Word Recognition Reconsidered: Toward a Multi-Context Model

Peter Mosenthal, Sean Walmsley, and Richard Allington

This paper first reviews the various models which have been proposed to explain word recognition. Several shortcomings of these models are discussed: for example, most word recognition models have described word processing almost exclusively in terms of linguistic variables and have overlooked several significant paralinguistic variables. A new model is proposed which describes word processing as a gestalt phenomenon, defined by the interaction of four types of context: linguistic, schematic, social, and strategic. The interaction of the variables within and between these contexts is explained in terms of the notions of context "transparency" and "opacity." The implications of previous word recognition models and the present word recognition model are also discussed in terms of defining good and poor readers. This paper argues that any definition of good and poor readers must be operationalized on the basis of paralinguistic as well as linguistic factors. It is further argued that good readers are those who are able to maximize the transparency within and between the four contexts for processing words.

Visible Language, XII 4 Autumn 1978, pp. 448-468

Author's address:
Department of Reading,
SUNY at Albany,
Albany,
NY 12222.

0022-2224/78/1000-0 $02.00/0 450

Word Recognition Reconsidered: Toward a Multi-Context Model

Peter Mosenthal, Sean Walmsley, and Richard Allington

A significant yet poorly understood question in the literature on reading research is what is meant by the process of "decoding" or "word recognition." Of particular interest are the differences between good and poor readers with respect to these skills.

Although much research has been conducted in an attempt to define "decoding" and "word recognition," this research has been quite fragmented. This stems partly from the fact that this research has focused usually on a few variables at a time — e.g., word frequency, word length, word meaningfulness, and word imagery — and has failed to control for the interaction between these variables. Another reason is that there has been little attempt to operationalize systematically what it means to say a word has been "decoded." Most operational definitions of decoding have emphasized identification or reproduction of physical aspects of a word; e.g., speed by which words can be pronounced, recognized, or compared under various tachistoscopic time-frame conditions.

In most of these experiments there has been little effort made to consider decoding as some type of process whereby one arrives at the meaning of a word. A third reason for the confusion in word-recognition research is that researchers have been more preoccupied with discovering data to support a given model rather than creating models which account for the disparate, often contradictory data. A final problem with word-recognition studies is that they have focused primarily on the question, "How is a word recognized?" and have overlooked the question, "Why is a word recognized?" In this regard, word recognition research has been preoccupied with investigating a means related to no well identified ends. Presumably the end is not merely recognition of a word as an orthographically pronounceable unit, but also the comprehension of a word as a semantic concept.

Further, these limitations carry over into the research which attempts to distinguish between good and poor readers' ability to recognize and comprehend words.

The purpose of this paper is to suggest several ways research in word recognition might overcome these limitations. These suggestions will then be extended to propose a possible framework for distinguishing between good and poor readers' ability to process words. The limitations of these models are discussed. A new model is proposed, which distinguishes between several types of contexts. Word recognition is viewed as a function of **transparency** and **opacity** within and between these contexts.

Transparency and opacity refer to one's understanding of how the parameters relate within and between given contexts. A context is transparent when the parameters are easily recognized and manipulated relative to a given end. A context is opaque if the parameters are difficult to recognize and/or manipulate. Examples of transparency and opacity are given relative to single and multiple encounters between a reader and text. It is noted that good readers are those who maximize transparency whereas poor readers are those who are subject to maximum opacity. Finally, a model of word recognition is described that demonstrates how a reader uses transparency of various contexts to process a word.

Models of Word Recognition

Three models of word recognition have been proposed: the bottom-up model, the top-down model, and the interactive model. The bottom-up model assumes that word recognition proceeds through a linear series of stages of analysis beginning with sensory representation and culminating in meaning (e.g., Gough, 1972; LaBerge & Samuels, 1974; Mattingly, 1972; Norman, 1972). In the top-down model it is assumed that the cognitive system directs the type and amount of information abstracted from the visual signal. The cognitive system is said to "select available cues" or "confirm expectancies." Under this approach, reading is viewed as a problem-solving task, with the visual signals simply being sampled, and only partially analyzed to confirm semantic hypotheses (e.g., Smith, 1971; Kolers, 1970). While some top-down systems are assumed to sample from several sources of information, including phonological sources (e.g., Goodman, 1970), others are assumed to specifically exclude some sources of information from word analysis (e.g., Smith, 1973).

A third type of model, descriptive of how words are recognized, is the interactive model. Interactive models may assume that processing is either bottom-up or top-down, but whatever the direction of the processing, the assumption is that processing occurs simultaneously at several levels of analysis. Under this approach word recognition is said to depend on information provided from all levels of processing (e.g., Norman & Bobrow, 1976; Rumelhart, 1977). Interactive models seem to differ from top-down systems largely in terms of the independence, yet interactiveness, of the various levels of analysis. This means that in the interactive system, each informational level (e.g., feature, letter, syntactic, semantic) attempts to solve the message input at its own level. Although each level's hypotheses are constrained by information from other levels, each level does its own job and is not simply a data source for the semantic system, which directs processing and decides where comprehension has occurred.

Unfortunately, even given these three models, there has been little consensus as to what is the basic unit of lexical processing and how this processing actually occurs relative to the different levels of a word. For example, even if one were to adopt the bottom-up model, one is still left with the problem of deciding whether the word is first recognized as a letter by letter event (e.g., Gough, 1972), as a series of spelling pattern units (e.g., Gibson, Pick, Osser, & Hammond, 1962; Gibson, Bishop, Schiff, & Smith, 1964; Gibson, 1970), or as a whole unit (e.g., Johnson, 1975, 1977).

Rather, comprehension is achieved when the message is understood at all levels of analysis (e.g., Rumelhart, 1977). Thus, instead of directing processing the cognitive system might constrain the hypotheses at "lower" levels of analysis, but is also itself constrained by lower level information (e.g., Hawkins, Reicher, Rogers, & Peterson, 1976; Marlsen-Wilson & Welsh, 1978).

Furthermore, even given the constraints of a bottom-up model, one further must decide among the following alternative interpretations of the lexical processing procedure. The first interpretation is that speech recoding does **not** occur as a mediating stage between visual and meaning analyses; this position maintains that there are direct pathways from the visual signals to meaning, making an intermediary phonemic strategy unnecessary (e.g., Baron, 1973; LaBerge, 1972; LaBerge & Samuels, 1974). The second interpretation is that recoding visual signals into a speech code is necessary in order to address those items in the mental lexicon (e.g., Gough, 1972; Rubenstein, Lewis, & Rubenstein, 1971). This view claims that the reader proceeds through the text in a letter-to-sound-to-meaning manner. The third interpretation is that the lexical access of each word occurs without speech recoding, but speech recoding then occurs in working or short-term memory in order to keep single items active long enough for semantic integration or message comprehension to occur (e.g., Johnson, 1977).

The basic problem posed by these different models and different positions is that although they suggest competing, often times contradictory hypotheses, they each can be supported empirically. In short, one can cite evidence in defense of any one of the three models outlined above, supporting any one of the positions that the letter, the multi-letter, or the word is the basic unit of word recognition, and supporting the positions that lexical recoding does take place — either directly or indirectly — or does not take place. (For substantial reviews of the evidence supporting these various positions, see LaBerge & Samuels, 1977; Levy, 1977; Marslen-Wilson & Welsh, 1978; Meyer, Schvaneveldt, & Ruddy, 1974.)

To account for this discrepant evidence, several reading researchers have argued that people process words differently because they possess different word recognition skills (e.g., Guthrie, 1973; Guthrie & Seifert, 1977; Jorm, 1977; Juel, 1978; Mason, 1976, 1977, 1978; Samuels, Begy, & Chen, 1975-1976). The basic shortcoming of this explanation is that it assumes that all children share the same purpose in processing a word—i.e., arriving at its semantic meaning. Such a view is expressed by Postman and Krusei (1977, p. 368) when they note that when subjects are given a levels-of-processing task:

It may be well to remember that subjects come to the experiment with a lifelong habit of processing words semantically. It may be a basic error to assume that instructions to attend to a nonsemantic property effectively shunt out this disposition. Rather, the imposition of a nonsemantic task may interfere to a greater or lesser degree with a persisting tendency to process words semantically. Thus, we see considerable merit in the recent suggestion of Arbuckle and Katz (1976) that nonsemantic orienting tasks may "simply provide a less efficient means of encoding semantic information" (1976, p. 362).

The typical view, then, is that good and poor readers both maintain the same goal when recognizing words—the goal of arriving at a word's semantic meaning.

It is traditionally assumed that because poor readers are less adept at achieving this goal than good readers, poor readers must have some type of developmental deficiency, strategy deficiency, linguistic deficiency, or sensory deficiency (cf. Cromer, 1970; Oaken, Wiener, & Cromer, 1971; Steiner, Wiener, & Cromer, 1971).

An alternative explanation of why people, especially good and poor readers, perform so differently in word recognition studies is because people have different goals (e.g., expectations or intentions) for processing words. Morris, Bransford, and Franks (1977) have demonstrated this point by noting that people attend first to the meaningfulness of a task before they attend to the meaning of a stimulus. In their study they showed that the semantic level of a word is not the most meaningful dimension of a word for a subject whose goal it is to recognize words which rhyme.

Several other studies have similarly presented evidence that people's intention to process determines how a stimulus is to be interpreted, even more than the semantic meaning inherent within the stimulus itself (e.g., Brewer, 1974; Flavell & Wellman, 1977; Mosenthal, 1977; Spiro, 1977).

That a person's goal determines the manner in which a person will process a word has been forcibly demonstrated in studies by Thompson, Massaro, and Estes. In a series of experiments Thompson and Massaro (1973) and Massaro (1973) demonstrated that subjects with a goal of processing words at a given level will make optimal use of this level, excluding or minimizing information from other levels. In particular, in their experiments Thompson and Massaro showed that if target letters are known in advance, then letters can be identified more accurately in isolation than in the context of a word or pronounceable nonword. On the other hand, when the target letters are not known in advance, letters can be identified more accurately in the context of a word. Similar results have been obtained by Bjork and Estes (1973) and Estes (1975, 1977).

A Preliminary Model of Word Recognition: The Variables

Most models define word recognition only in terms of a limited number of variables (typically linguistic). The above mentioned studies suggest that word recognition must be viewed as an interactive process. In this process both linguistic and non-linguistic variables must be considered. These include the following contexts: linguistic, social, schematic, and strategic (see Figure 1).

Linguistic Context. The linguistic context may be defined in terms of five levels of word processing: (1) orthographic, (2) phonetic, (3) syllabic, (4) morphemic, and (5) semantic. In the bottom-up model of word recognition, one starts at either levels (1), (2), or (3) and proceeds through (4) and (5). In the top-down processing model, one starts processing at either level (4) or (5) and proceeds through levels (3), (2), and (1). The interactive model allows readers to enter at any level, though processing occurs at all levels. The general scheme for such processing depends upon the relative opacity/transparency of a given level. Opacity/transparency refers to the ease by which a given level is accessed. For instance, "sight" words (e.g., **was, the, said, through**) are phonetically opaque but semantically transparent. This means that while one can easily access the semantic meaning of these words, ease of access via their phonetic features is relatively difficult. In contrast, the words **gig, bap** (Scottish for **loaf**), **cull,** and **sine** are phonetically transparent but semantically opaque.

Social Context. Social context can be defined as the co-operative interaction between a reader and the parameters of his environment (Garfinkel, 1967; Mehan, 1978; Mehan & Wood, 1975). Such parameters may include: (1) place of interaction, (2) person(s) with whom the reader is interacting, (3) time of interaction, and (4) task demands as defined by the context and the person for whom the reader is reading (e.g., teacher, experimenter, father). There are basically two general categories of social context—opaque and transparent. An opaque context is one in which the place, person(s), schedule, and/or task demands are unfamiliar to the reader; the maximally transparent context is one in which these parameters are all familiar

to the reader. For example, while the reader may be situated in a familiar classroom during the normally scheduled reading lesson (transparent parameters), he may be asked to perform an unfamiliar task (e.g., 50 msec. tachistoscopic identification task) by an unknown experimenter (opaque parameters).

Schematic Context. Schematic context in general refers to one's knowledge of the world (Anderson, 1977; Anderson & Pichert, 1978; Minsky, 1975; Winograd, 1977). The basic unit of a schematic context is a **schema,** which is defined in terms of "instantiating slots relative to a given frame." There are two types of frames — superordinate and subordinate. A subordinate frame represents some characteristic feature or example of a superordinate frame. Superordinate frames are said to have been instantiated by subordinate frames when possible interpretations (i.e., slots) of the superordinate frame are made specific. For example, the superordinate frame RESTAURANT would contain such possible "slots" as food preparation, food delivery, food consumption, and food type (in other words, food preparation, delivery, etc., are considered representative features of the concept RESTAURANT). Subordinate frames or features which may be used to instantiate the superordinate frame RESTAURANT are as follows: for food preparation, kitchen in full view vs. kitchen concealed; for food delivery, over the counter vs. via waitress; for food consumption, seated in an automobile vs. seated at a dining table; for food type, hamburger vs. Coquille St. Jacques. Instantiation occurs when a slot is filled by a specific feature or group of features. For example, one would instantiate the frame MCDONALDS by assigning to its slots the subordinate frames: kitchen in full view, over the counter food delivery, hamburger food type, etc.

The notions of opacity and transparency again apply to descriptions of schema types. An opaque schema is one in which the superordinate frame is difficult to instantiate due to lack of knowledge of subordinate frames. For example, the superordinate frame PIGGIN would be opaque either as an individual word or in a sentence context if one did not know its general subordinate frames for instantiating it. A **piggin** is, in fact, a small wooden pail with one long stave that serves as a handle. The subordinate frame STAVE would be opaque if one did not know its subordinate features such as "strip of wood," "thinness," "function to serve as the wall of a water container," and so on.

Strategic Context. The strategic context is defined by the range of strategies for reading behaviors (Newell & Simon, 1972). A strategy refers to "a pattern of decisions in the acquisition, retention, and utilization of information that serves to meet certain objectives, that is to insure certain forms of outcome and to insure against others" (Bruner, 1973, p. 135). Again, the notions of opacity and transparency can once more be applied. Strategic opacity may be a result of (a) a lack of knowledge specifying a pattern of decisions, or (b) having ill-defined objectives. One example of strategic opacity would be if the student has no knowledge of decision-making patterns for recognizing words, then he will be unable to acquire, retain, or use information relative to this end. An instance of this might be: if the reader has no visual analysis strategies for breaking polysyllabic words into manageable units, he will be unable to pronounce an entire polysyllabic word, if that is the desired end. Another would be if the student had no objective for recognizing a word, then no specific outcome could be insured.

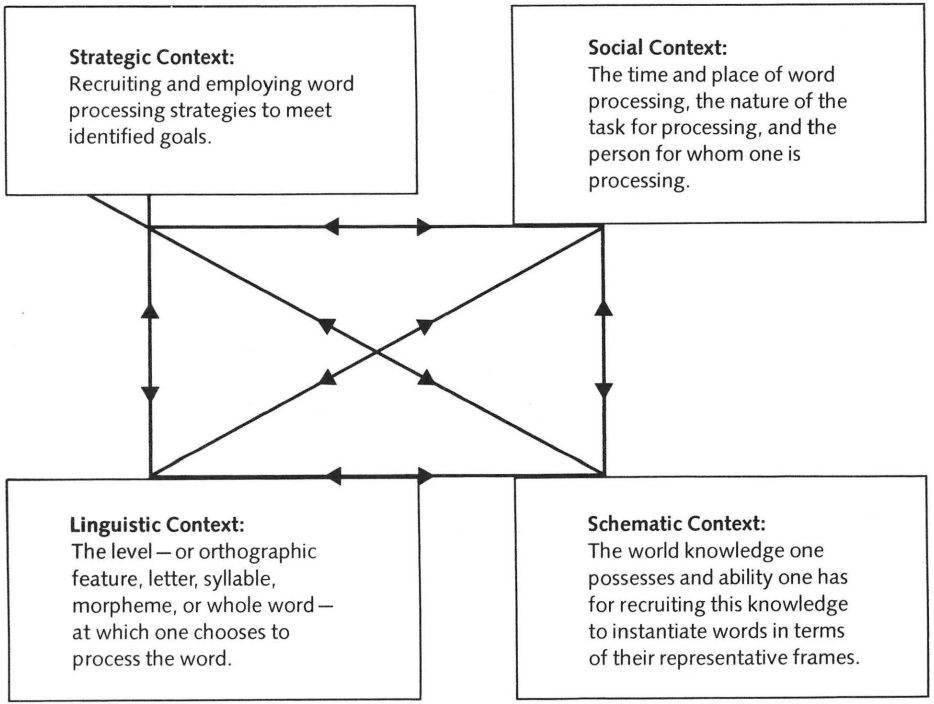

Figure 1.
Linguistic and paralinguistic factors influencing the manner in which a person recognizes a word.

Defining Good and Poor Readers as a Function of Contextual Transparency: Within a Single Episode of Word Processing

To present, the only context that has been considered in distinguishing between good and poor readers is the linguistic. In other words, independent variables in the research on good and poor readers appear invariably to have been linguistic, and they have been studied only in terms of absolute conditions in the social, schematic, and strategic contexts. Good and poor readers are typically distinguished in terms of their ability to process at a given linguistic level (i.e., orthographic, phonetic, semantic, etc.) within a formal social context (e.g., in a school testing situation), with one acceptable lexical instantiation (e.g., the teacher's definition), and with one strategic objective (e.g., meeting the teacher's expectations for processing the word).

According to the model presented here, good and poor readers would be defined quite differently. Given a single encounter with a text, an optimally good reader may be defined as one who is capable of maximizing transparency in the four contexts. For example, in the strategic context, the good reader might recognize the objective of, say, faithfully reproducing the phonetic representation of the word. This is in keeping with his understanding of the transparent social context in which, say, a reading teacher is using a formal oral reading test (e.g., Gray Oral) to assess his reading ability. In this circumstance, the schematic context is transparent, if the reader recognizes that the phonetic representation of a frame (lexical item) is to be instantiated independent of the semantic level. Finally, the linguistic context is considered transparent if the reader easily recognizes the phonetic patterns of the letters comprising the word.

Another example might be: in the strategic context, the good reader might recognize the objective of, say, reconstructing the meaning of a word. What this might mean is that given a word in context, the reader might have to infer the word's meaning from surrounding semantic context. This would be consonant with the transparency of the social context as perceived by the reader, as exemplified by the reader reading a passage for a teacher/experimenter using Goodman's (1970) miscue analysis, and substituting one synonym for another. The schematic context is transparent in this instance, given that the reader can instantiate the target word relative to the semantic context in which it occurs. The linguistic context is considered transparent if the reader's reconstructed meaning is semantically acceptable relative to its surrounding linguistic environment.

A final example is demonstrated by a good reader adopting, within the strategic context, an objective, say, of embellishing the meaning of a word. The objective here might be to make a passage more humorous or relevant (one might imagine a parent reading to a child, substituting the child's name for the name of the main character in the passage or story). This is congruent with a transparent social situation in which a parent informally reads to a child before bed time. The schematic context is transparent if the parent instantiates the word relative to the objective of making the child laugh, or pay atention. The linguistic context is transparent in the sense that the reader is capable of redefining the semantic function of the word in its linguistic context, even though the reader recognizes the real meaning of the target word.

On the other hand, the (theoretically) poorest reader, given a single encounter with text, is subject to maximum opacity in the four contexts. For instance, in the strategic context, this reader may have no idea of the objective of whether to reproduce, reconstruct, or embellish text at a given time — provided this reader understands these strategic objectives in the first place. In social context, this reader might have no understanding of the task demands, nor be aware of such parameters as the person for whom he reads, or the setting and time of the reading encounter. In the schematic context, this reader may be unable to instantiate a given frame due to his lack of world knowledge. Finally, this reader will find the linguistic context opaque if he lacks the ability to access a word at any given linguistic level.

Note that unlike previous descriptions of word processing, it is argued here that in any single encounter between reader and text, such as in the examples described above, all of the four contexts interact. Previous descriptions — even if they admitted to the legitimacy of paralinguistic contexts — have assumed that the interaction between levels (e.g., between semantic and phonetic, as in hierarchical models — cf. Rumelhart, 1977) is constant, and levels always interact in such a manner as an aprioristically identified objective (e.g., correct pronunciation of a word) is either achieved or not achieved.

What is important here is to understand that a single episode of word processing is a gestalt, defined by the interaction of these four contexts, and not merely a linguistic phenomenon disturbed or not disturbed by events occurring in the other contexts.

But even more important is to understand that reading is not a single-episode phenomenon; reading is a series of encounters between a reader and text that are defined by the interaction of the four contexts over time. The interaction within and between these contexts is obviously constantly shifting: transparency of linguistic levels shifts from word to word; transparency of social context shifts as a function of changes in task demands and time, as well as the people for whom the reading is done, and the setting in which reading occurs; transparency of schematic context shifts relative to the changes of lexical frames and one's ability to instantiate these frames; finally, strategic context shifts according to the reader's goals and strategies for attaining them. Such shifts suggest that word processing is a gestalt not only **within** these contexts but a gestalt **between** these contexts; any shift in one context over time may produce a dramatic shift in other contexts, as suggested by the interaction examples presented earlier. In short, this gestalt defines word recognition.

Defining Good and Poor Readers as a Function of Contextual Transparency: In a Series of Episodes of Word Processing

In a typical processing of words, contexts are rarely all transparent. The good reader is he who is capable of transforming opacity within and/or between contexts into transparency by drawing upon transparency in other domains — within and between contexts. The poor reader, on the other hand, lacks this ability. This accounts for the typical example whereby a reader having difficulty in decoding a word uses the transparency of, say, the semantic level to overcome the opacity of the phonetic level.

An example where the transparency of one context is used to resolve the opacity of another context is as follows: Imagine a reader presented with an unfamiliar text by an experimenter. If at the beginning of the experiment the strategic context for word processing is opaque, a good reader may use the transparency of the social context (i.e., an experimental situation) to overcome this opacity by inferring that the experimenter wants a reproductive interpretation of the words. A poor reader may have only one concept of how the contexts interact. What this means is that while in an experimental situation he may reproductively interpret the words, unlike the good reader when the formal experiment shifts to an informal reading, he persists in employing reproductive strategies whether appropriate or not in this latter context.

In brief, the significance of this model lies in its definition of word recognition as a relative, rather than an absolute phenomenon. In terms of testing word recognition ability, it is generally assumed that one operational definition of word processing is sufficient to distinguish between good and poor readers, be it reproduction of the phonetic level (i.e., words in context, as tested by the Gray Oral, words in isolation as tested by the Bryant Phonics Test or the Sipay Word Analysis Test) or reconstruction at the semantic level (Goodman, 1970), or reconstruction/reproduction at some other level. The assumption underlying these traditional definitions is that a good reader meets the criterion of a given operational procedure, while a poor reader does not. Consequently a reader who is capable of reconstructing at the semantic level but poor in consistently reproducing at the phonetic level is nevertheless considered a good reader according to the Goodman criteria; however, the same performance judged according to the Gray Oral criteria results in the reader being labeled as poor.

The model presented in this paper would argue that the good reader is one who is capable of meeting the differing demands of various contexts, be they linguistic, social, schematic, or strategic. In the above example, the good reader would be he who performs well under both operational criteria. But this does not mean that good readers are merely good test-takers under varying test conditions; they are capable of maximizing the transparency of contexts, be they teacher-defined or self-defined.

Toward a Multicontext Model of Word Recognition

Given these examples distinguishing good and poor readers and given the variable nature of how the above-mentioned contexts interact, the following model is proposed to demonstrate tentatively how a reader uses transparency of these contexts to process a word (see Figure 2).

The model posits that word recognition is basically an inference generating, inference confirming process which may lead to either reproductive, reconstructive, or embellished understanding of a word or words in context. Depending upon the strategic objective a person wishes to achieve and the person's disposition for processing at a given linguistic level (this may be reader-initiated or task-invoked), a person inputs the words as a new event.

Depending upon the level at which one is processing, a set of plausible inferences from this event are generated as a means for recognizing a given level of the word. The actual number of inferences generated, of course, depends upon the interrelationship between paralinguistic and linguistic variables previously identified. If there is a currently active frame or context which identifies the particulars of this word level, it is stored with its inferences. If this level matches the person's intended level of processing and if a person is willing to accept the certainty of his inference as to the meaningfulness of a given level, the person will discontinue further processing of the word.

It may be the case, however, that a person cannot find an active frame by which the particulars of a given word level can be identified. Or it may be that although a person begins to process the word at one level, he had the additional strategic objective of interpreting the word at another level. Or it may be that a person is uncertain about the amount of information he should use from the various linguistic levels to identify a word. Depending upon one or more of these cases, the reader will proceed to another level of the word and will generate a new plausible inference about the nature of this level. Again, if there is a currently active frame or context which identifies the particulars of this word level, this frame or context is stored with its inferences. If for the reasons cited above a person wishes to move to another level to generate and confirm additional inferences, newly generated and confirmed inferences and frames may or may not make use of the previously stored knowledge generated and confirmed at one or more of the levels previously processed.

An additional assumption of this model is that if a person is unable to generate a plausible inference or if he is uncertain as to the validity of his generated frame and inference, he may prefer not to adopt the strategy of proceeding to an additional level. On the other hand, he may simply generate new frames and inferences **within** the level he is presently processing, in order to account for the incoming event.

In sum, while previous models have focused almost exclusively on the linguistic context of word recognition, this paper has argued that word processing is more properly viewed as a gestalt, defined by the interaction of four principal contexts (linguistic, strategic, social, and schematic). Even in cases where previous models have acknowledged the legitimacy of contexts other than linguistic, these models have attempted to describe only single episodes of word processing. This has resulted in the belief that one operational definition is sufficient for defining word recognition and is also sufficient for distinguishing between good and poor readers.

This paper has presented a multicontext model that describes word recognition as a reader's attempt to maximize transparency within and between linguistic and paralinguistic contexts. The significance of this model is that it describes not only how the transparency shifts within and between contexts in a single encounter with text, but also how transparency shifts within and between contexts in multiple encounters with text. The implication of this model is that word recognition can only be defined in terms of multiple operational definitions (representing the varying interactions of contexts over time); similarly this model implies that good and poor readers can only be distinguished on the basis of several operational definitions representing the reader's ability to maximize transparency in various interacting contexts for processing words.

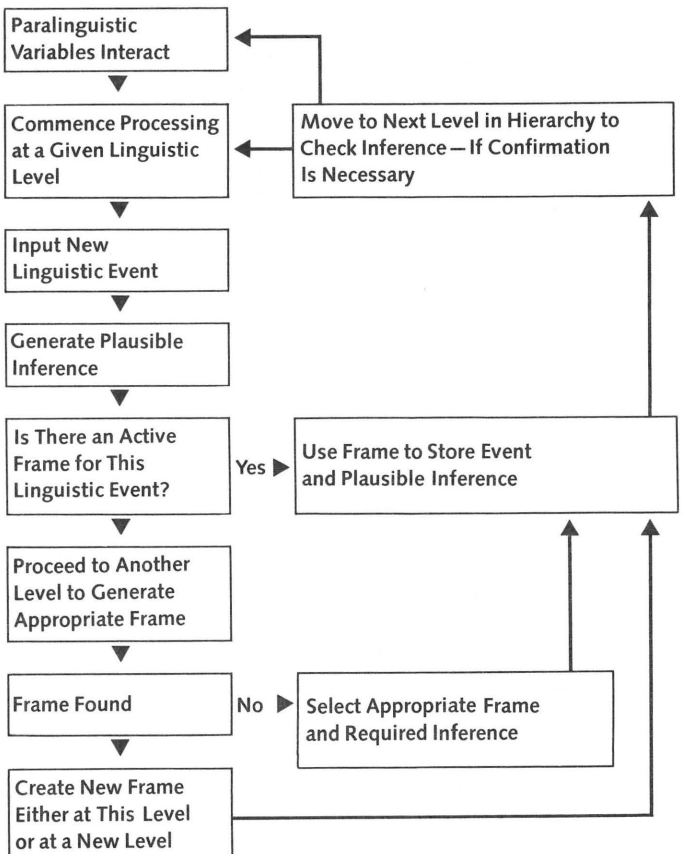

Figure 2.
Word recognition procedures within the domain of the linguistic context.

References

Arbuckle, T.Y., & Katz, W.A.
Structure of memory traces following semantic and nonsemantic orientation tasks in incidental learning.
Journal of Experimental Psychology: Human Learning and Memory, 1976, *2,* 362-269.

Anderson, R.C.
The notion of schemata and the educational enterprise.
In R.C. Anderson, R.J. Spiro, and W.E. Montague (eds.), *Schooling and the acquisition of knowledge.*
Hillsdale, N.J.: Erlbaum, 1977.

Anderson, R.C., & Pichert, J.W.
Recall of previously unrecallable information following a shift in perspective.
Journal of Verbal Learning and Verbal Behavior, 1978, *17,* 1-12.

Baron, J.
Phonemic stage not necessary for reading.
Quarterly Journal of Experimental Psychology, 1973, *25,* 241-246.

Baron, J.
Mechanisms for pronouncing printed words: Use and acquisition.
In D. LaBerge & S.J. Samuels (eds.), *Basic processes in reading: Perception and comprehension.*
Hillsdale, N.J.: Erlbaum, 1977.

Bjork, E.L., & Estes, W.K.
Letter identification in relation to linguistic context and masking conditions.
Memory and Cognition, 1973, *1,* 217-223.

Brewer, W.F.
There is no convincing evidence for operant or classical conditioning in adult humans.
In W.B. Weimer & D.S. Palermo (eds.), *Cognition and the symbolic processes.*
Hillsdale, N.J.: Erlbaum, 1974.

Bruner, J.S.
The process of concept attainment.
In J.M. Anglin (ed.), *Beyond the information given.*
New York: W.W. Norton.
Originally published in J.S. Bruner, J.J. Goodnow, and G.A. Sutin, *A study of thinking.*
New York: John Wiley.

Cromer, W.
The Difference model: A new explanation for some reading difficulties.
Journal of Educational Psychology, 1970, *61,* 471-483.

Estes, W.K.
The locus of inferential and perceptual processes in letter identification.
Journal of Experimental Psychology: General, 1975, 104, 122-145.

Estes, W.K.
On the interaction of perception and memory in reading.
In D. LaBerge & S.J. Samuels (Eds.), *Basic processes in reading: Perception and communication.*
Hillsdale, N.J.: Erlbaum, 1977.

Flavell, J.H., & Wellman, H.M. Metamemory. In R.V. Kail, Jr., & J.W. Hagen, *Perspectives on the development of memory and cognition.* Hillsdale, N.J.: Erlbaum, 1977.

Garfinkel, H. *Studies in ethnomethodology.* Englewood Cliffs, N.J.: Prentice Hall, 1967.

Gibson, E.J. **The ontogeny of reading.** *American Psychologist,* 1970, *25,* 136-143.

Gibson, E.J., Bishop, C.H., Schiff, W., & Smith, J. Comparisons of meaningfulness and pronounceability as grouping principles in the perception and retention of verbal materials. *Journal of Experimental Psychology,* 1964, *67,* 174-182.

Gibson, E.J., Pick, A., Osser, H., & Hammond, M. The role of grapheme-phoneme correspondence in the perception of words. *American Journal of Psychology,* 1962, *75,* 554-570.

Goodman, K.S. Behind the eye: what happens in reading. In K. Goodman & O. