Comprehending Verbal Comprehension

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ABSTRACT: We discuss cognitive bases of verbal comprehension, emphasizing in particular the role in verbal comprehension of learning from context. Our discussion is divided into four parts. First, we provide a review of three alternative cognitive approaches to understanding verbal comprehension. Second, we describe our own developing theory of learning from context and summarize some empirical data supporting our theory. Third, we attempt to relate our ideas to relevant earlier ones, describing a tentative componential framework for comprehending verbal comprehension. Finally, we discuss some of the psychological implications of our theory for the understanding of intelligence in general.

Verbal comprehension refers to a person's ability to understand linguistic materials, such as newspapers, magazines, textbooks, lectures, and the like. Verbal comprehension has been recognized as an integral part of intelligence in both psychometric theories (e.g., Guilford, 1967; Thurstone, 1938; Vernon, 1971) and information-processing theories (e.g., Carroll, 1976; Hunt, 1978; Sternberg, 1980), and has, under a variety of aliases, been a major topic of research in differential and experimental psychology for many years.

The theoretical construct of verbal comprehension can be operationalized in a number of different ways. Most often, it is directly measured by tests of vocabulary, reading comprehension, and general information. Indeed, vocabulary has been recognized not only as an excellent measure of verbal comprehension but also as one of the best single indicators of a person's overall level of intelligence (e.g., Jensen, 1980; Matarazzo, 1972). Verbal comprehension is also measured indirectly by tests intended to measure constructs other than verbal comprehension, but that have a heavy verbal load. Examples of such tests include verbal reasoning tests such as analogies and classifications, if the vocabulary level is relatively high, and mathematical reasoning, if the test items are presented as word problems. The importance of verbal comprehension to the assessment as well as to the theory of intelligence is shown by the fact that almost all of the major tests of intellectual ability contain verbal tests of the kinds noted above, and that those that do not include such tests are self-consciously nonverbal to minimize measurement of abilities through content that is culture-laden (e.g., Cattell & Cattell, 1963; Raven, 1965).

Alternative Cognitive Approaches to the Bases of Verbal Comprehension

Three major approaches to understanding the origins and development of verbal comprehension are a bottom-up and a top-down approach, both of which emphasize information processing, and a knowledge-based approach, which emphasizes knowledge, often at the expense of processing. The bottom-up approach deals with speed of execution of certain very basic mechanistic cognitive processes. The top-down approach deals with higher order utilization of cues in complex verbal materials. The knowledge-based approach deals with the role of prior information in the acquisition of new information. As will be seen, the three approaches are complementary rather than contradictory.

The Bottom-Up Approach

Bottom-up research has emerged from the tradition of investigation initiated by Earl Hunt (e.g., Hunt, 1978; Hunt, Lunneborg, & Lewis, 1975) and followed up by a number of other investigators (e.g., Jackson & McClelland, 1979; Keating & Bobbitt, 1978; see also Perfetti & Lesgold, 1977, for a related approach). According to Hunt (1978), two types of processes underlie verbal comprehension ability—knowledge-based processes and mechanistic (information-free) processes; Hunt's approach has emphasized the latter kind of process. Hunt et al. (1975) studied three aspects of what they called "current information processing" that they believed to be key determinants of individual differences in developed verbal ability. These were:

> (a) sensitivity of overlearned codes to arousal by incoming stimulus information, (b) the accuracy with which temporal tags can be assigned, and hence order information can be processed, and (c) the speed with which the internal representations in STM and intermediate term memory (ITM, memory for events occurring over minutes) can be created, integrated, and altered. (p. 197)

Their basic hypothesis is that individuals varying in verbal ability differ even in these low-level mechanistic skills—skills that are free from any contri-

bution of disparate knowledge or experience. Intelligence tests are hypothesized to measure indirectly these basic information-processing skills by measuring directly the products of these skills, both in terms of their past contribution to the acquisition and storage of knowledge (such as vocabulary) and their present contribution in the current processing of information.

For example, in a typical experiment subjects are presented with the Posner and Mitchell (1967) letter-matching task. The task comprises two experimental conditions, a physical-match condition and a name-match condition. In the physical-match condition, subjects are presented with pairs of letters that either are or are not physical matches (e.g., "AA" or "bb" versus "Aa" or "Ba"). In the name-match condition, subjects are presented with pairs of letters that either are or are not name matches (e.g., "Aa," "BB," or "bB" versus "Ab," "ba," or "bA"). Subjects must identify the letter pair either as a physical match (or mismatch) or as a name match (or mismatch) as rapidly as possible. The typical finding in these experiments is that the difference between mean name match and physical match times for each of a group of subjects is correlated about −.3 with scores on tests of verbal ability. The theoretical interpretation of this finding is that speed of lexical access, as measured by the name match minus physical match time, is in some sense causal of acquired level of verbal ability.

The finding described above seems to be widely replicable, but its interpretation is a matter of dispute (Carroll, 1981; Hogaboam & Pellegrino, 1978; Sternberg, 1981b). We are concerned that .3-level correlations are abundant in both the abilities and the personality literatures (indeed, they are rather low as ability correlations go) and provide a relatively weak basis for causal inference. A further concern is that most of the studies that have been done on the name minus physical match difference have not used adequate discriminant validation procedures. When such procedures are used, and perceptual speed is considered as well as verbal ability, this difference seems to be much more strongly related to perceptual speed than it is to verbal ability (Lansman, Donaldson, Hunt, & Yantis, in press; Willis, Cornelius, Blow, & Baltes, Note 1), although these findings are subject to alternative interpretations (Earl Hunt, Note 2). Thus, the obtained correlations with verbal ability may reflect, at least in part, variance shared with perceptual abilities of the kind that the letter-matching task would seem more, at least on the surface, to measure. But whatever may be the case here, it seems likely to us that speed of lexical access plays some role in verbal comprehension, and what remains to be clarified is just what this role is (see, e.g., Beck, Perfetti, & McKeown, 1982; Curtis, Note 3).

