaired relative to alcoholics and normal controls on both these tasks. This outcome on straight matching to sample implied that deficient visual-perceptual analysis as well as impaired memory were contributing to these subjects' failures in facial recognition. These tests were followed up with Carey and Diamond's (1977) facial matching task (described above). Both Korsakoff and right hemisphere subjects made significantly more errors than alcoholics and normal controls on Type I and II problems ("paraphernalia-to-fool"). The two patient groups were found also to be significantly impaired compared to alcoholics on Type III and IV items ("expression-to-fool"). However, this latter result is difficult to interpret since neither patient group differed significantly from normal controls. Dricker et al. (1978) interpreted their findings here as indicating that both Korsakoff and right posterior patients are restricted to their depth of perceptual encoding. For Korsakoffs, this apparent

tendency to restrict facial analysis to superficial features was interpreted as 1) being analogous to their tendency with verbal stimuli to rely on acoustic as opposed to semantic encoding; and 2) contributing, as does their limitation in verbal encoding, to poor subsequent recognition. Dricker et al. suggest that right hemisphere and Korsakoff patients' above-chance performance on the Carey and Diamond task indicates that they are able to carry out some configurational analyses of faces and speculate as to why this ability did not contribute to better recognition on the Milner delayed-identification task. They state that 1) the tendency to rely on piecemeal analysis may become more evident with increased task complexity, and/or 2) that Korsakoff and right hemisphere patients may have additional storage or processing problems which contributed to their chance performance on the delayed-identification task.

Dricker et al. also speculate that, for Korsakoffs, findings might represent one instance of a more general deficiency in depth of processing while, for right posterior patients, such a suggested deficit might be limited to the visual modality.

The fact that alcoholics behaved like normal controls, despite findings that their performance on visuoperceptive tasks have, in a number of instances, fallen intermediate to those of Korsakoffs and normal controls, may relate to issues of task complexity; the tasks used here may have been too easy to demonstrate such a distinction.

Dricker et al.'s. (1978) findings that both Korsakoffs and right posterior patients are impaired on the Milner and on the Carey-Diamond facial recognition and matching tasks, suggest interpretations in addition to the ones they have offered and raise issues for further research:

1. Korsakoffs and/or right posterior patients may be more or less capable of carrying out configurational analyses but have difficulty resisting a "pull" to salient perceptual features of stimuli when they are present. Indeed, if such a distinction could be made it might help to separate factors underlying failure by these two subject groups. It may be that right posterior patients, like six and eight year olds, are incapable effectively of encoding faces as configurations. Their similar performance to young children on the Yin paradigm would tend to support such a possibility. Korsakoffs, on the other hand, may be able to encode faces as configurations but, and this would be consonant with their tendency to perseverate, be "pulled" to salient perceptual features of the stimuli when such features are present;

2. Above chance performance on the Carey and Diamond matching task by both Korsakoff and right posterior subjects is not necessarily indicative of ability to carry out configurational analyses when given sufficient time, as suggested by Dricker et al. Rather, it might indicate that one (or both) of these subject groups, given extra time, is able to carry out more effective piecemeal analyses of faces;

3. While Dricker et al. have demonstrated that Korsakoff and right posterior subjects are impaired on facial recognition and also base identification on details of paraphernalia, i.e., at least under certain conditions appear to limit analysis to superficial features of stimuli, no direct connection is established between these two deficits.

"Levels of Processing" and Facial
Recognition in Alcoholic
Korsakoff Patients

Butters et al. (unpublished, personal communication), based on

Dricker et al.'s. (1978) suggestion that alcoholic Korsakoffs' failure, at least spontaneously, to process faces to a deeper, i.e., configurational, level of analysis, turned to Bower and Karlin's (1974) paradigm in an attempt to establish a more direct link between Korsakoffs' inadequate encoding of facial stimuli and their impaired recognition of those faces. As noted above, Bower and Karlin had been able to manipulate normal subjects' facial recognition by varying the encoding task; their requirement to carry out character judgments ("honesty" and "likeability") at input resulted in significantly better facial recognition than did gender judgments. Furthermore, Cermak and Reale (1978) had demonstrated that requiring Korsakoffs to carry out a deeper level, i.e., semantic, as opposed to a more superficial, i.e., phonemic, analysis of words, contributed to improved performance on a subsequent recognition test. Butters et al.'s. use of the Bower and Karlin paradigm constituted an attempt to extend this finding with Korsakoffs to the nonverbal domain.

Butters et al., like Bower and Karlin, required subjects to make binary judgments as to 1) likeability ("deep level" task) and 2) sex of the individual pictured ("superficial" task). They found that alcoholic Korsakoffs, unlike normal controls, did not show improved facial recognition following the presumed "deep level" encoding task. Bower and Karlin (1974) had suggested that the character judgment task improved subjects' performance because it induced encoding of a greater number of facial features, possibly with reference to a "vague prototype or memory of, for example, an honest person," whereas gender decisions could be based on one or two salient cues (see page 64, above). Butters et al. suggested that their failure to affect alcoholic Korsakoffs' facial recognition by varying the encoding task might reflect a tendency

by alcoholic Korsakoffs to base character judgments on one or two "superficial" details. Their use of the Bower and Karlin paradigm, in which the encoding task required simple binary judgments, provided no means of analyzing the data for such a possibility.

