NONANALYTIC COGNITION: MEMORY, PERCEPTION, AND CONCEPT LEARNING

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I. Introduction 1
II. The Parallel between Perceptual, Categorical, and Episodic Memory Tasks 4
A. Perceptual Identification 4
B. Conceptual Categorization 19
C. A Summary of the Parallel: A Processing Episode View of Generalization ... 27
III. Nonanalytic Processing in Explicit Episodic Memory Tasks 28
A. Separate Memory Systems and Memory for Source 28
B. Nonanalytic Judgments in Explicit Memory Tasks 32
C. The Importance of Nonanalytic Prior Processing for Memory 41
IV. Summary and Conclusions 42
References 43

I. Introduction

For the past 20 years, cognitive theorizing has operated within a framework that has now outlived its heuristic usefulness. In this framework, tasks that require generalizing to new events were assumed to be accomplished in an essentially different way than tasks that require remembering unique past events. Perceptual identification and categorization, for example, are tasks that ask for generalization across trivial variations in detail; the subject's job is to identify the word *house* as essentially the same word despite its being presented in different typefaces or to identify two different dogs as being the same type of animal. In the traditional framework, these generalizing tasks are accomplished by coding the new events in terms of general procedures and stable units that have been abstracted from past experiences. The new event is analyzed into relevant and irrelevant elements, with the relevant elements being used to identify the more abstract, higher level units that constitute most of our stable, "semantic" knowledge. A string of letters, for example, would be identified as a particular word using the relevant letter features or graphemes, but not the nominally unpredictive cues from typeface or ink color.

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In contrast, recent treatments of tasks that require memory for specific episodes have emphasized the importance of specificity and variability in both encoding and retrieval. Tulving's principle of encoding specificity (e.g., Tulving & Thompson, 1973) states that one does not simply store a replica of a to-be-remembered item, but rather, encodes the item in a much more variable manner, a manner that is specific to the context in which it occurred. For retrieval, the similarity of the retrieval cues and the encoded trace is important, making it necessary to consider encoding and retrieval jointly rather than in isolation. This approach does not emphasize the stability and recombinability of component units, but rather the tightly integrated and interactive encoding of both conceptually relevant and irrelevant aspects of the episode. Along with the specificity and variability of encoding, the importance of differences in processing has been a central theme in recent theorizing about memory. Kolers (1979) emphasizes the importance of processing by referring to remembering operations rather than memory traces. Similar to the intent of the encoding specificity principle, Kolers stresses the uniqueness of the way an item is treated in a processing episode; good transfer depends on the similarity of the specific operations required at test to those that were applied earlier.

There is a contrast, then, in the usual treatment of generalizing tasks and the recent treatment of explicit episodic memory tasks. The processing usually thought to underlie generalizing tasks emphasizes the stability of units and identification procedures, probably in order to facilitate analytic generalization. Recent treatments of explicit episodic memory tasks, such as recognition and recall, emphasize the variability and specificity of processing, with little emphasis on the recombinability of component units. This contrast has encouraged the use of different experimental materials and procedures as well as different theoretical expectations for the two types of tasks. As a result, possible differences among the ways such tasks as recognition memory, perceptual identification, and conceptual categorization are normally accomplished have been emphasized to an unjustified extent. In contrast, we shall argue that the continuities among these tasks are far more impressive than their discontinuities.

An essential element in our argument is the distinction between analytic and nonanalytic generalization. As outlined above, the traditional cognitive approach to generalization relies on isolating, across many episodes, the features that individually help to predict a higher level unit, such as a grapheme, word, logogen, prototype, or semantic unit. Since this type of generalization requires breaking the original stimulus into stable relevant and irrelevant features, we shall refer to it as *analytic generalization.* The generalizing tasks of categorization and perception, however, can also be performed by reference to specific prior episodes, just as is the obviously

specific task of remembering those episodes. Instead of relying solely on the analytic generalization of recombinable units, generality could come from treating similar situations analogously. By this process, a word could be identified by reference to a previous occurrence of a word in a similar context, from a similar source and in a similar format, rather than by reference to a generalized representation of the word, such as a logogen. A dog could be identified by reference to a similar, already-known animal rather than by reference to a general prototype of the species. Since this does not require breaking the current stimulus into separate relevant and irrelevant features, we will refer to it as *nonanalytic generalization.*

Nonanalytic generalization gains its validity from the high probability that an extremely similar previous episode represents an occurrence of the same generalized word or category as does the current episode. Furthermore, this form of generalization relies on the same interactive, context-specific organizations of the stimulus that have proven important in the recent literature on memory for particular episodes. With this type of organization, we should expect to see perceptual and categorical performance that would reflect tight integration among content, form, and source, that is, among the nominally relevant and the nominally irrelevant aspects of a processing episode. As we shall demonstrate, there is much in the recent literature that supports this suggested continuity between generalizing and episodic memory tasks.

In this article we shall describe evidence that challenges major points in the usual, divergent treatment of perception, categorization, and episodic memory. Specifically:

1. Perceptual and categorical processing cannot be assumed to depend on high-level units that change only over many trials and that are relatively independent of context. Rather, such processing seems to be as vulnerable to changes in context and task as is memory for individual episodes.
2. The effect of attentive processing need not be to systematically discard information about surface characteristics; many perceptual and conceptual judgments depend upon nominally irrelevant information about source and format. Depending on the processing selected by the task and context, these aspects of the processing episode can be integrally involved and therefore can affect later processing of closely similar material in both generalizing and explicitly episodic tasks.
3. Both generalizing and explicitly episodic memory tasks can be accomplished in several different ways. The analytic extreme, emphasized in the usual cognitive framework, depends solely on definitionally relevant information. A nonanalytic procedure depends on tightly integrated combinations of definitionally relevant and irrelevant (including adventitiously

correlated) information. How any of these tasks will be done, then, depends partly on how integral the previous processing of the probe stimulus was. Since there are so many variations in the way that an item can be processed, we expect many different relations among the generalizing and explicitly episodic tasks.

In short, we shall argue that we have no reason to believe that perceptual identification and conceptual judgments are any less variable or context dependent than explicit memory for episodes has proven to be. This, of course, is not an argument that categorical and perceptual judgments are never analytic. In perception, as in memory, it all depends on the particulars of processing.

II. The Parallel between Perceptual, Categorical, and Episodic Memory Tasks

In the following sections, we shall examine the effects on perception and categorization of manipulations that have traditionally been employed in investigations of explicit episodic memory tasks. Parallel effects would suggest that generalizing tasks often rely on memory for prior episodes rather than mainly on abstract representations such as logogens or schema.

A. Perceptual Identification

1. *Priming as Opposed to Memory for Prior Episodes*

The effect of the long reign of the traditional analytic and abstractive framework in cognition has been to build its assumptions nearly invisibly into the paradigms and terminology of the field. An excellent example of this is the use of the term *priming* to refer to the effect of a single presentation of an item on its later speed of processing or probability of correct identification. Priming is not a theoretically neutral term, but rather, is derived from the view that perception relies on abstract representations of knowledge such as schemata and logogens (e.g., Friedman, 1979; Morton, 1979). Morton (1969, 1979), for example, used the term to refer to a temporary reduction in the threshold of a logogen, that is, in the amount of information that must be collected for the subject to decide that a particular word has occurred. In contrast to the temporary effect of priming, Morton suggested that permanent effects on perception are gained only through a large number of repetitions of a word. These repetitions would combine to determine relatively permanent differences in the threshold of logogens so that logogens corresponding to high-frequency words would have a lower threshold than those for low-frequency words. This pooling of repetitions, of course, would not preserve information that is unique to any single presentation of a word. By a logogen view, then, a single prior presentation of a word would have almost no permanent influence on perception but could serve as a source of priming by temporarily lowering the threshold of a preexisting logogen.

The notion of priming, in general, implies that the memory system underlying perception differs from the episodic memory responsible for recognition memory in the magnitude and persistence of effects of a single presentation of a word. Large and persistent effects of a single presentation are predicted for a test of recognition memory but not for a test of perception. Recent experiments, however, have in fact yielded evidence of large and persistent effects of a single prior presentation of a word on its later perceptual identification. In fact, the effects of infrequency in the language can be greatly diminished by a single presentation of words in the experimental setting (e.g., Jacoby & Dallas, 1981); that is, a single presentation of a low-frequency word is sufficient to largely overturn a long history of differential exposure to high- and low-frequency words. Furthermore, the effects of a prior presentation persist over at least 5 days in visual perceptual identification (Jacoby, 1983a) and have been shown to last for a year in an investigation of reading inverted text (Kolers, 1976). To account for these persistent effects, it cannot simply be assumed that a single presentation of a word is sufficient to permanently lower the threshold of its corresponding logogen. Since threshold is itself an abstractive notion, it becomes meaningless when used to account for large and persistent effects of a single presentation.

The persistence of perceptual enhancement that comes from limited prior study trials suggests that perception relies on memory for prior episodes, the same type of memory that underlies performance on recognition and recall tests. As further evidence of this, even a single presentation of a pseudoword is sufficient to produce substantial facilitation of perceptual identification (Feustel, Shiffrin, & Salasoo, 1983; Hayman, 1982). Apparently working against this conclusion, however, is the finding that perceptual enhancement has been found to be independent of recognition memory performance. Even when a person does not recognize a word as having been previously presented, prior presentation of a word enhances its later tachistoscopic identification (Jacoby & Witherspoon, 1982), the completing of a fragmented version of the word (Tulving, Schacter, & Stark, 1982), and the speed of reading an inverted version of the word (Kolers, 1976). Tulving (1983) has interpreted the persistence of such enhancement effects as evidence that "priming" does not reflect an influence on semantic memory, for example, a reduction in the threshold of a logogen. Furthermore, he takes the independence of perceptual enhancement and recognition memory as evidence that perceptual enhancement does not rely on episodic memory.

Having eliminated these two forms of memory as a basis for perceptual enhancement, Tulving suggests that a third, rather poorly specified, form of memory is responsible. As will be discussed later, we believe Tulving was premature in dismissing the possibility that perceptual enhancement relies on the same form of memory as does performance on recognition memory and recall tests.

2. *The Role of Attention*

The effects of attention are another criterion that might be used to suggest that perceptual identification and episodic memory tasks are based on different memory systems. Generally, when assessed by explicit episodic memory tests, little or no memory has been found for items that were unattended during their prior presentation. As an extreme example, Moray (1959) presented words to the subject's unattended ear 35 times during a shadowing task and still found only chance recognition memory for those unattended items. Similar effects of attention have been found when items are visually presented. Fisk and Schneider 1984) found that recognition memory and frequency judgments of words that had served as nontargets were higher when the target words had been specified on the basis of meaning than on the basis of graphic characteristics, corresponding to an effect of levels of processing. Although effects of this sort are not sufficient to allow the conclusion that attention is necessary for memory, they do serve to relate attention, defined as differences in processing, to memory performance (Johnston & Heinz, 1978). Results from another condition reported by Fisk and Schneider provide more direct support for the necessity of attention for memory. In that experiment, subjects searched for target numbers among numbers presented at the corners of displays while being instructed to ignore words presented in the center of displays. The presentation rate of the displays was too fast to allow eye movements, resulting in foveal presentation of the to-be-ignored words. Later recognition memory of the previously ignored words was at chance level. Using a variety of procedures, other investigators have also reported evidence and arguments to support the conclusion that attention is required to produce memory.