The Top-Down Approach

Top-down processing refers to expectation- or inference-driven processing, or to knowledge-based processing, to use Hunt's (1978) terminology. Top-down processing has been an extremely popular focus for research in the past decade, with many researchers attempting to identify and predict the sorts of inferences a person is likely to draw from a text and how these inferences (or lack thereof) will affect text comprehension (see, e.g., Kintsch & van Dijk, 1978; Rieger, 1975; Rumelhart, 1980; Schank & Abelson, 1977; Thorndyke, 1976). Usually top-down researchers look at how people combine information actually present in the text with their own store of world knowledge to create a new whole representing the meaning of the text (e.g., Bransford, Barclay, & Franks, 1972). To our knowledge, however, the top-down approach, although often used in models of text processing in general, has been only minimally applied to understanding individual differences in verbal ability or to understanding vocabulary acquisition as a special subset of knowledge acquisition in general. The first of a small handful of investigators who looked at the use of inference in the acquisition of word meanings from context were Werner and Kaplan (1952), who proposed that

> the child acquires the meaning of words principally in two ways. One is by explicit reference either verbal or objective; he learns to understand verbal symbols through the adult's direct naming of objects or through verbal definition. The second way is through implicit or contextual reference; the meaning of a word is grasped in the course of conversation, i.e., it is inferred from the cues of the verbal context. (p. 3)

Werner and Kaplan (1952) were especially interested in the second way of acquiring word meanings, the inference of meaning from context. They devised a task in which subjects were presented with an imaginary word followed by six sentences using that word. The subjects' task was to guess the meaning of the word on the basis of the contextual cues they were given. One example (from the 12 imaginary words they used) is *contavish,* which they intended to mean *hole.* They did not, of course, tell

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the children in their study the meaning of the word, but rather presented them with six sentences:

1. You can't fill anything with a contavish.
2. The more you take out of a contavish the larger it gets.
3. Before the house is finished the walls must have contavishes.
4. You can't feel or touch a contavish.
5. A bottle has only one contavish.
6. John fell into a contavish in the road. (p. 4)

Children ranging in age from 8 to 13 years were tested in their ability to acquire new words presented in this way. Developmental patterns were analyzed by a number of different means. Werner and Kaplan (1952) found that (a) performance improves gradually with age, although the various processes that underlie performance do not necessarily change gradually—whereas some change gradually, others change abruptly; (b) there is an early and abrupt decline in signs of immaturity that relate to inadequate orientation toward the task itself; (c) the processes of signification for words undergo a rather decisive shift between approximately 10 and 11 years of age; and (d) language behavior shows different organizations at different ages.

Daalen-Kapteijns and Elshout-Mohr (1981) pursued the Werner-Kaplan approach by having subjects think aloud while solving Werner-Kaplan type problems. They proposed an ideal strategy for learning from context with which subjects could form a model (provisional representation) of the meaning of a new word. In this strategy (a) the sentence is reformulated so that it can be brought to bear directly upon the neologism; for example, in Sentence 1 above, the strategy might yield the statement that "a contavish is not a substance that can be used to fill anything" and (b) the reformulated information is transformed into an aspect of the meaning of the neologism, for example, "a contavish may be some kind of absence of substance." Using ingenious protocol-analysis techniques, the investigators found that (a) word acquisition is guided by models, with an initial model chosen on the bases of the interpretation of the new word's meaning in the first sentence and with subsequent processing guided by this model; (b) the processing of each new word presentation in context can lead to the filling of slots in the model, to adjustment of these slots, or to the formation of a new model altogether; (c) if the model is not sufficiently well articulated to permit active search and evaluation of possibly relevant information, as tends to be the case for low-verbal subjects, model-guided search can be replaced by sentence-based processing (Step a of the ideal strategy without the subsequent use of Step b of this strategy); and (d) high- and low-verbal subjects learn word meanings differently, with high verbals generally using both steps of the ideal strategy and low verbals generally using only the first step (sentence-based processing).

Whereas Daalen-Kapteijns and Elshout-Mohr (1981) specified strategy for word acquisition in some detail but the representation (what they referred to as the *model*) of information about the word in only minimal detail, Keil (Note 4) has specified representation in considerable detail but strategy in only minimal detail. Keil presented children in kindergarten and Grades 2 and 4 with simple stories in which an unfamiliar word was described by a single paragraph. An example of such a story is "*throstles* are great, except when they have to be fixed. And they have to be fixed very often. But it's usually very easy to fix throstles." Subjects were then asked what else they knew about the new word (here, throstle) and what sorts of things the new word described. Keil found that even the youngest children could make sensible inferences about the general categories denoted by the new terms and about the properties the terms might reasonably have. Errors were systematic and in accordance with Keil's (1979, 1981) theory of the structure of ontological knowledge. This theory provides a powerful basis for inferring a possible structure for storing (at least ontological) information about the meaning of a new word and for inferring the possible predicates of the word.

Jensen (1980) has suggested that vocabulary is such a good measure of intelligence "because the acquisition of word meanings is highly dependent on the *eduction* of meaning from the contexts in which the words are encountered" (p. 146). Marshalek (Note 5) has tested this hypothesis by using a faceted vocabulary test, although he did not directly measure learning from context. The vocabulary test was administered with a battery of standard reasoning and other tests. Marshalek found that (a) subjects sometimes could give correct examples of how a given word is used in sentences, despite their having inferred incorrect defining features of the word; (b) subjects with low reasoning ability had major difficulties in inferring word meanings; and (c) reasoning was related to vocabulary measures at the lower end of the vocabulary difficulty distribution but not at the higher end. Together, these findings suggested that a certain level of reasoning ability may be prerequisite for extraction of word meaning. Above this level, the importance of reasoning begins to decrease rapidly.

It has been assumed in the above review that the ability to learn from external context leads to higher vocabulary. It should be pointed out, however, that the relationship between learning from context and level of vocabulary is probably bidirectional (Sternberg, 1980; Anderson & Freebody, Note 6): Learning from context can facilitate vocabulary

level at the same time that a higher vocabulary level can facilitate learning from context.

The Knowledge-Based Approach

The knowledge-based approach assigns a central role to old knowledge in the acquisition of new knowledge. Although "knowledge" is often referred to in the sense of domain-specific knowledge, the knowledge-based approach can also encompass research focusing on general world knowledge, knowledge of structures or classes of text (as in story grammars), and knowledge about strategies for knowledge acquisition and application (see, e.g., Bisanz & Voss, 1981). Proponents of this approach differ in the respective roles that they assign to knowledge and process in the acquisition of new knowledge. A fairly strong version of the approach is taken by Keil (in press), who argues that

> structure plays a more important role in understanding many instances of cognitive change than process. Obviously there are content-specific strategies (as well as, I think, domain-general ones), but they usually are very simple and do not seem to yield major insights into transitions. . . . Although a range of possible models can always be constructed with different structure/process tradeoffs, most natural cognitive systems may have a tendency to trade off multiple stages of processing and elaborate computational routines for prestored knowledge. (pp. 9–10)

Proponents of this approach usually cite instances of differences between expert and novice performance—in verbal and other domains—that seem to derive more from knowledge differences than from processing differences. For example, Keil (in press) suggests that development in the use of metaphor and in the use of defining features of words seems to be due more to differential knowledge states than to differential use of processes or speed of process execution. Chi (1978) has shown that whether children's or adults' recall performance is better depends on the knowledge domain in which the recall takes place, and particularly, the relative expertise of the children and adults in the respective domains. And it is well known, of course, that Chase and Simon (1972) found that differences between expert and novice performance in chess seemed largely to be due to differential knowledge structures rather than processes.