In the study reported here, a preliminary attempt was made to "replicate" the Butters et al. (unpublished, personal communication) study by using a task which would come closer than the Bower and Karlin paradigm to allowing the experimenter to guide and monitor the way in which facial stimuli were analyzed at input. Rather than asking subjects to make yes-no judgments, they were required to compare the photographs either to caricatures ("deep level" task) or to hairdo tracings ("superficial level" task) and to decide in each case which one out of three choices matched the photo. Caricatures were based on the eyes-nose-mouth configurations. The rationale for using caricatures was that since they are impressions, rather than exact copies of faces, the subject is forced to transform the photographed face into some more abstract representation for comparison with the caricature. Moskovitch et al. (1976) had concluded that caricature matching represented a relatively deep level of processing, as reflected in their finding of a left visual field advantage for caricature matching even at very short tachistoscopic exposures. They suggested that "the processes involved in determining whether a photograph and a caricature represent the same person may be similar to those involved in forming and maintaining a stable representation of a face in memory. Both activities may require the formation of similar, but not identical, abstract and idealized representations of the face. Taken further, this analysis implies that it is these higher level operations and codes, rather than memory per se,

that require the specialized processes of the right hemisphere" (p.412). They later stated that "... if the comparison between faces requires the abstraction of higher order pictorial features, as in the caricatures-photograph matching test ... performance favors the left visual field-right hemisphere" (p. 414). The choice of hairdo comparisons as the "superficial level" task was based on a number of studies with normal subjects (Warrington & Ackroyd, 1975; Winograd, 1976; etc.) in which judgments based on information directly available in the photographic stimuli were used as "superficial level" tasks and resulted in significantly poorer subsequent facial recognition than was the case following character judgments or other questions, for example, "How heavy is this person?" which required going beyond, i.e., somehow transforming or abstracting from, the information available in the picture.

Use of a nonverbal, three-choice matching task would, it was hoped, guide subjects more directly to particular types of processing than the types of judgments previously employed (Bower & Karlin, 1974; etc.), would hopefully provide a measure of how effectively subjects are able to carry out one as compared to the other task, and also would determine how well subject groups performed the orienting tasks in relation to one another. A standard (free inspection) condition, not included in the Bower and Karlin (1974) study, was used here to provide information concerning how subjects performed spontaneously.

Since early piloting appeared promising, a number of subjects from three groups, normal controls, long-term alcoholics and alcoholic Korsakoffs, were tested. Results showed that except for the fact that normal controls and long-term alcoholics performed overall better than alcoholic Korsakoffs, no meaningful pattern emerged in relation to the

different encoding tasks within or between subject groups. The possibility was then considered that a subject did better on a particular encoding task because it happened to reinforce his preferred mode of facial analysis, i.e., either piecemeal (hairdos) or configurational (caricatures). I therefore returned to the same subjects and administered the Yin upright and inverted faces test (see above). Again, no consistent pattern, i.e., relationship between performance on my test and on the Yin test, emerged.

A series of pilot studies was then carried out to determine whether the nature of the encoding task itself or some other variable(s) might account for my failure to achieve a "levels" effect. Repiloting showed that 1) too few stimuli were being used at each session, and 2) the encoding tasks that had been used were not working in the expected manner.

The study as it now stands is closer to the Butters et al.--Bower and Karlin model. Subjects were asked to make character (likeability) or physical (size of nose) judgments. However, rather than binary decision, the encoding task required them to rate the faces for these qualities on four-point scales. This somewhat more demanding task would, it was believed, force subjects to make more considered judgments and to allow finer comparisons to be made within and between groups.

Three subject groups in addition to normal controls participated. Individuals suffering from the alcoholic Korsakoff syndrome were the major focus of this study. As stated above, the aim of this study was to see if a direct relationship could be found between Korsakoff subjects' demonstrated faulty processing of nonverbal stimuli and their

impaired ability to retain such material. Furthermore, it was believed that, if such a relationship could be demonstrated, that it would lend support to the levels of processing model of memory (Craik & Lockhart, 1972).

An interesting finding of the present study is that, given "deep level" instructions at stimulus presentation, the AKs were able to recognize as many faces as the normal control subjects. To my knowledge, equivalent performance has not been shown between AKs and controls on any tests of verbal learning. This finding may represent an important distinction between words and faces, or more specifically between verbal and nonverbal mediation. Kinsbourne and Wood (1975) in accounting for the amnesic syndrome, have emphasized the inability of amnesic subjects to retrieve the context in which items of information are presented (see page , above). In relation to the present findings, it seems plausible that words presented for subsequent recall or recognition are much more vulnerable to contextual confusion than faces. Words are always presented against a background of the subject's semantic associational network so that his own store of associations serves as a potential source of contextual confusion with list words. Evidence for this is provided, in fact, by Mattis et al's. demonstration that AK's ability to distinguish targets from nontargets with repeated presentation of lists of words was inversely related to increments in the intrinsic semantic organization of the list (see above, page 31). These authors suggested that repeated exposure to real words may have continued to "trigger" associations to those words in the Korsakoff subject's semantic associational network to the point where the trace strength of the target words and their non-target associates become indistinguishable.

For faces, there is probably nothing comparable to the "semantic associational network" for words. While faces can be encoded on a feature by feature basis (probably involving verbal mediation, e.g., "big eyes," "arched eyebrows"), the fact that many faces share particular verbalizable features would make it very difficult to remember large numbers of faces on this basis (which appears to be the case, Carey, 1978). However, when faces are processed as configurations, or the extent to which they are processed as configurations, which probably involves a strictly nonverbal form of mediation, each face's representation in memory may retain its uniqueness. The probability that faces are encoded as unique entities and not in association with other faces is supported by Bower and Karlin's (1974) finding that normals' ability to recognize faces is not facilitated by presenting them for recognition alongside faces with which they had been paired at input.

If faces are encoded in this manner as unique entities, this may be the basis for humans' prodigious capacity to remember hundreds of faces over many years with apparent ease (Bahrick & Bahrick, 1975). Although familiar faces may be confused with other familiar faces in terms of when and where they were learned, the fact that each face's representation in memory is so unique makes it unlikely that a new face will be confused with an old face. It is also noteworthy that Yin (1969) showed that faces were better recognized than other classes of complex visual stimuli that he tested. It may be then that when configuration encoding was included in alcoholic Korsakoff subjects in the present study by requiring them to make global-evaluative, i.e., likeability judgments, that the face was "registered" so to speak,

and once "registered" was neither lost from memory nor any more likely than would be the case in normals to be confused with any new face.

"Levels of Processing" and Verbal
Recall in Alcoholic
Korsakoffs

McDowall, using a levels of processing paradigm and verbal stimuli, obtained similar results with AKs and alcoholic controls to those described in this study which used facial stimuli with AK and NC groups. While acknowledging that his results provided support for the limited encoding hypothesis of Butters and Cermak, he questioned whether they might not also be explained in terms of a retrieval deficit. In order to test this assumption, he essentially replicated his first study, but provided strong (semantic) cues at recall testing in all three conditions (semantic, nonsemantic and free study). While both groups showed overall improved performance, AKs now retrieved just as many words following free study as following semantic instructions. McDowall interpreted his findings as suggesting that AKs encode words spontaneously (i.e., under free study) to the same extent that they do following semantic instructions, but are unable to generate their own retrieval cues at recall. Presumably, category (semantic) cues given at stimulus presentation somehow remained available at recall in the semantic condition. He suggested that AKs' failure to generate retrieval cues at recall might have reflected their failure, perhaps due to slow processing, to organize words at input into their appropriate conceptual categories. McDowall's results do not negate the limited encoding hypothesis. Semantic cues at input appeared to induce more effective encoding since, if one accepts McDowall's thesis,

the superordinate cue was somehow encoded in association with the to-be-remembered word and subsequently facilitated recall.

Emphasis on retrieval as well as on initial encoding mechanisms in recent memory research was given impetus by Tulving and Thomson's (1973) proposal that "specific encoding operations performed on what is perceived determines what is stored, and what is stored determines what retrieval cues are effective in providing access to what is stored." Cermak and Reale (1978) found that AK subjects failed to show the normal pattern of remembering significantly more words following semantic as opposed to phonemic or case questions unless the list of words was broken down and presented in short, i.e., 12 items, segments. Recently, Cermak et al. (1980) have suggested that a possible explanation for this finding is that, given a longer list, an AK subject might have been unable to recall the manner in which he had analyzed each word and therefore was unable to use his "induced" deep level analysis effectively to aid his retrieval of the correct response. In keeping with Tulving and Thomson's hypothesis, the authors further suggested that "Perhaps normals profit not simply from the act of semantic analysis but also from the retention of having performed that act." In two follow-up experiments, various combinations of strong and weak cues were presented along with stimuli at input and at recall to alcoholic Korsakoff and control subjects. Results were only partially consistent with Tulving and Thomson's (1973) hypothesis since AKs' ability to recall words benefitted only from provision of the same "strong" cues at stimulus input and output and not when both cues were "weak." Cermak et al. suggested that a cue provided at input could benefit AK's recall only if it reestablished old learning.

(i.e., a previous association) via a "strong" cue; these subjects appeared unable cognitively to reorganize their semantic networks to retain a new, "weak" association between target and cue.

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