Thinking of perceptual identification as being subject to the same influences as explicit episodic memory tasks, then, we would expect perceptual identification to also be affected by attentional variations in prior processing episodes. There are reasons to suspect, however, that attention plays no role in the effect of a prior presentation on later perceptual identification. First, effects on perceptual identification apparently are less reliant on variations in the type of prior processing than are recall or recognition memory. Whereas recall and recognition are influenced by level-of-processing manipulations (Craik & Tulving, 1975), superficial prior processing of a word (searching through the word for a target letter) does as much to enhance its later identification as does processing the meaning of the word (Jacoby & Dallas, 1981). Of course, in both the surface-feature judgment and the meaning-judgment conditions, the words were probably perceptually identified, which may be the only form of attention necessary for later enhancement of perceptual identification. This, however, raises a second possible basis for distinguishing perceptual and episodic tasks on the basis of memory: The forms of processing that are required for the perceptual enhancement effect may be automatic, that is, carried out without the necessity of attention. There is evidence that both the meaning (Marcel, 1983) and the phonemic characteristics (Humphreys, Evett, & Taylor, 1982) of a visually presented word are activated even under conditions that do not allow the person to report the word that has been presented. Activation of this sort might persist and act as the basis for the repetition effect in later perceptual identification.

A series of experiments carried out by the first author was designed to directly manipulate attention in a visual search task and observe its effect on subsequent perceptual identification. In the first phase of each of the experiments, words were presented at a rapid rate (e.g., 300 msec/word) at the same visual location so that words were subject to both forward and backward masking. Subjects were instructed to search through these words for members of a specified target category (e.g., animal names). The phenomenological experience in this task is not one of actively searching through a list of words but rather of members of the target category "jumping out" or being seen clearly against a background of visual noise that comes from the presentation of nontarget words. This experience of only seeing the target words has been attributed to there being an attentional response to the target words but not to the nontarget words (Shiffrin & Schneider, 1977). The notion seems to be that both targets and nontargets are fully processed but only target words gain awareness. In a second phase of each experiment, words that had previously served as targets and those that had served as nontargets were mixed with new words and presented for a test of perceptual identification. For this test, words were flashed for a short duration (e.g., 35 msec), followed by a mask, and subjects were to report the word that had been flashed.

If attention plays a role in producing the effect of repetition in perceptual identification, the probability of identifying words that served as targets during the first phase of the experiment should exceed that of identifying words that served as nontargets. Prior target words, however, may gain an advantage due to repetition of the category in addition to any advantage gained from repetition of the particular words representing that category.

That is, an advantage in later identification of prior target words may be due to attention to their category rather than being due to attention to the particular words. In support of this possibility, Fisk and Schneider (1983) have employed a visual search task and found substantial transfer from searching for a given set of targets to searching for new targets from the same taxonomic category. To check the sufficiency of this possibility, some of the words that were new on the identification test were taken from the target category, making it possible to separate effects of category repetition from those of repeating particular words.

In the first experiment, subjects were instructed to search through a rapidly presented list of 40 items for either animal names or clothing names. Both animal names and clothing names were included in the list so that members from the one category served as nontargets while those from the other category served as targets. The 40-word list comprised 6 target items, 6 nontarget items, and 28 fillers. Half of both the target and nontarget items were high-frequency words and the other half were low-frequency words. After the list had been presented, subjects were asked to recall the target items that had appeared in the list. In a second phase of the experiment, a test of perceptual identification was given. New words on this test were equated in number, category membership, and frequency in the language with old words, words presented in the first phase. The probability of perceptual identification served as the primary dependent variable.

The results of the first experiment are displayed in Table I. In line with the results of prior experiments, high-frequency words were more likely to be correctly identified than were low-frequency words, and words that were old were more likely to be correctly identified than were words that were new on the perceptual identification test. More important, the effects of prior presentation were larger for words that had served as targets in the prior "search" phase than for words that had served as nontargets. That

TABLE I

PROPORTION CORRECT PERCEPTUAL IDENTIFICATION AS A FUNCTION OF PRIOR ATTENTION

	Category			
	Target		Nontarget	
Frequency	Old	New	Old	New
High	.86	.69	.76	.72
Low	.53	.40	.46	.44

is, the effect of previously presenting a word on its later identification did depend on attention to that word during its prior presentation. Furthermore, the effects of prior presentation were restricted to the particular target words that had been presented rather than generalizing to new members from the target category. Items from the target category were not identified any more readily than were new members from the nontarget category. Later experiments in this series confirmed the advantage of the target words over nontargets and furthermore demonstrated that the gain was actually at the expense of the nontargets, a further confirmation of the effect of attention in a prior episode on later perceptual identification.

In combination, these experiments strongly support the notion that attention on a single prior trial does affect perceptual identification. The marked effect of attentional variations during a single prior episode certainly does not suggest that the perception of a word is largely based on an automatic process that changes only across many trials. Rather it provides another area in which there is a clear continuity between the bases of perceptual identification and explicit episodic memory tasks.

3. *The Effect of Variability in Prior Processing Episodes*

More qualitative variations in attention in a prior processing episode also affect perceptual enhancement. The experiments described in this section demonstrate that variability in processing due to manipulations of context and task play a role in determining perceptual effects that are comparable to that observed in recognition memory and recall. And, as with these explicit episodic memory tasks, the effects in perception critically depend on the compatibility of the study processing with that demanded at the time of test.

Variability in perceptual processing is evident in the research designed to specify the unit of processing that underlies speech perception or reading. McNeill and Lindig's (1973) findings for speech perception provide a clear example. They note that Savin and Bever (1970) required listeners to detect the presence of phonemes or syllables in a list of syllables; they used the shorter detection latency of syllables to conclude that syllables are the unit of speech perception. The important extension of this finding reported by McNeill and Lindig is that minimum reaction times occur whenever the linguistic level of the target and that of items in the search list are the same. Phonemes are detected most rapidly in a search list comprising phonemes; syllables are detected most rapidly in a search list comprising syllables; etc. It is the match between the target and search lists rather than the particular level of the unit that is important. Thus, no one level of unit is more "real" or fundamental than is any other level.

In a parallel to the data used as evidence for the encoding specificity principle, the match between the unit of study processing and that of test has also been shown to be important for the effects of training on later perception. In their investigations of the reading of inverted text, Kolers and Magee (1978) required students to either name letters or read text as training for subsequent letter naming or text reading. Transfer was maximal when the units presented for test matched those of earlier training. Practice in reading text was good training for reading text but provided less transfer to letter naming than did prior practice naming letters. Similarly, reading of text benefitted more from practice reading text than from practice naming letters. Letters in a textual context are apparently processed differently than are letters in isolation, and the similarity of processing at study and test is important for transfer.

Effects that can be attributed to a mismatch in unit size have also been found in investigations of perceptual identification of words. Osgood and Hoosain (1974) report that presenting wordlike nominal compounds such as *peanut butter* did not enhance later tachistoscopic identification of the individual words in the compound. In contrast, presenting nouns in ordinary noun phrases (e.g., copper block) was found to result in later enhanced identification of the nouns in isolation. They interpret their results as evidence that the meaning of the individual words in nominal compounds is lost in the larger unit and that this change in meaning is responsible for the lack of an influence on later identification of the individual words. Perceptual identification is seen as utilizing feedback from central mediational processes concerned with meaning. The use of nominal compounds, however, is not the only means of finding an influence of context change on later perceptual identification. Monsell and Banich (1983) presented words either individually or embedded in a sentence during training and then presented words individually, intermixed with nonwords, for a lexical decision test. The effect of the prior presentation on later lexical decisions was reduced when the words were presented in sentences rather than individually.

Jacoby (1983b) has also demonstrated processing specificity effects in perception resulting from variations in the amount of data-driven or conceptually driven processing during the prior presentation. In his experiments, a word was presented to be read either in isolation (xxxx *cold*), or in the context of its antonym (*hot cold*), or was not presented to be read but was generated from its antonym as a cue (*hot* ???). Later tachistoscopic identification of the target word (*cold*), presented individually, was highest when the word had previously been read in isolation, next highest when the word had been read in context, and poorest when the word had previously been generated but not read. An opposite ordering of conditions was found when a recognition memory rather than a tachistoscopic identification test

was given. Presumably, conceptually driven processing of target words was dominant when they were generated in the first phase of the experiment, whereas data-driven processing was dominant when words were read in isolation. In agreement with prior research, recognition memory improves from increases in "deeper," conceptually driven processing, the processing of meaning (e.g., Craik & Lockhart, 1972). Effects in perceptual identification are reliant on prior processing as are those in recognition memory. For perception, however, it is the extent of data-driven rather than that of conceptually driven processing that is the important determinant of later performance.

These effects due to variations in level and size of unit suggest a way to retain the notion of abstract units that is a key part of the logogen model. One could propose that the units at each of the levels have corresponding thresholds that can be temporarily lowered by their prior use. Effects in perception of the sort that would be taken as evidence of encoding specificity in investigations of memory can then be explained as being due to a mismatch between study and test of the activated units of perception. In contrast to the extreme variability in processing that is thought to be reflected by recognition memory performance, variability in perceptual processing would be constrained to differences in the units that are processed. By proposing units at a number of different levels, however, the number of representations is greatly increased and the generality of at least some of those representations is decreased, which diminishes the attractive simplicity of the model. In addition, this still leaves the difficulty, discussed earlier, with retaining the key notion of a temporary lowering of thresholds. Rather than being temporary, the effects of a prior presentation are so persistent as to cause problems for a logogen model and other hierarchical, abstracted unit models such as that proposed by McClelland and Rummelhart (1981). Further difficulties for a logogen view are created if the visual appearance of a word that is read is remembered and influences its later perceptual identification. Since a word can assume an essentially infinite number of shapes prior to its presentation, there is potentially no representation of its word shape whose threshold can be lowered. Evidence that changes in "surface characteristics" such as the visual details of a word reduce the effect of prior study on later perception is reviewed in Section II,A,4.

In summary, perceptual identification is strongly influenced by variations in the type of processing that occurs on single prior processing episodes. This supports treating much of perception as relying on the same type of memory as do explicit episodic memory tasks. Notice, however, that this does not force us to predict that performance on recognition memory and perceptual identification will always be correlated. Both the Jacoby and

Dallas studies (1981) and the Jacoby (1983b) study show that the two measures can rely on different aspects of the processing in the prior processing episode.