We have no argument with the position that the knowledge base is highly important in understanding differences in current performance between experts and novices in both verbal and nonverbal domains. But accounts such as Keil's that essentially slight the role of information processing in the development of expertise seem to beg an important question, namely, that of how the differences in knowledge states came about in the first place. For example, why did some people acquire better vocabularies than others? Or in the well-studied domain of chess, why is it that of two individuals given equally intensive and extensive exposure to the game, one will acquire the knowledge structures needed for expertise and the other will not?

In sum, we accept the importance of old knowledge in the acquisition of new knowledge, and incorporate a role for old knowledge in the theory we propose. But we do not believe the overemphasis on process that characterized some past research should be replaced by an overemphasis on knowledge in present research. Rather, it should be recognized that knowledge and process work interactively in complex ways. The knowledge-based approach is complementary to the process-oriented approaches, not a replacement for them.

Summary

To summarize, we have described three basic approaches to understanding the cognitive bases of verbal comprehension. We have argued that these approaches, a bottom-up one, a top-down one, and a knowledge-based one, are complementary and ultimately would all have to be incorporated to understand fully the nature and development of verbal comprehension. In the next section, we present our own approach to understanding verbal ability, an instantiation of the top-down one.

Theory of Learning From Context

In this section we will present our own subtheory of general verbal ability—our theory of learning from context. We believe that the ability to infer the meanings of unfamiliar words from context deserves such a prominent place within a discussion of verbal comprehension in general for three reasons. First, a theory describing how people use context to infer the meanings of words could tell us much about vocabulary-building skills. Identifying what types of information people of different ability levels use to construct a tentative definition for a word and how additional information influences a working definition for a word could tell us much about training vocabulary acquisition skills, thus better enabling people to improve their own vocabularies. Second, a theory of learning from context can help explain why vocabulary is the single best predictor of verbal intelligence overall. Our hypothesis is that learning from context reflects important vocabulary acquisition skills, the end products of which are measured by the extent of one's vocabulary. Thus, on our view, vocabulary tests are such good predictors of one's overall verbal intelligence because they reflect one's ability to acquire new information. Third, a theory of learning from context is useful in illuminating the relationship between the more fluid, inferential as-

pects of verbal intelligence, usually measured by tests of verbal analogies, and the more crystallized, knowledge-based aspects of verbal intelligence, usually measured by vocabulary tests (see Horn & Cattell, 1966). Learning from context thus provides a way of integrating the two aspects of verbal ability—vocabulary and comprehension—and of placing vocabulary acquisition within the framework of general cognitive theories of language comprehension.

Two basic ideas underlie our theory of learning from context. The first idea pertains to why some verbal concepts are easier to learn than others. It is that the difficulty of learning a new verbal concept is in large part a function of the degree of facilitation (or inhibition) of learning provided by the context in which the new verbal concept is embedded; the same or very similar contextual elements that facilitate or inhibit learning a new verbal concept are hypothesized also to facilitate (or inhibit) later retrieval of the concept and also its transfer to new situations. The second idea pertains to why some individuals are better at learning verbal concepts than are others. It is because individual differences in verbal comprehension can be traced in large part to differences in people's ability to exploit contextual elements that facilitate learning and in their ability to be wary of contextual elements that inhibit learning. The same or very similar sources of individual differences are hypothesized to be involved in people's differential abilities later to retrieve verbal concepts and to transfer these concepts appropriately to new situations.

The theory distinguishes between those aspects of vocabulary acquisition that lie strictly outside of the individual, that is, contextual cues present in the verbal context itself that convey various types of information about the word, and those aspects of vocabulary acquisition that lie at least partially within the individual, that is, mediating variables that affect the perceived usefulness of the contextual cues. The contextual cues determine the quality of a definition that can theoretically be inferred for a word from a given context. The mediating variables specify those constraints imposed by the relationship between the previously unknown word and the context in which that word occurs that affect how well a given set of cues will actually be utilized in a particular task and situation. We shall consider in turn the application of each of these aspects of context utilization, the cues present in a given context and the variables mediating their use, to external and internal context. The experiments reported here are preliminary in that they do not fully test our theory—this is especially true for our theory of internal context—but the results obtained so far are encouraging and, we believe, indicative of fruitful areas for further research.

Theory of Decoding of External Context

During the course of one's reading (or other encounters with words), one commonly comes upon words whose meanings are unfamiliar. When such words are encountered, one may attempt to utilize the external context in which the words occur in order to figure out the meanings of the words. Our theory specifies external contextual cues and the mediating variables that influence the likelihood that these meanings will be correctly inferred.

Contextual cues. Context cues are hints contained in a passage that facilitate (or, in theory and sometimes in practice, impede) deciphering the meaning of an unknown word. We propose that context cues can be classified into eight categories depending on the kind of information they provide. These context cues are (a) temporal cues: cues regarding the duration or frequency of X (the unknown word) or regarding when X can occur; (b) spatial cues: cues regarding the general or specific location of X or possible locations in which X can sometimes be found; (c) value cues: cues regarding the worth or desirability of X or regarding the kinds of affect X arouses; (d) stative descriptive cues: cues regarding physical properties of X (such as size, shape, color, odor, feel, etc.); (e) functional descriptive cues: cues regarding possible purposes of X, actions X can perform, or potential uses for X; (f) causal/enablement cues: cues regarding possible causes of or enabling conditions of X; (g) class membership cues: cues regarding one or more classes to which X belongs or other members of one or more classes of which X is a member; and (h) equivalence cues: cues regarding the meaning of X or contrasts (such as antonymy) to the meaning of X. Although the cues are at present listed in terms of the sorts of information that a given context can provide about X (the unknown word), each of these types of cues can alternatively be used to refer to the sort of information that X (the unknown word) provides about Y (another word or concept in the passage). Alternative and related classification schemes have been proposed in the past by Ames (1966), McCullough (1958), Miller and Johnson-Laird (1976), and Sternberg (1974), among others.

An example of the use of some of these cues in textual analysis might help concretize our descriptive framework. Consider the sentence, "At dawn, the *blen* arose on the horizon and shone brightly." This sentence contains several external contextual cues that could facilitate one's inferring that *blen* probably means *sun.* "At dawn" provides a temporal cue, describing when the arising of the *blen* occurred; "arose" provides a functional descriptive cue, describing an action that a *blen* could perform; "on the horizon" provides a spatial cue,

describing where the arising of the *blen* took place; "shone" provides another functional descriptive cue, describing a second action a *blen* could do; finally, "brightly" provides a stative descriptive cue, describing a property (brightness) of the shining of the *blen*. With all of these different cues, it is no wonder that most people would find it very easy to figure out that the neologism *blen* is a synonym for the familiar word *sun*.

We make no claim that the categories we have suggested are mutually exclusive, exhaustive, or independent in their functioning. Nor do we claim that they in any sense represent a true categorization of context cues. We have, however, found this classification scheme useful in understanding subjects' strategies in deriving meanings of words from context. Not every type of cue will be present in every context, and even when a given cue is present, our theory proposes that the usefulness of the cue will be mediated by the sorts of variables to be described in the next section.

Mediating variables. Whereas the contextual cues describe the types of information that might be used to infer the meaning of a word from a given verbal context, they do not at all address the problems of recognition of the applicability of a description to a given concept, weaning out irrelevant information, or integration of the information gleaned into a coherent model of the word's meaning. For this reason, a set of mediating variables is also proposed that specifies relations between a previously unknown word and the passage in which it occurs, and that mediates the usefulness of the contextual cues. Thus, whereas the contextual cues specify the particular kinds of information that might be available for an individual to use to figure out the meanings of unfamiliar words, the mediating variables specify those variables that can affect, either positively or negatively, the application of the contextual cues present in a given situation. The mediating variables for external context consist of (a) the number of occurrences of the unknown word, (b) the variability of contexts in which multiple occurrences of the unknown word appears, (c) the density of unknown words, (d) the importance of the unknown word to understanding the context in which it is embedded (both at the sentence level and at the overall passage level), (e) the perceived helpfulness of surrounding context in understanding the meaning of the unknown word, (f) the concreteness of the unknown word and the surrounding context, and (g) the usefulness of prior knowledge in cue utilization.

Consider, for example, how the variable "variability of contexts in which multiple occurrences of the unknown word appear" can mediate utilization of contextual cues. Different types of contexts, for example, different kinds of subject matter or different writing styles, and even just different contexts of a given type such as two different illustrations within a given text of how a word can be used, are likely to supply different types of information about the unknown word. Variability of contexts increases the likelihood that a wide range of types of cues will be supplied about a given word and thus increases the probability that a reader will get a full picture of the scope of a given word's meaning. In contrast, mere repetition of a given unknown word in essentially the same context as that in which it previously appeared is unlikely to be as helpful as a variable context repetition because few or no really new cues are provided regarding the word's meaning. Variability can also present a problem in some situations and for some individuals: If the information is presented in a way that makes it difficult to integrate across appearances of the word or if a given individual has difficulties in making such integrations, then the variable repetitions may actually obfuscate rather than clarify the word's meaning. In some situations and for some individuals, variable contexts may cause a stimulus overload to occur, resulting in reduced rather than increased understanding. The other mediating variables for external context can similarly facilitate or inhibit the acquisition of a word's meaning from a given text.

Initial Empirical Tests: Learning From External Context

We have conducted some initial empirical tests of the theory presented in the preceding section. The results of these tests are encouraging for further empirical exploration and theory development. We present here a summary of some of the data we have collected so far, leaving details of our methodology and data analyses for elsewhere (Powell & Sternberg, Note 7).

The theory of external decontextualization was tested by asking 123 high school students to read 32 passages of roughly 125 words in length that contained embedded within them from 1 to 4 extremely low-frequency words. Thirty-seven of these words (all nouns) were used in the passages; each target word could appear from 1 to 4 times, resulting in a total of 71 presentations altogether. Passages were equally divided among four different writing styles: literary, newspaper, scientific, and historical. An additional sample passage was written in the literary style.

The students' task was to define as best they could each of the low-frequency words within each passage (except for multiple occurrences of a single word within a given passage, which required only a single definition). Students were not permitted to look back to earlier passages and definitions in mak-

ing their current responses. The following passage (the sample passage from the experiment) illustrates the experimental materials, and particularly the kinds of words in context, that the students were required to define. The words to be defined are italicized:

> Two ill-dressed people—the one a tired woman of middle years and the other a tense young man—sat around a fire where the common meal was almost ready. The mother, Tanith, peered at her son through the *oam* of the bubbling stew. It had been a long time since his last *ceilidh* and Tobar had changed greatly; where once he had seemed all legs and clumsy joints, he now was well-formed and in control of his hard, young body. As they ate, Tobar told of his past year, recreating for Tanith how he had wandered long and far in his quest to gain the skills he would need to be permitted to rejoin the company. Then all too soon, their brief *ceilidh* over, Tobar walked over to touch his mother's arm and quickly left.

Like the words in this passage, all to-be-defined words were nouns and were of sufficiently low frequency to assure that most subjects had never even seen the words before but that if they had, the subjects were extremely unlikely to know in advance what the words meant (*oam* means steam, and a *ceilidh* is a visit).

Two kinds of data analysis sought internal and external validation of our ideas about learning from context. In the internal-validation procedure, the main dependent variable was the quality of the students' definitions of each of the 71 word tokens. Qualities of definitions were rated independently by three trained raters. Mean interrater reliability was .92, so an average of the three ratings was used as a definition-goodness score for each word for each subject. These averages were then averaged over subjects to obtain a mean goodness-of-definition rating for each word. The main independent variables were ratings of the number or strength of the occurrences of our contextual cues and mediating variables (with the exact nature of the rating depending on the independent variable) with respect to their roles in deciphering the meaning of each low-frequency word in the passage. Ratings for contextual cues were counts of the number of occurrences of each type of cue for each target word in the passage and were provided by one of the investigators (J.S.P.), who was blind to the data at the time. Ratings for the mediating variables were provided by 128 students from the same high school as the students who actually defined the words; there was no overlap in subjects between the two tasks.

In the external-validation procedure, the ratings of definition goodness served as independent variables to predict students' scores on standardized tests of intelligence, vocabulary, and reading comprehension. These scores were available from school files. Prediction was accomplished via simple correlation. The logic of our procedure was based on the belief that individual differences in measured verbal intelligence and comprehension derive from differences in individuals' abilities to ascertain meanings of words presented in context. Obviously, though, our experimental and correlational procedures did not permit establishment of a directed causal link, and any obtained correlations could be interpreted equally well as suggesting that the ability to define words in context is derivative from verbal ability or as suggesting that decontextualization ability and verbal ability are both dependent on some third, higher-order variable.

For the internal-validation procedure, separate regressions were computed for each of the four passage styles because preliminary analyses showed the relevant variables and the regression weights to differ from one style to another. We used a stepwise procedure in which we allowed only three variables plus a regression intercept to enter into our final models. The decision to limit the number of variables was made on the basis of our judgment of the degree of refinement of our data and in the hope of minimizing the risks of capitalization upon chance that inhere in stepwise regression. Because of multicollinearity (correlation among) independent variables, it was not possible to make strong inferences regarding the true subsets of variables that were differentially relevant from one passage style to the next. The correlations between predicted and observed goodness ratings were .92 for literary passages, .74 for newspaper passages, .85 for science passages, and .77 for history passages. All of these values were statistically significant.

To check to see whether internal context variables, by which we mean the presence of familiar prefixes, suffixes, or roots, or the sound of the word, were contributing to subjects' ability to define the target words, in spite of our attempts to avoid words with significant internal context cues, we collected internal context scores from an additional 101 high school students from the same school as used previously. These students were presented a list of the target words plus their definitions and were asked to use the words' internal context to try to match each word with its definition. The percentage of subjects correctly doing so for each word was then used as a variable reflecting internal-context cues for that word. Inclusion of this variable added no significant increment to the goodness of fit of our modeling, however. Thus, subjects appear to have made only minimal use of internal context in our learning-from-context task.

We conclude on the basis of these data that the contextual cues and mediating variables proposed by our model can provide good predictions of the

goodness-of-definition data, although we certainly do not believe that our model accounts for all of the reliable variance. Indeed, the square roots of the internal-consistency reliability coefficients (based on all possible split halves of subjects) for our four data sets, which place upper limits on the values of *R*, were all .98 or above, showing that there was a considerable amount of reliable variance not accounted for by our model. Nevertheless, the fits of the model subsets seemed sufficiently high to merit optimism regarding our initial attempts to understand differential word difficulty in learning from context.

For the external-validation procedure, subjects' scores (mean rated goodness of all written definitions) on the learning-from-context task were correlated with scores on the psychometric tests. Correlations for the various passage types combined were .62 with IQ, .56 with vocabulary, and .65 with reading comprehension. Correlations with the psychometric test scores were quite similar for learning-from-context scores computed for the individual passage types. Not only were these obtained correlation coefficients statistically significantly greater than zero, but they were also significantly greater than .30, a level of correlation that is fairly typical between measures of cognitive tasks and psychometric verbal tests (see, e.g., Hunt, Lunneborg, & Lewis, 1975). Higher-level correlations are, of course, to be expected when one increases the complexity of experimental tasks, but what is worthy of note here is that our learning-from-context task was very different in form and content from the standardized IQ, vocabulary, and reading comprehension measures used in our study. Yet, we still obtained high correlations. Indications are that our task tapped a basic skill of intermediate complexity between basic information-processing and full-scale reading. We believe that identification of basic skills at this intermediate level of complexity provides a fruitful basis for understanding, and eventually for training, verbal comprehension. This intermediate level is high enough to preserve the richness of complex verbal information processing, but low enough to provide explanatory power.

One might argue at this point that perhaps the high correlations obtained with ability measures are not due to the effect of ability to acquire vocabulary from context at all but rather are due to differential ability of subjects to write good definitions. To test this alternative hypothesis, we presented the same 101 high school students that provided our internal context ratings with a group of 11 familiar words (e.g., camel, professor, honesty) and asked them to write synonyms or short definitions for the words. The goodness ratings of the definitions for these familiar words were then correlated with IQ scores for this group of subjects, yielding an apparent relationship of .41 between ability to write definitions and IQ. However, when individual correlations were computed between scores on each familiar word and IQ, it was found that only quality of definitions for the more abstract words was significantly correlated with IQ. Quality of definitions for the more concrete words was not significantly correlated with IQ. This finding suggests that for abstract words, subjects did not actually have equal knowledge about the words' meanings and that the scores on these words reflected differential knowledge. For the other, truly familiar words, there was no significant correlation between ability to write a good definition for the word and verbal ability. A study by Marshalek (Note 5) supports this interpretation. Using a faceted vocabulary test, Marshalek found that vocabulary acquisition is a gradual process and that many adults have only partial concepts for some words that are normally considered to be familiar words. Thus, we believe we are in a reasonable position to conclude that our learning-from-context task is measuring something closely akin to that which is measured by standardized tests of verbal intelligence in general, and of verbal comprehension in particular, and that the ability measured in each case is the ability to acquire new verbal knowledge. More research is needed to explore why these differences in ability to learn from context exist and to specify further how previously existing knowledge structures interact with knowledge acquisition processes.

Theory of Decoding of Internal Context[1]

By *internal context* we refer to the morphemes within a word constituted of multiple morphemes, such as prefixes, suffixes, and stems, that combine to give the word its meaning. Again, our theory proposes a set of contextual cues and a set of mediating variables that together determine the quality of a definition that can be inferred from a word's internal context.

Contextual cues. The contextual cues specify the particular kinds of information that individuals can use to figure out the meanings of new words. Because internal context is much more impoverished than is external context, the diversity of kinds of cues is much more restricted (see, e.g., Johnson & Pearson, 1978; O'Rourke, 1974). The four kinds of contextual cues constituting our scheme are prefix cues, stem cues, suffix cues, and interactive cues. Interactive cues are formed when two or even three of the word parts listed above convey information in combination that is not conveyed by a given cue considered in isolation from the rest of the word.

[1] The theory of decoding of internal context was developed as a collaborative effort between Robert J. Sternberg and Daniel B. Kaye.

The usefulness of each type of contextual cue depends on the correct identification of the cue and the mediating effect of other variables to be described in the next section.

The usefulness of these kinds of cues in decoding meaning can be shown by an example. Suppose one's task is to infer the meaning of the word *thermoluminescence* (see Just & Carpenter, 1980). The word is probably unfamiliar to most people. But many people know that the prefix *thermo-* refers to heat, that the root *luminesce* is a verb meaning to give off light, and that the suffix *-ence* is often used to form abstract nouns. Moreover, a reasonable interpretation of a possible relation between *thermo-* and *luminesce* would draw on one's knowledge that heat typically results in some degree of light. Note that this cue derives from an interaction between the prefix and the stem. Neither element in itself would suggest that the light emitted from heat would be a relevant property for inferring word meaning. These cues might be combined to infer that *thermoluminescence* refers to the property of light emission from heated objects. This inference would be correct.

We make no claims that our simple (and unoriginal) parsing of internal contextual cues represents the only possible classification scheme, although we think it represents one, if not the only, plausible parsing. Collectively, these kinds of cues describe the types of information that might be present for an individual's use; the extent to which these cues are utilized, if present, depends on the mediating variables described in the next section.

Mediating variables. These variables specify relations between a previously unknown word and the external context in which it occurs that mediate the usefulness of internal contextual cues. Our model includes five variables that affect internal cue usefulness, usually by influencing the effort to be expended on deciphering the word in general and on utilizing the internal context in particular. These internal mediating variables are (a) the number of occurrences of the unknown word, (b) the density of unknown words, (c) the density of decomposable unknown words, (d) the importance of the unknown word to understanding the context in which it is embedded, and (e) the usefulness of previously known information in cue utilization. The mediating variables are similar but not identical to those considered for external context.

Consider, for example, how the variable "density of decomposable unknown words" might affect utilization of internal contextual cues present in an unknown word. Because internal decontextualization may not be a regularly used skill in many individuals' repertoires (see, e.g., Rubin, Becker, & Freeman, 1979), individuals may need to be primed for its use. The presence of multiple decomposable unknown words can serve this function, helping the individual to become aware that internal decontextualization is possible and feasible. Thus, whereas a high density of unfamiliar words may encourage word-by-word processing and a greater focus on cues internal to unfamiliar words, the fact that many of these words are decomposable may further prime a decomposition strategy by the repeated cues regarding the strategy's applicability.

To summarize, our theory of learning from internal context specifies kinds of internal cues that individuals can use in inferring meanings of previously unknown words and also specifies variables that affect how well these cues can be utilized in actual attempted applications. The contextual cues refer to the types of information that might be present within a word; however, these cues are not sufficient for describing actual context utilization and so our theory also includes a set of mediating variables that determine the differential application of the set of internal contextual cues, both across texts for a single individual and within a single text across individuals.

Our theory of internal context has not yet been tested. Initial work has been done, however, to address the question of whether individuals use internal context at all in figuring out word meanings (Kaye & Sternberg, Note 8; see related work by Freyd & Baron, 1982; Manelis & Tharp, 1977; Rubin, Becker, & Freeman, 1979; Stanners, Neiser, & Painton, 1979; Taft, 1979; and Taft & Forster, 1975). Kaye and Sternberg tested a total of 108 secondary school and college students. Each subject was exposed to 85 very low frequency prefixed words that were selected each to contain 1 of 15 commonly used Latin prefixes and 1 of 15 commonly used Latin stems. Each word was paired with four possible definitions, one of which was correct and three of which were incorrect. One of the incorrect definitions retained the meaning of the prefix only, one retained the meaning of the stem only, and one retained the meaning of neither the prefix nor the stem. An example of an item in the word-definitions task is

EXSECT

(a) to cut out	(totally correct)
(b) to throw out	(prefix only correct)
(c) to cut against	(stem only correct)
(d) to throw against	(totally incorrect)

The data we have obtained are preliminary but nevertheless suggestive. The results suggested that college students, but not high school students, were able to use internal context to help infer word meanings. The pattern of results suggested that the word stem was the central focus for determining what

each of the various words meant, with the prefix modifying this stem meaning. Interestingly, knowledge of prefixes was better than knowledge of stems, at least for the words used in this study. This result may be attributable to the much larger number of stems than of prefixes in the language.

Kaye and Sternberg (Note 8) concluded that college-level students, at least, spontaneously used internal context to figure out word meanings. That younger students appear not to do so gives greater force to O'Rourke's (1974) arguments that there is a real need for training at the lower age levels in word-part utilization for decontextualization of word meanings. We have proposed a training program that combines instruction in both external and internal decontextualization skills (see Sternberg, Powell, & Kaye, 1983). Our conclusion from our own data and that of others is that a theory of learning word meanings from context is an important part of a full theory of verbal comprehension, and that such a theory can pave the way both for a fuller understanding of the nature of verbal comprehension and for a means by which to train individuals to improve their comprehension.

A Componential Framework for Verbal Comprehension

The theory of learning from context that we have presented represents only a subtheory of verbal comprehension in general. In this part of our article, we attempt to place our theory and research into a broader context by proposing a framework that we believe encompasses much of the work currently being done on the topic of verbal comprehension. This framework organizes theory and data into a coherent structure that may help elucidate interrelationships among various contributions to the field of verbal comprehension. The framework divides verbal comprehension processes into three general kinds: metacomponents, performance components, and knowledge acquisition components (Sternberg, 1980, 1981a, in press).

Metacomponents

Metacomponents are higher-order control processes used for executive planning and decision making in cognitive performance in general and verbal performance in particular. Metacomponents functioning collectively are what have sometimes been referred to as the *executive* or the *homunculus*. Several different metacomponents have been identified in previous work (Sternberg, 1979, 1980; see also Brown, 1978, for a related point of view): (a) deciding on the nature of the problem, (b) deciding on processes for solving a problem, (c) deciding on a strategy for combining these processes, (d) deciding on how to allocate processing resources, (e) deciding on how to represent the information on which processes and strategies act, and (f) monitoring one's solution of a given problem. We view several lines of research on verbal comprehension processes as addressing metacomponential issues. Consider the six metacomponents proposed here.

The metacomponent of deciding on the nature of a given problem seems to be addressed in the fairly large volume of work that has been done on the effects of purpose in reading on reading comprehension (e.g., Anderson & Biddle, 1975; Black, 1981; Just & Carpenter, 1980; Shores, 1960; Smith, 1967). A given text presents a problem situation to a reader that can vary greatly as a function of the particular purpose for which one is expected to read the text. The research on reading purpose shows that reading outcomes can be highly variable as a function of the reader's definition of the problem situation posed by the text and the kind of reading of it that is required.

The metacomponents for deciding on processes for solving a problem and deciding on a strategy for combining these processes are addressed by information-processing models of reading such as those of Frederiksen (1980), Just and Carpenter (1980), and Kintsch and van Dijk (1978), which attempt to account for real-time processing of information while reading is taking place. These models specify with considerable precision the decisions that the reader has to make to process incoming text. Text-processing computer programs (see, e.g., Schank, 1975; Schank & Abelson, 1977) also specify these decisions in great detail for the particular classes of text each of them is able to handle.

The metacomponent of deciding on how to allocate processing resources during reading seems to be particularly well addressed both by eye-movement methodologies (e.g., Carpenter & Just, 1977; Just & Carpenter, 1980; McConkie, 1976; Rayner, 1978) and by dual-task methodologies (e.g., Hunt & Lansman, 1982). The former method is able to suggest where in a given text a reader is placing his or her attention (or processing resources more generally) at a given time during reading. The latter method is able to suggest the extent to which processing resources are being drawn upon at a given time during reading. Each method, then, addresses in a different way the question of how readers budget their time and efforts.

The metacomponent of deciding on how to represent information mentally can be seen as the topic of what has become a large volume of research on the representation of meaning (e.g., Anderson, 1976; Hampton, 1979; Katz, 1972; Keil, 1979; Kintsch, 1974; Medin, in press; Rosch, 1978; Smith, Shoben, & Rips, 1974; McNamara & Sternberg, 1983; see Smith & Medin, 1981, for a review of this literature).

Some of these models apply most clearly at the level of individual words, others at the level of semantic categories, and others at the level of sentences. In this research, alternative models of meaning, such as necessary-and-sufficient (defining) feature models, prototypical (characteristic) feature models, and models based on various ways of combining defining and characteristic features, are tested for their ability to account for different types of language-understanding data. These representations are then assumed to be accessed during the reading process.

Finally, the metacomponent of solution monitoring can be seen as addressed by work such as that of Collins and Smith (1982), Flavell (1981), and Markman (1977, 1979, 1981) on comprehension monitoring. This work is particularly relevant to our present concerns because it deals with the role of context in understanding whole passages, and not just single words (as in Werner & Kaplan, 1952). Markman (1981) has suggested some signals that people can use to detect failure to comprehend verbal materials. These signals use surrounding context and constitute part of what might be construed as means of effective comprehension monitoring. One signal is perceived absence of structure. If one finds it difficult or impossible to impose a structure on verbal materials, then this failure should serve as a signal that the information is not well understood. A second signal is multiple perceived structures. In the sentences "John and Bill went to the store. He bought some bread," at least two possible structures can be imposed, signalling the difficulty one has in understanding the message the writer intended to communicate. A third signal is the discovery of inconsistencies, which has been the topic of Markman's recent research (e.g., Markman, 1977, 1979). Inconsistencies may indicate mis-structuring of information comprehended earlier, so that the imposed structure does not work for information that is comprehended later. A fourth signal is inability to use structure to formulate expectations. Except in the case of highly novel materials, if one cannot formulate plausible expectations about what is to come next on the basis of what has come already, this failure may indicate a lack of comprehension of the text.

Performance Components

Performance components are the processes used in the execution of various strategies for task performance. They are the processes that the metacomponents decide to execute to attain the goal of task completion. Many of the research programs described in the preceding section on metacomponents deal with performance components as well. For example, the reading models of Frederiksen (1980), Just and Carpenter (1980), and Kintsch and van Dijk (1978) address not only questions of how and on what bases subjects decide what to do, but also what, exactly, they do as they read. Computer models also must address both kinds of issues. But the research that has most directly addressed the question of the role of performance components in verbal comprehension is that which has emerged from the cognitive-correlates tradition of research initiated by Earl Hunt (e.g., Hunt, 1978; Hunt, Lunneborg, & Lewis, 1975) and followed up by a number of other investigators (e.g., Jackson & McClelland, 1979; Keating & Bobbitt, 1978; Perfetti & Lesgold, 1977). For example, by using the name (Aa) and physical match (AA) comparison tasks described earlier in this article, Hunt, Lunneborg, and Lewis (1975) have looked at performance components in their purest form, that is, by using such a low-level comparison task that they were able to minimize interference from the amount of knowledge a subject has or the strategy used for the task.

Knowledge-Acquisition Components

The proposed account of knowledge acquisition suggests that three components of knowledge acquisition are critical in the acquisition of word meanings and of verbal concepts in general: (a) selective encoding, (b) selective combination, and (c) selective comparison. (See Sternberg & Davidson, 1982, and Sternberg, in press, for more general discussions of these components as they apply to insightful learning and problem solving.) Selective encoding involves sifting out relevant information from irrelevant information. When new information is presented in natural contexts, relevant information for one's given purposes is embedded in the midst of large amounts of purpose-irrelevant information. A critical task facing the individual is that of sifting the wheat from the chaff: recognizing just what information among all the pieces of information presented is relevant for one's purposes. Selective combination involves combining selectively encoded information in such a way as to form an integrated, plausible whole. Simply sifting out relevant from irrelevant information is not enough to generate a new knowledge structure; one must know how to combine the pieces of information into an internally connected whole (see Mayer & Greeno, 1972). Selective comparison involves relating newly acquired information to information acquired in the past. Deciding what information to encode and how to combine it does not occur in a vacuum. Rather, encoding and combination of new knowledge are guided by retrieval of old information. New information will be all but useless if it cannot somehow be related to old knowledge to form an externally connected whole (Mayer & Greeno, 1972).

Consider, for example, the passage cited earlier requiring decontextualization of the meaning of the word *oam*. Even this short passage fragment contains a considerable amount of information, most of it irrelevant to figuring out the meaning of the word *oam*. For example, it makes no difference to the meaning of the word *oam* that there are two people, that they are ill-dressed, that one is a woman, that the woman is tired, that she is middle-aged, and so on. It is relevant, however, that the oam is emanating from the stew, that the stew is bubbling, that the oam can be peered through, and that the bubbling is associated with a fire. Distinguishing these later cues as relevant and the former cues as irrelevant is critical to proper decontextualization of the word's meaning, and this sifting process forms the basis for selective encoding. But simply isolating these cues is not enough for acquisition of the word's meaning. One must figure out, for example, how the bubbling relates to the fire and stew, and how the fact that the oam can be peered through relates to these other facts. Thus, constructing a definition requires a highly selective combination of the relevant information. But selective combination and encoding do not occur in a vacuum either. They are guided by a selective comparison of the new information to old information. The relevant cues will not make sense unless one realizes that fire causes stew to bubble and that steam, which is translucent and thus can be seen through, emanates from a bubbling stew. In short, one must bring just the right prior information to bear on the problem and in just the right way.

Two other lines of research that we see as especially relevant to an understanding of knowledge-acquisition components are those on story grammars and on inference taxonomies (e.g., Collins, Warnock, Aiello, & Miller, 1975; Mandler & Johnson, 1977; Rieger, 1975; Rumelhart, 1975; Stein & Glenn, 1977; Warren, Nicholas, & Trabasso, 1979; Lebowitz, Note 9). These grammars and taxonomies provide schemes for understanding how context is organized and the ways in which context can and cannot facilitate learning. To understand learning from context, it seems reasonable that first one should have a structural model for context. We view these grammars and inference schemes as providing alternative structural models for the global contexts from which so much of learning takes place.

Concluding Remarks

To summarize, we have attempted to describe a componential framework for interrelating a variety of theoretical and empirical endeavors in the field of verbal comprehension.[2] We make no claim that our assignment of research enterprises to aspects of our framework is uniquely correct. Nor do we claim that our framework is the only one or even the best one possible. But we believe that what we have attempted is, at least so far, a unique endeavor, and therefore may serve as a basis on which others can build in the attempt to understand verbal comprehension in a unified and systematic way.

Where do the three approaches outlined in the first section of this article—that is, the top-down, the bottom-up, and the knowledge-based approaches—fit into this suggested framework for comprehending verbal comprehension? Whereas any of the three approaches can theoretically be applied to any level of the componential framework, distributions of effort have tended to be uneven. Researchers adopting a particular approach to understanding verbal ability have also tended to adopt a particular world view as to what aspects of the phenomenon are worthy of their extended efforts. Bottom-up researchers have tended to focus their efforts on mechanistic, knowledge-free processes and so have concentrated on the role of basic, low-level performance components. Top-down researchers have tended to use more complicated tasks, and so these researchers have tended to concentrate on learning components and higher-level performance components such as inference. Knowledge-based researchers have tended to concentrate on the knowledge structures on which the various levels of the componential framework are proposed to act. There is nothing intrinsically wrong in placing limits on the parts of a phenomenon one is trying to understand or in placing hedged bets as to the best area in which to start one's investigations, given one's limited resources. In fact, some sort of reductionism is probably essential to avoid being paralyzed by the enormity of the task at hand, in this case, understanding verbal comprehension (Sternberg & Powell, 1982). But there is a danger of losing sight of the phenomenon as a whole. The end result can be much like that in the Indian tale of the three blind men trying to describe an elephant: One feels the trunk and thinks the elephant is like a snake; another feels a leg and thinks the elephant is like a tree; and so forth. By following only one approach to understanding verbal comprehension, we, too, may have trouble picturing what the whole process looks like.

We see the recent trend toward taking an interactive view of verbal processes—that is, seeing the top-down and the bottom-up processes as aiding and abetting each other—as a strong step toward a more

[2] We wish to emphasize that the framework suggests one possible basis for the theoretical integration of subtheories and data from a variety of perspectives, but it does not provide the actual integration itself, which we would hope would be a high priority for subsequent research by ourselves and others.

nearly complete theory of verbal comprehension (see Lesgold & Perfetti, 1981, for examples of such interactive enterprises). These multilevel, interactive approaches are likely not only to contribute to coherence of theory, but also to provide better diagnostics, as when one tries to pinpoint the cause(s) of reading difficulties. There is no single cause of difficulty across all readers—some students may be lacking in decoding ability, others in vocabulary, still others in inference or comprehension abilities (see, e.g., Adams, 1980). One may observe different patterns of weaknesses and compensating strengths across the different levels of processing skills for different subjects (see, e.g., Stanovich, 1981). The most salutory approaches to verbal comprehension will provide us with greater understanding of the complex interactions between the knowledge store, bottom-up processes, and top-down processes.

Conclusion

We have attempted in this article to present an overview of the nature of verbal comprehension, with particular attention to the role of learning from context in verbal processing. We conclude our overview with a discussion of some implications of our theoretical point of view for the understanding of intelligence in general.

We view the ability to acquire information from context and, in particular, the ability to distinguish relevant from irrelevant context in the acquisition of new information and to combine disparate elements into a new coherent whole, as a key source of individual differences in intelligence. This ability is important in nonverbal as well as verbal tasks. Consider, for example, two chess players, both of whom have played chess for thousands of hours, but one of whom has become a master chess player and the other of whom has become a duffer. It is common in the literature to attribute a large part of the difference in level of performance between the two players to differences in knowledge structures and contents (e.g., Chase & Simon, 1972), and we agree with this interpretation. But this interpretation, like Keil's (in press) knowledge-based view of cognitive transitions, fails to account for why two individuals with approximately equal amounts of experience should show such different ultimate levels of performance. Our view is that the difference in developed performance derives from differential ability of the players to profit from their chess-playing experience, particularly differential abilities to see what in their chess-playing experience may be relevant for future games, to differentiate this relevant information from the mass of irrelevant and ultimately useless information in their chess-playing experience, to appropriately combine the newly acquired information with prior knowledge, to store the relevant information in a way that will later be accessible, and then later, to access the information as needed. Thus, while acknowledging the importance of knowledge-based differences, we would emphasize the origin of these differences in differential processing of information as it is acquired in context, here, the context of chess play. The same principle would apply to the performance of other games, such as Go (see Reitman, 1976), and in the development of other forms of expertise, such as the solution of physics problems (see Chi, Glaser, & Rees, 1982; Larkin, McDermott, Simon, & Simon, 1980), and of insight problems (Sternberg & Davidson, 1982). The present view is consistent with the knowledge-based view but goes beyond it in attempting to account for how differences in knowledge come to be.

We believe our view has implications both for the assessment and the training of verbal comprehension in particular and of intelligence in general. Our emphasis in assessment would be on the identification of individuals' contextual acquisition skills, and in training emphasis would be on the teaching (a) of the kinds of cues that are relevant for knowledge acquisition and (b) of how these kinds of cues can be spotted in context, much of which is irrelevant for one's purposes. Indeed, we see our external and internal decontextualization tasks as providing crude, first-pass measurements of these skills (see also Cook, Heim, & Watts, 1963; Heim, 1970). More refined measures would more precisely isolate indices of the individuals' skills and extend beyond the range of strictly verbal comprehension. We are currently preparing a program to train decontextualization skills as they apply to the strictly verbal domain.

Returning to the question of why measures of verbal comprehension, in particular, provide such superior measurements of intelligence in general, we believe it is because such measures target decontextualization skills: Either directly or indirectly, they provide excellent measures of people's abilities to acquire important information from context, distinguish it from unimportant information, and then both to store and retrieve this information as needed. Vocabulary tests measure the results of past acquisition from context, our own tasks measure present acquisition, and both types of tasks are highly correlated with more general measures of intelligence. Understanding of verbal comprehension thus provides one important inroad to the study of what it is that constitutes intelligent performance.

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