4. *Memory for Surface Characteristics*

By the traditional cognitive framework, the memory underlying the tasks of recognition memory or recall is more specific than that underlying perception. For recognition memory, a person must remember the time and place that an event occurred along with the superficial details of that prior event such as who said what and the particular words that were said. The memory underlying perception, in contrast, has been described as being more general, the superficial details that distinguish one member of a class of events from another having been discarded. In light of this contrast, it is important for us to demonstrate that effects of prior experience on later perception reflect memory for supposedly superficial characteristics of that prior experience.

In trying to make this argument for the effect of superficial details in perception, we must avoid a trap. If we demand that effects in perception be specific to superficial characteristics of an event before being willing to conclude that memory for prior episodes is involved, then we would be demanding that perception reflect more detailed episodic memory than does recognition memory, a task that, by definition, relies on memory for prior episodes. In fact, of course, explicitly episodic tasks often do not reveal an effect of changing supposedly superficial characteristics of an item between its study and test. Even when there are effects on recognition memory of changing the type font of an item (Kirsner, 1973), the speaker's voice (Craik & Kirsner, 1974), or the syntactic form of a sentence (Sachs, 1967), they are often small and sometimes short lived. Although changing environmental context between study and test does have an effect on recall, it does not influence recognition memory (Eich, 1980). Based on this evidence of weak memory for details in episodic tasks, there has been a push toward proposing representations that are at a higher level of abstraction for recognition memory as well as for perception. This emphasis on lack of memory for surface characteristics has led to the claim that it is only memory for meaning that is retained over the long term. The possibility, however, that memory primarily relies on abstract representations has been substantially refuted in a thorough review by Alba and Hasher (1983). In our view, the abstractive notion overlooks the very wide variance among different processing episodes.

Our claims, then, are (1) there is no reason to believe that there is necessarily a difference in the role of abstraction between explicitly episodic tasks and generalizing tasks and (2) the prevalance of abstraction has been overestimated in explicit episodic memory tasks. According to these claims, both kind of tasks can show many effects of surface details. To support these claims, we first shall discuss the factors that vary the importance of surface characteristics in recognition memory tasks. Next, we shall argue that the same factors are important for finding evidence that perception can rely on the details of memory for a prior episode.

Novelty or distinctiveness is one factor that influences retention of surface characteristics as measured by a test of recognition memory or recall. For example, McDaniel (1981) reported better memory for the surface characteristics of the more complicated self-embedded form of sentences than for that of more standard forms. The orientation of text is better remembered if the text was inverted or in some other unusual orientation during study rather than being in a normal orientation (Kolers, 1976). The influence on recognition memory of changes in type font between study and test is larger for nonwords than for words (Hock, Throckmorton, Webb, & Rosenthal, 1981). It seems that surface characteristics are most likely to be remembered in areas in which people have little expertise, resulting in their dealing extensively with the surface characteristics.

The claim that memory for surface characteristics is enhanced when people lack expertise with a particular type or material or task implies that gaining expertise always results in poorer memory for details such as type font, voice, or modality. Characteristics of this sort, however, are so relevant to some tasks that gaining expertise at those tasks should result in better, not poorer, memory for supposedly superficial characteristics. As an example, the interpretation of a sentence sometimes depends on its syntactic form, the particular words that are said, and whether the sentence is spoken by a male or by a female. In this vein, subjects maintain relatively accurate memory of surface characteristics when sentences are high in interpersonal content, leading to surface characteristics having an influence on the pragmatic inferences that are drawn (e.g., Keenan, MacWhinney, & Mayhew, 1977). Memory for the sex of the speaker is also relatively well remembered when the sex of the speaker influences the interpretation of a sentence (Fisher & Cuervo, 1983). Similarly, Hock *et al.* (1981) manipulated the task that subjects engaged in during study such that the type font of a presented item was made relevant to the task under one set of conditions but irrelevant under another set of conditions. A change in type font between study and test produced a larger reduction in later recognition performance when type font had been relevant for the prior task. In essence, if you use it, you don't lose it.

The effects of changing surface characteristics between training and a later perceptual identification test generally parallel those observed in rec-

ognition memory tasks. A change in environmental context does not reduce the influence of a prior presentation of a word on its later perceptual identification (Jacoby, 1983a). The effects of changes in type font are small and restricted to words that are tested in lower case. For words tested in lower case, previously reading the word in upper case produces less enhancement than does having read the word in lower case; significant facilitation, however, as compared to new items, is still observed (Jacoby & Witherspoon, 1982). Morton (1979) reports that reading words in a handwritten format confers as much benefit to later tachistoscopic identification of those words presented in a typed format as does having previously read the words in a typed format. Previously reading a word, however, does more to enhance its later visual perceptual identification than does either having previously heard the word (e.g., Jacoby & Dallas, 1981; Morton, 1979) or having previously generated the word as a response to some cue (Jacoby, 1983b; Winnick & Daniel, 1970) in the experimental setting. Transfer is only reduced, not eliminated, by a change in modality; previously generating (Jacoby, 1983b) or hearing (Kirsner, Milech, & Standen, 1983) a word sometimes does act as a source of transfer for later visual perceptual identification. Transfer between the visual and auditory modality is asymmetrical, being larger for visual to auditory identification of words than for the converse. This asymmetry in transfer might be due to subjects saying words to themselves that are presented to be read during study (Postman & Rosenzweig, 1956). That is, the asymmetrical transfer may be due to differential ease of translation in the direction from the written to the spoken form of a word as compared to the spoken to written form. Although with more difficulty and, perhaps, less reliability, hearing a word does sometimes result in access to the visual form of the word (Seidenberg & Tannenhaus, 1979). It has not yet been determined what proportion of the transfer across modalities, if any, is due to translation between surface forms rather than being due to the involvement of some abstract representation of meaning that is shared by auditory and visual forms of a word. But conversely, there is the same doubt about the necessity of assuming the mediation of abstract representations.

When subjects are required to engage in a novel perceptual task, changes in surface characteristics between practice and test have a substantial impact on perceptual performance. In his investigations of the reading of transformed text, Kolers and his colleagues have found that the effects of prior training are specific to the orientation of the text read during practice; changes in orientation between practice and test typically produce a substantial reduction in the amount of transfer that is observed. Even after a year, there is an advantage in reading speed for sentences that were previously read in the unusual orientation as compared to new sentences read in the same orientation (Kolers, 1976). Furthermore, transfer to reading

sentences in an unusual orientation is specific to the typeface and spacing of letters read during training. Kolers, Palef, and Stelmach (1980) report that skill at reading text improved more from practice naming letters as the order of approximation to English of the letters was increased, but only if the letters were aggregated rather than being widely spatially separated. Furthermore, transfer was substantially reduced if the typeface of letters that were named was different from that of the text that was to be read. Kolers interprets his data as evidence that people remember the operations that they carried out so that no distinction can be made between surface characteristics and meaning; that is, knowledge is always source dependent.

The arguments that surface characteristics can affect perception and that the effect depends on task demands at study were supported in a recent series of experiments of our own. The notion underlying these experiments was that the effect of changing surface structure between practice and a perceptual test, like effects observed in recognition memory, would depend on whether subjects had been required to make use of the surface structure during the prior practice. The perceptual task that was employed was that of requiring subjects to name a degraded version of a picture. This choice of tasks was inspired by the evidence that amnesics are able to name a degraded version of a picture better if they had previously named an intact version of the same picture (Milner, Corkin, & Teuber, 1968). This influence of prior experience on the naming of pictures by amnesics is nearly as large as that shown by normals, although after having named a degraded version of the picture, amnesics profess to have no memory of having earlier named an intact version of the picture. It seemed to us that it is important to find out how specific the influence of prior experience on picture naming is in order to gain an understanding of the memory deficit suffered by amnesics. It could be that the amnesics' transfer only depends on a previously presented picture having the same name as does the later-presented degraded picture. If surface structure is not remembered, practice on the same picture that is to be tested may provide no advantage over practice with a different picture that has the same name. In support of this possibility, Milner (1970) suggests that effects in picture naming revealed by amnesics do not reflect new learning. Rather, the prior presentation of the intact version of the picture is seen as priming its name, information that is already in memory. Alternatively, transfer may be specific to the particular picture that was named during practice. Specificity of this sort would provide evidence that the amnesics are capable of remembering the particular new pictures that they are shown even though they may not be aware that they are doing so. In keeping with one of the main points of this section, we would also expect that this ability would depend on task demands at the time of study.

Our initial experiments were with normals and were aimed at developing

procedures that would give us a fine-grained picture of the role of task demands in the specificity of transfer in both normals and amnesics. The test procedure that we developed uses a digitizer in combination with an Apple computer to vary the degree of degradation of presented pictures. This presentation procedure builds a picture by illuminating point locations on a television monitor. To produce degraded pictures, a portion of the points constituting a plot of a picture were intermixed with noise, points that were extraneous to the plot of the picture. The pictures presented at the beginning of a test trial were extremely degraded; very few points from the picture were presented and were intermixed with a large amount of noise. By pressing the return key on the computer, a subject could clarify the picture by increasing the ratio of points from the picture to noise points. A subject was to continue pressing the return key until he or she could name what was pictured. The number of key presses prior to a correct response along with the total amount of time that elapsed served as measures of perceptual identification performance.

Pictures in the test sequence were either identical to a picture that had been previously presented (identical), shared the name of a previously exposed picture but were not identical to that picture (name match), or were unrelated to any previously presented picture (new). The number of key presses required to identify a picture plotted across these three types of test picture corresponds to a transfer gradient. Extreme specificity in transfer would be evidenced by facilitation of the identical pictures and no facilitation of the name pictures as compared to new pictures. A lack of memory for the surface structure of pictures would be evidenced by no difference in the identification of pictures in the identical and name match conditions.

Several training conditions were run in order to investigate the effect of task demands on the specificity of the transfer. In one condition, subjects were simply instructed to name the presented pictures during this practice phase of the experiment. For subjects in a second condition, pictures were presented in a slightly degraded form and subjects went through a very abbreviated version of the clarification procedure that would be employed for the later test of perceptual identification. The procedure was abbreviated in that it took very few key presses to fully clarify the picture. Subjects in this abbreviated clarification condition were required to clarify the picture until they could name it. After they had correctly named the picture, it appeared fully clarified on the screen. The abbreviated clarification procedure was expected to require subjects to deal more extensively with the visual details of the picture than would simply naming the picture presented originally in a fully clarified form. Because of this differential processing of detail, transfer to the later test phase was expected to be more specific to the picture previously presented for subjects in the abbreviated clarification condition as compared to subjects in the condition that simply named pictures in the first phase of the experiment. That is, having previously clarified the picture should result in more transfer to identical pictures and less transfer to name match pictures than would having previously named the pictures. The results of this experiment are displayed in Table II.

In line with our expectations, the specificity of transfer did reflect the differential processing of pictures during their prior presentation. For subjects who only named fully clarified pictures in the first phase, the perceptual identification measure returns little evidence of memory for surface structure. The number of key presses required for identification did not differ greatly for identical and name match pictures. Test pictures of both sorts required fewer key presses for their identification than did new pictures. In contrast, there is more evidence that surface structure was remembered when subjects engaged in an abbreviated clarification procedure while viewing pictures in the first phase of the experiment. In that condition, identical pictures were identified after fewer key presses than were name match pictures. The difference between conditions in the identification of identical pictures might be attributed to the operations required by the test procedure being more similar to the operations required by the abbreviated clarification procedure than to those required to simply name the picture during its prior presentation. Later experiments in the series showed, however, that instructions to prepare for a forthcoming recognition memory test facilitated later identification of identical pictures nearly as much as did requiring subjects to engage in an abbreviated clarification procedure. Furthermore, requiring subjects to go through a prior full clarification procedure that was identical to that required for the later test did not enhance identification of identical test pictures any more than did requiring subjects to go through only an abbreviated clarification procedure. Results produced by recognition memory instructions and those produced by prior experience viewing a picture by means of going through the full clarification procedure were nearly identical to the results displayed in Table II for the abbreviated clarification condition. Thus, although there was certainly an effect of task demands on

TABLE II

CLARIFICATION STUDY: NUMBER OF BUTTON PRESSES BEFORE IDENTIFICATION

	Identical	Similar	New
Name	37.3	40.7	55.4
Clarify	34.2	45.5	56.2

the specificity of transfer, there was not the specific dependence on the particular extent of clarifying operations that we would have liked.

In a related experiment, Warren and Morton (1982) first presented a set of pictures and then compared the tachistoscopic identification of identical pictures, pictures that only shared the same name as a previously viewed picture (name match), and new pictures. Similar to our results from the abbreviated clarification condition, Warren and Morton found that identical pictures were more likely to be correctly identified than were name match pictures, although both types of picture were more accurately identified than were new pictures. Warren and Morton interpret their results as evidence that perceptual identification of pictures partially relies on an abstract representation of the appearance of objects sharing a name. This abstract representation is termed a *pictogen* and is seen as being similar to the logogens said to underly word perception. The identification of name match pictures reflects the priming of a pictogen. To account for the advantage in identifying identical pictures over name match pictures, Warren and Morton suggest that memory for the particular picture that was previously viewed as well as the threshold of a pictogen can contribute to later perceptual identification.

A hybrid model of the form proposed by Warren and Morton encounters some difficulty accounting for the results of our experiment. Their model does not allow for an influence of task demands during practice on later identification. Some effects of task demands, however, could be easily incorporated by their model. It could be claimed that requiring more attention to the visual detail of a picture resulted in better memory for the particular picture but had no further influence on the threshold of the relevant pictogen. These assumptions would be sufficient to account for any facilitation in the identification of identical pictures that came from requiring subjects to further process visual detail. Requiring further processing of visual detail during the first phase of our experiments, however, not only enhanced the identification of identical pictures but also slowed the identification of name match pictures. This reduction in transfer to name match pictures is difficult to explain within the context of Morton's model since there seems to be no reason to believe that further processing of a picture should raise the threshold of its corresponding pictogen. Warren and Morton admit the possibility that repeated exposure to a picture results in a new pictogen being developed. Rather than number of exposures being the important factor, our results suggest that it is task demands that control memory for detail. One could claim that it is possible to create a new pictogen with a single prior presentation of a picture under some circumstances, but this eliminates the difference between a pictogen model and an instance-based model of transfer. Work that is currently going on in our labs is aimed at finding manipulations of task demands that have a larger influence on the specificity of later transfer. Manipulations of this sort are seen as being important for understanding the performance of normals as well as that of amnesics.

In general, the view that we are advocating is that the role of "surface" characteristics in memory will depend on the prior processing conditions and their match with processing conditions at retrieval. There is neither reason to believe that details are always important at some stages nor that later stages necessarily drop them. And, in keeping with our general point, the variable role of the details of prior processing episodes are visible in perceptual identification as well as in explicit episodic memory tasks.

B. Conceptual Categorization

Concept learning has traditionally been the bastion of analytic and abstractive thinking. For most of its history, in both the hands of the behaviorists and those of the information processors, this field was construed as the study of how people acquired the stable, context-free resources that allow generalization to novel situations. Regardless of whether these resources took the form of prototypes, schemata, frames, diagnostic rules, or even differential habit strength, there was an almost exclusive concentration on the abstraction of the "relevant" (individually correlated with the category) features from the "irrelevant" or "surface" features in the learning instances. In the terms presented earlier in this article, this was a concentration on analytic generalization; generalization based on identifying units by means of relevant features. Recently, however, there has been interest in schemes of concept learning based on nonanalytic generalization, that is, based on the close similarity of new events to whole past events (Brooks, 1978; Hintzman & Ludlam, 1980; Medin and Schaeffer, 1978; Medin & Smith, 1981; Medin & Schwanenflugel, 1981). In line with this literature, our aim in the current section is to show that conceptual categorization does not have to be, and possibly is not usually, dependent on abstract units that change only slowly with experience. We shall also show a dependence on the processing of specific prior episodes comparable to that documented in the previous sections for perceptual identification.

We shall start with a recent experiment from our lab (to be reported in Brooks, Jacoby, & Whittlesea, 1984) that was designed to compare the relative importance of category prototypes and specific experience in determining the ease with which familiar objects could be categorized. Subjects were shown a set of 12 slides (initial study, IS): three cups, three bottles, three glasses, and three "other" glass items, all presented on a plain background. The subjects' task was to rapidly answer one of three categorical questions that immediately preceded the presentation of each slide: "Is it

[the object in the up-coming slide] a cup?", "Is it a glass?", "Is it a bottle?". In a continuous sequence, the subjects were then asked to perform the same task with a test sequence of 38 slides. Three of these slides were category prototypes for the three categories, that is, examples that the subjects after the test series rated as highly typical of the category. If the subjects' categorical judgments were being determined by typicality, by some form of closeness to the prototype, then these prototypes (or at least near prototypes) should be categorized more rapidly than the more deviant examples used throughout the rest of the experiment. And indeed, as is shown in Table III, the prototypes (P) were categorized more rapidly than either the initial items or a set of new items (new different, ND) that were mixed randomly into the test sequence with the prototypes. The ND slides were drawn from the same pool of items as were the IS items, all of which were selected to be easily distinguishable from one another. Thus, the conditions of the experiment were sufficient to obtain the usual classification advantage for more typical members of a category over less typical new items.

The intent of the study, however, was to show the effect of specific experience within the immediate experimental context. Twelve of the test slides were repeats (IS_2) of the IS items, and these items were classified faster than were the prototypes. So far this merely repeats the advantage of specific training exemplars that has been reported from the beginning of the work on prototypes (e.g., Posner & Keels, 1968). The result of major interest, however, is the effect on the categorization times of items that were only similar (new similar, NS), rather than identical, to the IS items. These NS items were selected to be clearly distinguishable from, but also clearly similar to, one member of the IS set; for example, one IS item was a child's yellow cup with a lion painted on it; the corresponding NS item was a blue cup of the same shape that had a dog painted on it and was

TABLE III[a]

VERIFICATION TIMES FOR YES RESPONSES (MSEC)

	Study phase	Test phase			
	IS_1	IS_2	NS	P	ND
Immediate	268	214	225	237	278
24-hour delay	301	207	211	218	245

[a] IS_1, First presentation of initial study items; IS_2, test presentation of initial study items; P, prototypes, items rated as very typical; NS, new similar items, similar to IS items; ND, new different items.

lying on its side. Another pair was two demitasse cups, similar in ornateness, but clearly differing in color, type of decoration, and fluting on the rim. The categorization times of these NS items were in fact facilitated over the ND items. The facilitation of the NS items from one prior presentation of a similar item was sufficient to put them in the vicinity of the prototypes. Again, the major result is that items that only resembled examplars previously seen *once* in the current experimental context were categorized at least as rapidly as items that presumably were receiving the benefit of many hundreds of exposures to cups, bottles, or glasses.

So far the results could be produced by the temporary modification, some form of priming, of stable categorical identification procedures. If so, then these results would require only a mild modification of the view that attributes the lion's share of processing variance to a stable cognitive prototype. The results of a test series, however, that was run 24 hours after the 12-slide IS series were the same in the order of comparisons mentioned above. The duration of the effects suggests specific learning rather than a temporary, rapidly decaying modification of an essentially stable identification routine, such as a prototype or pictogen. Whatever is different about the experimental context and whatever is distinctive about the items as presented on the slides are sufficient to weigh impressively against any stable structures that might be operating. Both this study and the picture clarification study shown in Table II show the same strong effect on picture categorization of the supposedly irrelevant aspects of prior processing episodes. These results are also reminiscent of the finding that one prior trial of a words presentation (in Jacoby & Dallas, 1981) essentially wiped out a word frequency effect; word frequency, like the current effect of typicality, presumably is based on many hundreds of trials of accumulated prior experience. None of these studies rules out the possibility that under some circumstances there is a general abstracted form of knowledge available for the categorization of new objects. But they do demonstrate that this form of knowledge does not operate in a clear field; the lessons of specific experience are impressive competitors with material that is well within the range acceptable for testing prototype theories.

The object identification study, just described, and the clarification studies were originally aimed at different literatures and probably reflect the different backgrounds of the two authors. The clarification study is focused on variations in the processing of the same stimulus due to task demands, a characteristic of recent memory research. The cups–bottles–glasses experiment, in keeping with the concept-learning literature, is primarily concerned with the basis of transfer to new stimuli. Yet they both demonstrate the importance of individual prior processing episodes for picture identification. This type of convergence reinforces our belief that the processing

episode perspective encourages cross-talk among areas often seen as separate: in this case, incorporating processing variations in concept-learning studies and concern about the structure of a transfer space in studies originating in memory problems.

The importance of considering variations in the processing of individual items was shown in a set of concept-learning studies that debated the conditions under which one would expect analytic as opposed to nonanalytic generalization. The studies, reported by Reber and Allen (1978), and, in reply, Vokey and Brooks (1983), all used strings of consonants, such as *TTXMT* and *VXM*. The order of the letters in these strings were sequenced according to an artificial grammar whose existence was mentioned to the subjects only after a set of the strings had already been studied. Reber and Allen proposed that presenting the strings as the stimuli in paired-associate learning (*TTXMT-Denver, VXM-Boston*), as had been done by Brooks (1978), would encourage subjects to differentiate the strings and would subsequently allow only nonanalytic transfer to new strings; that is, a new string would be categorized as having been generated by the same set of rules used for the study items only if it had close overall resemblance to at least one of the study strings. But if the subjects were merely to observe strings as they were being shown at a 5-sec-per-item rate, then conditions would be sufficiently nondirective that *implicit* abstractive mechanisms would be free to operate. Under this condition, then, Reber and Allen expected subjects to show analytic transfer, that is, categorization based on the grammaticality of the new items rather than their overall similarity to individual old items. Their results showed that subjects in the observation condition were, if anything, more accurate at categorizing than were those in the paired-associate condition. If one expected better nonanalytic transfer when the items were learned better, then this result would suggest that something other than nonanalytic transfer was operating; it was the observation condition, which produced less accurate recognition memory for the old items, that showed more accurate classification of the new items.

Vokey and Brooks argued that these results did not require hypothesizing that the subjects were unconsciously abstracting the grammar. Instead, as a result of differences in item processing among the study conditions, the old items might be generalizing to different ranges of new items. The old stimuli in the paired-associate conditions could be so differentiated that they would seem similar to few of the new items. As a result, responding to the new items would show few false alarms in recognition memory and few "grammatical" responses; only a small number of the new items would be seen as similar enough to any of the old items to be judged as probably having been generated by whatever rules had generated the old items. The items studied under the observation condition would be expected to show more false alarm recognitions and more classifications as "grammatical." Since in a rule system of this sort the grammatical items might be expected to resemble one another more than they resemble the ungrammatical items, responding with the laxer criterion of similarity used by the observation, subjects would be expected to produce more correct responses than would the more stringent criterion used by the paired-associate subjects. An even more stringent shift in criterion was expected in an additional condition in which subjects were given mnemonics for the study items (*VXM* = virgins expect miracles). To evaluate these possibilities, test items were used in which grammaticality and similarity to old items were unconfounded. For example, *VXR* differs in just as many letters from *VXM* as does *VXT,* but *VXT* violates the grammar that generated all of the study items and *VXR* does not; using both of them as test items allows us to unconfound the two variables that are normally confounded in the world and experiments alike. The results showed that a large majority of the variance was accounted for by the hypothesized shift in criterion of similarity to old items, leaving little, if any, reason in these data to hypothesize implicit abstraction. As in previous studies discussed in this article, the intent is not to claim that abstractive, analytic transfer never occurs. But these results do show the importance of nonanalytic transfer as well as the usefulness of considering variations in the processing of individual items in concept-learning experiments.

Again, this Vokey and Brooks study has an interesting parallel with the clarification study (Table II). In both cases the major manipulation was designed to vary the specificity of processing at study. In both cases greater specificity of processing of the study items decreased the range of categorical generalization, that is, no facilitation of the perception of other pictures in the same category and fewer judgments of "grammatical" for similar items. Thus, both pictorial identification and judgments of "well-formedness" showed sensitivity to a processing variable that normally has been associated with explicit episodic memory tasks. And finally, both studies were directed against the same type of claim: Implicit grammars and prototypes are the same sort of abstract resource as the logogens and semantic nodes on which human cognition was supposed to have routinely depended.

The variability of processing and its later effects on conceptual categorization raises a problem: The training conditions embedded in the common paradigms may be giving us a one-sided picture of generalization—a residual bias because of cognitive psychology's long emphasis on analytic generalization. Both the rule tradition (Bruner, Goodnow, & Austin, 1956; Bourne, 1974) and the "fuzzy category" tradition (Rosch, 1978; Posner & Keele, 1968) often use training conditions that do not encourage reasonably well-integrated processing of training items: Many similar stimuli are presented for few trials per item, with little information unique to the individ-

ual items. Even when unique information is given, it often simply adds to the load already imposed by the original volume of categorical information. Such training conditions are quite natural to select if the investigator already is thinking of concept learning as an analytic process, as normally being a shortcut that learners use to avoid having to learn about all of the variants of a category. But these experimental conditions are exactly those that might provide a strong motivation for the learners to reduce their learning load by analysis, by isolating a few predictive features. Even in experiments in which signs of nonanalytic transfer have been found, it often seems to result from the classification rule being so complicated that the subjects are virtually forced into individuating the items (Brooks, 1978; Medin & Schaffer, 1978; Vokey & Brooks, 1983). These considerations suggest that there are normal, even common, learning conditions that are not being represented in the concept-learning literature. For example, we often have relatively extensive interactions with a few instances of a new category before we are exposed to large numbers of them. A child's exposure to the family dog or furniture, or an adult's exposure to new equipment are examples. Furthermore, these exposures are likely to be confounded with particular contexts, a fact that suggests the possibility of context-specific generalization. The point is, a consideration of the conditions of processing at study could be very important in the concept-learning literature as well as in perception and memory.

One of the properties of nonanalytic transfer that has not been appreciated in psychology until recently is that it will produce many different patterns of results when applied to domains with different structures. Hintzman and Ludlam (1980) demonstrated that a strictly instance-based model could simulate results that have been taken as strong evidence for prototype theories. For example, previously unseen prototypes would be responded to at the same or better level than the old items from which they presumably had been derived, and the advantage of the prototype increased over time—presumably as the details of the individual instances were forgotten. These results arise in a theoretical stimulus space in which the training instances are clustered around the center, the prototype, of the distribution. If, in the instance model, the new items are responded to better the closer they are to an old item, then new items near the middle of a centrally clustered distribution will be responded to best. The central clustering of the old instances, argued by Rosch (1978) to be typical of natural categories, also means that if an item on the periphery is forgotten, then the effect on subsequent classification will be more severe than will be the forgetting of an item in the center where there are other neighboring old items. The results of Hintzman and Ludlam's simulation, in which an instance-based model simulated abstractionist results, suggest the same type

of caution in attributing observed consistency to a single, central abstraction that we have been urging throughout this article.

With different distributions of study items and with different degrees of integration in processing, however, a nonanalytic model can in principle produce a variety of outcomes other than the classic abstractionist patterns. This is well illustrated in a series of experiments by Whittlesea (1983) for both conceptual categorization and perceptual identification. Whittlesea's materials were pseudowords generated as variations from two prototypes: *nobal* and *furig*. Some of the variations on the *furig* prototype are shown in Fig. 1. The pseudowords could vary in the number of letters by which they differed from the prototype; all of the pseudowords on the second ring, for example, differ from the prototype by two letters. They could also independently differ from a training item by various numbers of letters; if

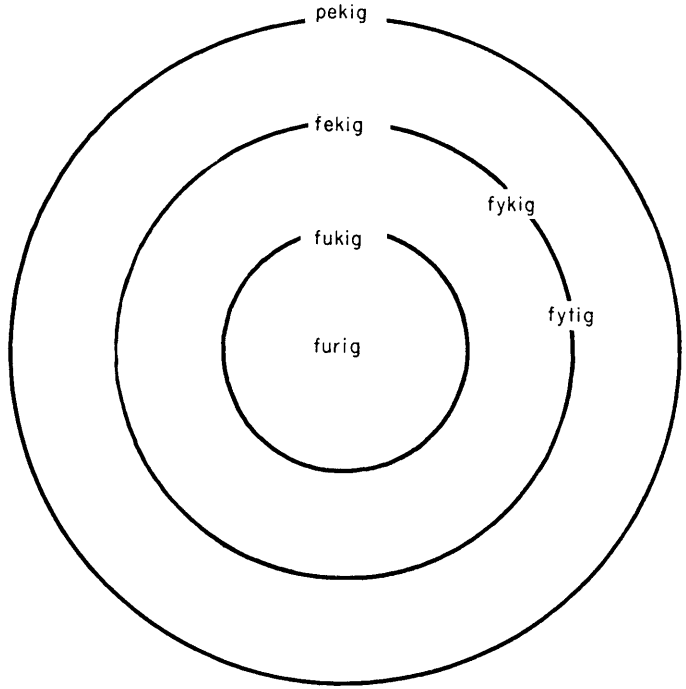

Fig. 1. Schematic representation of one set of stimuli from Whittlesea's experiments (1983). *Furig* is the prototype for this set. *Fekig, fykig,* and *fytig* all differ by two letters from the prototype. If *fekig* is a training item, then *fykig* and *fytig* would be test items that differ from it by one and two letters, respectively. These stimuli were used to unconfound distance from old and distance from the prototype.

fekig were a training item, then *fykig* and *pukig* would differ from it by one and two letters while still being only two letters from the prototype. In the perceptual identification studies, training simply consisted of three trials of copying down the training items as they appeared one at a time on the screen. The perceptual identification measure was the number of letters correctly reported in position in a rapid, masked presentation of the pseudoword. In the classification studies, the subjects were told that they would be shown two classes of pseudowords, some of which were nouns and some of which were verbs. Training consisted of three trials of copying down the pseudowords that were labeled as nouns with an *-ism* affix, *fekigism* from *fekig*; or, those labeled as verbs with an *-ing* affix, *notyling* from *notyl.* The dependent variables were the accuracy and confidence of classification of the same test series used in the perceptual identification studies.

Since the results were essentially the same for both the perceptual and the classification studies, they will be discussed together. If training consisted of three trials apiece on a few items (five from each prototype) on the second ring, then new test items from the first ring (closer to the prototype) were classified and seen better than items on the third ring—a simulation of the prototype results. The *new* items on the second ring, however, were responded to better if they were one away from the nearest training item than if they were two away, which suggests that analogy to the old items was important. But if the training items were moved out to the third ring, then there was little facilitation of response to the items on the first ring, even though the nominal prototypes, *furig* and *nobal,* were still the centers of the distributions. In this case one would expect a much smaller advantage for being close to the apparent prototype, an expectation that was confirmed. For example, a one-away (from closest old) item on the fourth ring was seen and classified better than a two-away item on the third ring; in this case, closeness to the apparent prototype was outweighed by closeness to the training item. The general picture given by these results was confirmed in detail in several other studies and analyses.

The point of these experiments is that nonanalytic transfer is observed when the encoding of items is reasonably well integrated, as presumably was assured by the subjects' prior experience with word pronunciation [which itself could be due at least partially to analogy (Glushko, 1979; McClelland & Rummelhart, 1981)]. Experiments in progress are designed to vary the degree of integration of the processing at study and hopefully produce the variations in ranges of transfer shown in the Vokey and Brooks studies. The hope here is to continue in the direction that we have been advocating in this article, namely, varying the type of processing at study in order to change the type of generalization. There is no reason to assume that all generalization is analytic, based on units abstracted over a large number of previous trials.

Finally, we would like to make two additional comments about nonanalytic transfer. The first is that the conditions under which abstraction, be it deliberate or automatic, provides an effective approximation to the complexity of the world are far more circumscribed than is generally appreciated. It strains credulity that people can do some of the pieces of analysis that they would have to do to produce the various unconscious orthographies, grammars, social systems, and game strategies that abstractionist theories attribute to them. Nonanalytic generalization can simulate these structures without requiring incredible feats of analysis, as demonstrated, for example, by the ability of McClelland and Rummelhart's (1981) interactive model to simulate English letter sequence rules without having any such rules directly represented. In addition, nonanalytic transfer is, by its very nature, likely to be very sensitive to local variations in complicated domains. This sensitivity to local variations could be important for fast, accurate perception as well as for conceptual categorization. The point is, under some circumstances, nonanalytic generalization is the process of choice, particularly if one is trying to account for where the cognitive resources came from (Brooks, 1983).

Our second comment is that we have been speaking as if nonanalytic transfer involves only the single most similar instance or episode. In fact, the context model of Medin and his colleagues (Medin & Schaffer, 1978; Medin & Smith, 1981), Hintzman's Minerva II model (Note), and Whittlesea's high metric (1983) all allow an effective influence of several similar items. This has the effect of computing a very local average at the moment of test, a local "chorus of instances." Since it is local, it would have some of the advantages of (small sample) averaging and yet still be able to simulate a complicated domain.

C. A Summary of the Parallel: A Processing Episode View of Generalization

In the preceding sections, we have argued that the generalizing tasks of perception and categorization are as susceptible to the influences of individual prior episodes as are the explicitly episodic memory tasks, such as recognition and recall. We have attempted to document parallels between the two types of tasks on characteristics that traditionally were supposed to distinguish them. Both types of task show a long-term effect of individual prior episodes, not just the temporary priming that was supposed to be distinctively true of perception. They both show selective effects of attention and of the quality of encoding in single prior processing episodes. And they both show specific and variable effects of the nominally irrelevant surface features of an item's presentation.

In this preceding discussion, we were arguing against the abstractionist framework that has long dominated cognitive psychology. In that framework generalization was supposed to be carried out almost exclusively by means of units that were abstracted across nominally irrelevant surface information. Since that framework sought to understand cognition by means of a stable architecture, it tended not to look for variation due to changes in the specific situation. This encouraged premature conclusions about the invariability of processing; that is, it suppressed the search for different relations among tasks. In our view there are a variety of ways various cognitive tasks can be accomplished, and consequently there are probably a variety of relations among tasks. In attempting to understand the relationships among these tasks, we are arguing for the heuristic value of paying close attention to the type of processing carried out at study and the compatibility of the prior processing with that demanded at the time of test.

In the following section, we shall apply both sides of this approach to topics in episodic memory. That is, we shall try to document relationships among different tasks that are too variable to encourage interpretation in terms of stable systems. And we shall illustrate the heuristic value of close attention to processing conditions for topics that have not normally been treated this way.

III. Nonanalytic Processing in Explicit Episodic Memory Tasks

Abstractionist assumptions have had an effect on theorizing about explicit episodic memory tasks as well as on the generalizing tasks discussed in the preceding section. In this section, we shall discuss two issues for which we believe an approach that stresses the explanatory value of variable processing yields a wider perspective than does the traditional view.

A. Separate Memory Systems and Memory for Source

Failure to remember the source of information that is itself remembered has recently become an important topic in memory research. In its mild form, examples of this phenomenon are commonplace; we often remember having previously heard some opinion or argument being expressed without remembering who expressed the opinion or made the argument. At an extreme, forgetting the source of a message takes the form of remembering without awareness; people's performance provides evidence for memory of a prior experience even though they deny being able to remember it at all. Amnesics provide the most dramatic examples of source amnesia simply because their explicit, reflective memory performance is so bad. For example, amnesics show gains from practice of a pursuit-rotor task (Corkin, 1968), despite claiming that they don't remember having ever performed the task before. In a more cognitive task, amnesics show the effect of a prior reading in their speed of reading inverted text (Cohen & Squire, 1980). In another clearly verbal task (Jacoby & Witherspoon, 1982), amnesics gave more low-frequency spellings of homophones (e.g., *reed* rather than *read*) when they had recently *heard* the homophone in a question that biased its meaning toward the low-frequency spelling ("Name a musical instrument that employs a reed"). This effect in spelling was independent of recognition memory for the previously heard homophones. Similar types of dissociations have also been found with normals. For example, the influence of a prior presentation of a word on its later perceptual identification can be statistically independent of recognition memory of the word (Jacoby & Witherspoon, 1982; in addition to similar evidence in Jacoby & Dallas, 1981; and the Jacoby, 1983b, studies described earlier). Effects of prior experience with words in the completion of word fragments (Tulving *et al.*, 1982) and the reading of inverted text (Kolers, 1976) have also been found to be independent of recognition memory.

The dissociation of memory for source and memory for content is usually attributed to the two types of information being represented in different memory systems. The preserved memory for content in amnesics is said to rely on semantic memory (Kinsbourne & Wood, 1975), procedural memory (Cohen & Squire, 1980), or some other memory (Tulving, 1983). Memory for source, as tested by recognition memory or recall tests, is supposed to rely on a separate memory system: episodic (Tulving, 1983) or declarative memory (Cohen & Squire, 1980). These proposals of separate memory systems encounter problems similar to those faced when proposing separate logogen systems or different units of analysis to describe interactions between memory for surface and that for meaning. In the face of specificity of effects, such as those reviewed earlier in this article, one is forced to increase the number of logogens, the levels of units, or the memory systems proposed. As the number of abstract representations is increased, the difference between a purely episodic view and an abstract representational view is reduced. If one tries to limit this proliferation by allowing some combination of memory for prior episodes and more abstract representations to mediate cognitive behavior, then the factors that choose the level of representation that is most important for a particular combination of study and test circumstances must be specified. Specifying these factors seems to necessarily involve examining interactions among tasks, materials, and subject differences—the approach that we advocate as a starting point. The point is that such a hybrid of abstractions and particulars does not achieve

the situational independence, the prediction of function from the nominal task that was once a selling point for an abstractive view.

Another major difficulty for these accounts is that the relationship between memory for source and memory for content is a variable one. Although effects of prior study in perceptual identification and recognition memory are sometimes independent of one another, dependence is also sometimes found. For example, Witherspoon (Jacoby & Witherspoon, 1982) found independence between perceptual identification and recognition memory of words, but found dependence between these measures when pseudowords were used. Again, if one were to try to explain these variable relationships by saying that sometimes the systems were sensitive to the same factors and sometimes they were independent, one would have to specify increasingly complex situational variables, an approach, we suspect, that will not turn out to be sufficiently flexible.

We expect variable relations between measures of source and content in memory for the same reasons we used to understand the variable relations between memory for surface information and memory for meaning. In fact, by our view, the problem of source amnesia is identical to that of forgetting surface characteristics. Although not usually described as such, the finding that a change in voice between study and test has no influence on recognition memory could as well serve as an example of source amnesia as an example of forgetting of voice information. Memory for the voice in which a communication was heard constitutes a part of the memory for the source of the communication as does memory for the particular words and syntactic form that were used to convey the communication. When source is identified with memory for a prior episode, as is done by employing tests of recognition memory, memory for surface characteristics is clearly implicated. The particular aspects of surface characteristics that are thought to be important usually are not specified. But when they are, it is usually memory for the time or the location of the prior presentation of an item that is said to be important. It seems to us that time and location do not differ in kind from other surface characteristics such as typeface or syntactic form.

By identifying source with surface characteristics, Tulving and Kolers can both be seen as taking too extreme a position on the relationship between memory for source and memory for content. By our reading of Tulving's position, his claim is that content is always remembered separately from its source, since the two involve separate memory systems. The content along with its surface characteristics constitute an episode that is retained in episodic memory, whereas the content stripped of its surface characteristics is represented by an abstract representation in semantic memory or some other memory system. It is this abstract representation that is said to be

responsive to "priming" and whose existence allows effects in perception to be independent of recognition memory judgments. By Kolers' view, in contrast, content is never remembered separately from its source since it is the operations by means of which the knowledge was acquired that are remembered. In view of the variable memory for surface characteristics shown in investigations of recognition memory and perceptual identification, both positions appear to us to be too extreme. It seems that sometimes source is remembered separately from content, sometimes forgotten although the content is remembered, and sometimes largely ignored; that is, analytic processing is possible. On the other hand, source and other surface characteristics are sometimes very well remembered and are not easily separated from memory for content. That is, processing is sometimes nonanalytic in the sense that source and content are not treated as being separate dimensions.

In our view, the details of prior processing are critical in determining the relationship between performance on tests of explicit memory for source and effects of varying source between study and test. Of particular importance is whether source and content were treated as being separate or as being more integral during the prior processing episode. As an example, consider memory for a seminar that one has attended (cf. Keenan *et al.*, 1977). Interpreting a comment or a theoretical argument made by a participant in the seminar is the processing episode. One could treat the speaker and his comments as separate aspects of the episode. If so, we would expect that presenting the comments for test in the same or a different voice would have little influence on recognition memory or perceptual identification. If the content were remembered separately from its source, then memory or perceptual judgments about content would not rely on the accessibility of memory for source. Even though manipulations of source between study and test had no effect, however, an explicit test of memory for source could still show that source was remembered. The source was an aspect of the same processing episode as was the content, allowing the content to be used as a cue for recall of the source. But this recall of the source would *follow* recognition memory or perceptual identification of the content rather than being integrally involved in that recognition memory or perceptual identification. When source and content are treated as being separate during the prior processing episode, identification of source on an explicit memory test would be expected to be independent of effects of maintaining versus changing the source when requiring memory or perceptual judgments. We would interpret this independence as evidence that processing had been analytic with regard to memory and source in the prior processing episode rather than as evidence that different memory systems were involved.

Our analysis would be favored, if not compelled, by the contrasting case

of integration of source and content. For example, the speaker's comments might have been high in interpersonal content, so that the content of the communication could not easily be interpreted separately from its source (Keenan *et al.,* 1977). As a result of this more nonanalytic processing, presenting the comments in the same rather than a different voice for test would result in a person being more likely to claim to have heard the comments before or later being more able to interpret a perceptually degraded version of the comments (identifying words in the comments when they are later played through noise, completing word fragments, tachistoscopic identification, etc.). Not having been separated during prior processing, memory for source would contribute to memory and perceptual tests of content rather than being accessed after the content is recognized or perceptually identified. After nonanalytic processing, we expect dependence between recognition memory or perceptual judgments and explicit memory for source, since source and content cannot be initially accessed separately from one another. Effects of source on judgments, however, can still be accompanied by a failure to show explicit memory for source. Indeed, an increase in dependence between recognition memory or perceptual judgments and explicit reports of source might even be accompanied by a reduction in the overall accuracy of explicit reports of source. When given a test of explicit memory for source, subjects are being asked to treat memory for source separately from memory for content. The tighter the integrality of the prior processing of source and content, the more difficult it would be to later separate them. Increasing the integrality of the prior processing of source and content, then, could have the apparently paradoxical effects of increasing the effects in recognition memory or perceptual identification of manipulating source between study and test while decreasing the probability that a person will show evidence of explicit memory for source by being able to report the source, isolating the source from the content. When people encounter difficulty isolating memory for source from that for content, it seems possible that they abandon attempts to do so, and they employ a more nonanalytic basis for responding even when a given explicit tests of memory for source. That is, rather than attempt to isolate memory for source from that for content, subjects may use a basis for responding that reflects the combined effects of memory for source and that for content. We consider this possibility in the next section.

B. Nonanalytic Judgments in Explicit Memory Tasks

To this point, we have argued that the generalizing tasks of perceptual identification and conceptual categorization can be performed in two general ways: analytically and nonanalytically. The difference between analytic and nonanalytic judgments can be characterized as the extent to which subjects rely solely on definitionally relevant information. When subjects are asked to categorize a new object, they are being asked to assess whether this object has the characteristics that generally determine membership in the category selected. If this is accomplished by noting that the new object has great overall resemblance to a known member of the category, then the definitionally relevant and definitionally irrelevant information are not being analyzed apart. Similarly, if the person is asked to identify a word, he or she is not being asked directly to assess the similarity of the item to its occurrence in a prior processing episode. Basing the identification on a particular prior processing episode is again not fully analyzing the definitionally relevant from the nominally irrelevant details.

Our argument has been that cognition has consistently emphasized analytic processing, with consequent limitation of perspective in experimental designs and theorizing. We now apply the same argument to explicit episodic memory tasks. In tasks such as recognition memory, the subject is asked to judge prior occurrence. Any information that links the item to a specific prior episode is definitionally relevant for the task. But the judgment could also be made by a fluency heuristic, namely, "If I can process this item so much more easily than other items in the list, I must have seen it before." If recognition memory is accomplished by a heuristic such as this, one that does not separate definitionally relevant from irrelevant information, then it is being accomplished in a way that is nonanalytic in the same sense that we used for the generalizing tasks. In this case also, we believe that there has been too strong a tendency to treat these tasks as if they could only be done using definitionally relevant information. In the following sections, this analysis will be applied to three types of tasks for which prior episodes are definitionally relevant. Again, we shall argue that considering the heuristic, nonanalytic ways in which the task can be done will result in a broader perspective on the problems. And, as with the generalizing tasks, the mode of processing at the time of judgments will depend heavily on details of the prior processing, details that are too variable to encourage treating memory judgments as reflecting the operation of discrete, independent memory systems.

1. Nonanalytic Judgments of Recognition Memory: A Fluency Heuristic

Mandler (1980), as well as others (e.g., Atkinson & Juola, 1974), has suggested that recognition memory judgments can be based either on familiarity or on the retrieval of study context. The retrieval of context is the more analytic and the more conservative basis for recognition memory in that the context in which the test item occurred is definitionally relevant

for a test of prior occurrence in a particular, usually the current, context. For analytic memory judgments, such as the reconstruction of an event, a person can engage in more analytic processing to gain external justification. In contrast, recognition on the basis of familiarity can be seen as being a nonanalytic judgment that is similar to judgments made in concept-learning experiments that are attributed to intuition. In concept-learning experiments, classification on the basis of overall similarity, which we have characterized as nonanalytic judgments, result in the relevant dimensions not being isolated from definitionally irrelevant ones; consequently, a decision cannot be justified by specifying the defining dimensions. If pressed for justification, the learner is likely to claim that his or her classification was based on intuition or, simply, a guess. This combination of above-chance classification performance accompanied by the claim that classification performance is based on guessing or intuition is a relatively common one and is reminiscent of the dissociation shown by amnesics. When presented with word fragments as cues for recall of words in a previously studied list, amnesics are able to correctly complete the fragments although they claim to be only guessing (Weizkrantz & Warrington, 1975). A claim of a feeling of familiarity as a justification of memory recognition, like a claim of intuition in categorization, is sometimes deemed unsatisfactory, barely differing from a guess. In general, recognition memory based on the feeling of familiarity has several aspects in common with intuitive categorization. For both, the judgment is relatively rapid, not easily justified, and subject to error.

If familiarity were a directly accessible attribute of an item in memory, then judging on the basis of familiarity would still have a considerable quality of analytic processing. We would prefer, however, to view familiarity as an attribution rather than an attribute. Some items on a recognition memory test are processed more fluently than others, and this difference in processing can be used as a heuristic for the recognition memory decision. Recognition memory judgments based on judgments of relative fluency are nonanalytic in that the definitionally relevant dimensions relating to the prior presentation of an item in the experimental setting are not isolated from definitionally irrelevant aspects of an item that contribute to its fluency of processing. For example, frequency in the language influences ease of word identification but is not definitionally relevant to a recognition memory judgment. Also, whether the item is written in the same format is definitionally irrelevant to whether the item itself had occurred previously, but it could contribute to ease of processing and a recognition judgment based on it.

This use of fluency of processing to judge prior occurrence is similar to using the availability heuristic to estimate probabilities (Kahneman & Tversky, 1973). When using the availability heuristic, a person infers that a class

of events is a probable one if an instance of that class can readily be brought to mind. When using the fluency heuristic, the person infers that an item must have occurred before if it can be processed relatively more easily. In both cases, subjects in principle also have recourse to means of making judgments that are more analytic. Contrary to one's expectations, if only a nonanalytic heuristic were being employed, judgments of recency and judgments of frequency (probability) can apparently be based on different information, being relatively independent of one another (Underwood, 1969). Our account of the fluency heuristic differs from that of an availability heuristic in placing greater emphasis on variability in encoding and retrieval processes than did Kahneman and Tversky. That is, we attempt to explicate differences in fluency by referring to current theorizing about memory and concept formation.

Reliance on a fluency heuristic for recognition memory judgments would result in a correlation between ease of perceptual identification and the probability of calling an item "old." That is, words that are readily perceived should be judged to be old. Feustel, Shiffrin, and Salasoo (1983) have presented data that shows such a correlation between perceptual fluency and recognition memory judgments is sometimes obtained. Their procedure for testing perceptual identification involved intermixing the presentation of a word and that of visual noise; the visual signal-to-noise ratio of the printed word was slowly increased so that the presented word appeared to clarify across time. The increase in clarification continued until the presented word could be named, providing a measure of identification time. After a presented word had been named, it appeared fully clarified and subjects were required to judge whether the word had been presented previously. In this procedure, words that were readily perceived were likely to be judged as being old. The correlation between identification time and the false alarm rate was $-.78$, showing more rapid perceptual identification of words that gave rise to false alarms as compared to those that were correctly rejected. For "hits," the correlation between identification time and the hit rate for items on their second presentation was $-.84$. For both hits and false alarms, then, subjects were likely to judge words that were readily perceived as being old. Conceivably, this correlation could be interpreted as resulting from words that were mistakenly judged as being old being processed in a faster, less cautious manner. We think, however, that it is more reasonable to interpret the correlation as arising from a tendency to judge items that are readily perceived, for whatever reason, as being old.

Despite the high correlation between identification time and recognition memory judgments evidenced by their data, Feustel *et al.* express doubt that judgments of perceptual fluency play an important role in recognition memory decisions. They note that perceptual fluency is an unreliable cue for

recognition memory and that some variables produce differential effects in recognition memory and perceptual identification, which suggests that performance on the two types of test can be independent of one another. It is the variable relationship between perceptual identification and recognition memory, however, that we have stressed and that we see as being important for differentiating our view from that of theorists who claim that recognition memory and effects in perceptual identification rely on separate memory systems (Tulving, 1983). Familiarity derived from differences in perceptual fluency is only one of the bases a subject could use to judge prior occurrence.

As mentioned in Section III,A, we expect that a subject's willingness to rely on nonanalytic judgments will vary with materials and task demands. Some materials provide relatively little opportunity for analysis as a means of arriving at a recognition memory judgment and so encourage nonanalytic judgments. For example, Witherspoon (Jacoby & Witherspoon, 1982) found that recognition memory performance was independent of perceptual identification for words, whereas for nonwords, dependence in performance on the two measures was found. The independence observed with words was interpreted as evidence that recognition memory can rely on retrieval of study context, a form of processing that is not important for perceptual identification of words tested out of context. Because of their lack of meaning and the consequent reduction in relationships among study items, recognition memory of nonwords was said to rely more heavily on the use of the fluency heuristic, producing dependence of perceptual identification and recognition memory judgments. Further evidence of the importance of materials comes from an experiment by Johnston, Dark, and Jacoby (1984). They used a procedure similar to that employed by Feustel *et al.* (1983) to examine the relationship between identification time and recognition memory judgments but, like Witherspoon, examined the relationship for nonwords as well as for words. In agreement with the results of Feustel *et al.,* they found a correlation between identification latency and the probability of an "old" recognition memory decision. Classifying on the basis of recognition memory decisions, hits and false alarms were identified with a shorter latency and more accurately than were misses and correct rejections—words responded to as being new. This correlation between ease of identification and the probability of an old recognition memory decision was higher for nonwords than for words.

The correlational data are consistent with the claim that a perceptual fluency heuristic is used as a basis for recognition memory judgments. A correlation between identification latencies and recognition memory judgments could arise, however, from sources other than the application of a fluency heuristic. Two types of data are required to provide more firm support for the conclusion that subjects sometimes employ a fluency heuristic when making recognition memory judgments. First, it would be useful to show that the magnitude of the correlation between identification time and recognition memory varies across tasks and materials in a predictable manner. The experiments by Johnston *et al.* provide evidence of this sort. Second, if judgments of fluency do serve as a basis for recognition memory decisions, it should be possible to manipulate fluency by a means other than prior presentation of an item and to find effects in recognition memory judgments. This possibility suggests an experiment that is the converse of that done by Whitherspoon and Allan (1984). Witherspoon and Allan found that a prior presentation of a word influenced the judged duration of its later presentation. Conversely, differences in true duration may also influence recognition memory judgments. If recognition memory decisions are based on an evaluation of overall ease of processing, subjects may misattribute true differences in duration to differences in prior study. That is, one can tamper with the validity of the cues offered by differences in overall processing and examine effects in recognition memory judgments. Experiments of this sort are planned.

2. *Nonanalytic Judgments for Meaning and for Surface Characteristics*

When a subject is asked to judge whether a current item means the same thing as a previously seen item, changes in surface characteristics such as syntax or synonyms are nominally irrelevant. As discussed earlier, the abstractionist view is that meaning is remembered separately from surface structure and, therefore, can be isolated as a basis for judgments. This view also claims that memory for surface structure is lost very rapidly so that only meaning is retained over the long term. If processing is nonanalytic, however, we expect changes in surface structure to influence judgments of meaning. Earlier, we briefly reviewed the results of experiments that demonstrated that surface structure can be retained over the long term and that meaning and surface structure are sometimes integrated to an extent that does not allow one to easily treat the one dimension in isolation from the other. In this section we shall discuss the effect of the nonanalytic judgments of surface and meaning information.

A recent experiment by Masson (1983) is an excellent demonstration of judgments of meaning being influenced by variations in surface structure. Following Kolers (1979), Masson presented words in either a normal or an inverted typography to be read in the first phase of his experiment. In the second phase of the experiment, both the orientation of previously read sentences and their wording was manipulated. Sentences read in the second

phase were either in the same or a different orientation and were either a verbatim or a paraphrased version of a sentence that had been read earlier. After subjects read a sentence in this second phase, several judgments were required. First, they were to judge whether the sentence had the same meaning as did a sentence that they had previously read. If they judged that the sentence did have the same meaning, they were to judge whether the sentence was in the same or a different orientation and whether it was a verbatim or paraphrased version of the earlier read sentence. An important finding was that both the manipulation of orientation between study and test and the manipulation of wording influenced judgments of meaning. Subjects were more likely to judge a sentence as being the same in meaning if it was a verbatim repetition read in the same orientation as it was during its prior reading. Judgments of orientation and judgments of verbatim as opposed to paraphrase were also not independent of one another. A paraphrased version of a sentence presented in the same orientation as its previously read counterpart was more likely to be judged as being a verbatim repetition than if orientation was changed between study and test. A change in orientation was less likely to be detected if the sentence presented at test was a verbatim rather than a paraphrased version of a previously read sentence.

The pattern of results reported by Masson is important in that it shows a lack of independence between judgments of surface structure and those of meaning. Prior experiments have shown that a verbatim version of a sentence can be identified more rapidly than a paraphrased version as being the same in meaning (e.g., Begg & Wickelgren, 1974; Hayes-Roth & Hayes-Roth, 1977). Effects of paraphrasing, however, are not necessarily due only to an influence of surface structure. Paraphrasing can produce subtle changes in meaning, producing effects that are due to a change in meaning rather than a change in surface structure. It is difficult to make a comparable claim when interpreting the influence of changes in orientation on judgments of meaning. The orientation of a sentence that is read is clearly definitionally irrelevant to its meaning. Effects in judgments, however, produce evidence that subjects were unable to isolate the nominally relevant dimension of meaning from the nominally irrelevant dimension of surface structure. That is, judgments of meaning were nonanalytic.

Other results reported by Masson can be taken as evidence that subjects judged meaning by using a fluency heuristic of the sort described for recognition memory. Subjects might rely on judgments of their fluency of reading sentences as a heuristic for recognition memory judgments. That is, subjects might expect sentences that mean the same as a sentence read earlier to later be read more easily and faster and use differences in reading fluency as a heuristic for judgments of recognition memory for meaning.

If subjects were relying on a fluency heuristic, sentences that were read faster at test should be judged to be old rather than new in meaning. The procedure of requiring subjects to read test sentences prior to making the required judgments allowed Masson to look at the relationship between reading speed and recognition memory judgments of meaning. In line with the possibility that subjects relied on a fluency heuristic, sentences that were judged to be old in meaning were read faster than those judged to be new. Classifying sentences on the basis of judgments of recognition memory for meaning, both hits (18.77 sec) and false alarms (18.48) were read faster than were misses (22.57 sec) and correct rejections (20.66 sec). Similar to results taken as evidence of a fluency heuristic for recognition memory of words, there was a correlation between reading speed of sentences and judgments of their meaning.

Fluency of reading might also be used as a heuristic for other judgments of meaning. A possibility that we find particularly interesting is that students might judge their comprehension of reading assignments or lectures by a nonanalytic means that is similar to a fluency heuristic. When talking to students, one gains the impression that they use their lack of "stumbling" as a criterion for judging their comprehension of material. If they can read through a chapter without being forced to backtrack, they are convinced that they understand the material and are then outraged when they do poorly on a classroom examination covering that material. By our view, the classroom examination requires evidence of more analytic processing as a measure of comprehension than did the nonanalytic measure that students employed to assess their comprehension when reading the material.

3. *Nonanalytic Judgments of Source*

Marcia Johnson and her colleagues have pointed out that accurate memory for source is necessary for people to monitor reality—to discriminate between memory for external events (perception) and memory for internal ones (thoughts). Johnson and Raye (1981) provided a summary of research on reality monitoring and a framework for its interpretation. Several experiments that they reviewed provided evidence that subjects can discriminate between memories obtained from an external source, such as reading, and memory obtained from an internal source, such as memory for an answer that subjects generated themselves. In line with our own observations, Johnson and Raye note that the relationship between recognition memory and memory for source is a variable one. Recognition memory and memory for source in some cases respond in the same way to experimental variables and in other cases appear to be affected in opposite ways (Johnson, Raye,

Foley, & Foley, 1981). To explain this variable relationship, they suggest that judgments of source rely on attributes of memory for an event such as memory for the speaker's voice or a person's memory for how a thought of his own related to his other thoughts or his goals in a situation. The variable relationship is supposed to result from the attributes of memory that are important for judgments of source not necessarily being the same attributes that subjects rely on when making judgments of recognition memory.

Although we agree that memory for source can rely on analytic judgments involving the isolation of attributes of a memory, we believe that judgments that are less analytic may also play an important role. For example, Johnson and Raye report a general finding that when subjects felt that a completely new item was familiar (a false positive), they were much more willing to attribute it to an external source than to say that they had generated it. That is, subjects expect self-generated information to have an advantage in memory and may be biased toward claiming that they generated items that they remember well. A bias of this sort is similar to the fluency heuristic that we have described for recognition memory judgments. The correlation between identification latency and recognition memory judgments could also be described as being due to a comparable bias. Subjects are biased toward calling items "old" that they can identify very readily.

Describing effects of this sort as being a bias, however, carries the risk of overlooking the potential validity of differences in ease of identification as a basis for recognition memory judgments. A single prior presentation of a word does have large and persistent effects on its later identification so differences in perceptual identification can serve as a valid cue for recognition memory decisions. Similarly, subjects are correct in their belief that self-generated material has an advantage in memory (e.g., Jacoby, 1978; Slamecka & Graf, 1978). Differences in "familiarity" generally provide a valid cue for judgments of source, although as we repeatedly encounter and work with somebody else's ideas, we may take them on as our own, forgetting the real source and being guilty of unintentional plagiarism. Describing nominally irrelevant dimensions as producing bias and nominally relevant cues as influencing sensitivity may be a separation of dimensions that is descriptive of the experimenter's behavior but not that of the subject's. The subject may not isolate the two types of dimensions but rather make nonanalytic judgments that reflect their combined effects.

The accuracy of nonanalytic judgments of source is likely to depend on the extent that source and content were processed interdependently during prior study. As an example further to those mentioned in the memory for source section, sex of the speaker may contribute to the intepretation of the message with the result that information about source is not remembered separately from the content of the message. If so, the message will later be interpreted more easily if it is delivered by the same speaker rather than a different one. In this circumstance, judged ease of interpretation, a nonanalytic judgment, will provide a partially valid basis for judgments of source. In contrast, if source and content were previously processed separately from one another, nonanalytic judgments of source should be particularly prone to error. A repeated message delivered from the same source as it was earlier will not be processed any more readily than would be the same message delivered from a different source; differences in ease of processing will not serve as a valid cue for judgments of source.

C. The Importance of Nonanalytic Prior Processing for Memory

The nature of prior processing is as important for the relations among later tests of memory as it is for concept learning. The processing assumed in the traditional accounts of analytic generalization in concept learning parallels that assumed by theories that view memory for an event as being a collection of attributes (e.g., Underwood, 1969), both in the idea of a fixed set of features and in their lack of integration. We share Kolers and Smythe's (1983) reluctance to speak in terms of a fixed set of attributes. The notion of a fixed set of attributes shares a major problem with that of a fixed number of levels of unit size or number of memory stores, that of not providing a convenient means of describing variability across situations. Regardless, if one does choose to describe memory for an event as a collection of attributes, it is clearly necessary to specify the relationships among those attributes. Integral processing of attributes provides a basis for nonanalytic memory judgments as well as a basis for nonanalytic classifications in a concept-learning task. In contrast, relatively separate processing disposes toward later analytic judgments and probable independence of generalizing and explicitly episodic memory tasks. We believe that dependence in performance among these two types of tasks (e.g., Jacoby, 1983b; McKoon & Ratcliff, 1979) is at least as common and as important as is the normally assumed independence. Furthermore, we believe that theories of memory necessarily contain assumptions, albeit sometimes hidden in a semantic memory, about the nature of concept learning. Proposing an episodic memory that is separate from semantic memory corresponds to a hybrid model of concept learning that describes both memory for prior episodes and more abstract representations as playing a role in classification judgments. Accordingly, the earlier discussion directed at those theories of concept learning is also relevant to theories of memory. By our view, both

memory judgments and classification judgments depend heavily on the details of prior processing, details that are too variable to encourage treating judgments as reflecting the operation of discrete, independent representational systems that differ in their level of abstraction.

IV. Summary and Conclusions

Taking nonanalytic cognition into account has considerable heuristic value. From this perspective many of the standard relationships and questions change drastically. In traditional analytic cognition, acts of perception, memory, and concept learning are generally discrete stages that often occur in a fixed order. First an item is perceived, then the person searches through memory for a match, and then categorizes the item, if required. In nonanalytic cognition, both perception and categorization are acts of memory that can rely on one or more prior episodes. By our view, memory for episodes is not something that can only be searched after perception of a test item but, rather, memory for episodes contributes to the perceptual identification of the test item; perception and memory are not discrete acts. The same flexibility discussed in connection with interactive models, well illustrated by McClelland and Rummelhart (1981), also is gained by emphasizing the importance of nonanalytic processing of item and context. Most important to us, however, is that an emphasis on nonanalytic processing encourages cross-talk among areas that are typically considered to be separate. Manipulations and materials that have been largely restricted to one area can be equally applicable to other areas. An example is the relevance for concept learning of manipulations of task demands common in investigations of memory. Task demands interact with characteristics of the material and those of the learner to choose between analytic and nonanalytic processing with the choice having important consequences for memory, perception, and concept learning.

An emphasis on nonanalytic cognition also has implications for training in applied settings, the choice among educational practices. Kemler (1983), studying children's judgments of change, has shown that children are more likely than adults to make nonanalytic judgments, to classify items on the basis of overall similarity, rather than isolating a dimension to be judged. For example, although differences in the size of stimuli are nominally irrelevant to judgments of their color, children sometimes respond as if color is not conserved across variations in size. Rudimentary analytic abilities are seen as being sharpened through experience, with their application being reliant on task demands. In contrast to this apparently natural developmental sequence, current educational practices often stress analytic approaches from the outset, attempting to provide the student with a set of rules, such as spelling or pronunciation rules, for analyzing a problem or for generating its solution, although the rules may apply only within a very limited domain. Perhaps treating similar situations analogously, via nonanalytic cognition, plays an important role in at least the earlier stages of learning. Given the prevalence of the nonanalytic effects reviewed earlier, however, we have little reason to assume that nonanalytic cognition is always simply an untutored basis for judgments. Rather, it may also be a way of exploiting the very local predictors provided by nominally irrelevant details, which may be the basis for true expertise in some areas.

We intend to continue to investigate the possibilities of nonanalytic cognition, exploring implications, seeking to recruit allies, and trying to differentiate our views from those of still others. We do not claim to have made any truly unique contribution, although we hope that we have pointed out the similarities among the work in several different areas. The prevalance of these types of results guarantees that there are people that we should have referenced but did not because of space limitations or oversight. If our work is seen as being only an elaboration of a new Zeitgeist, one that redresses the overemphasis on analytic processing, we shall not object.

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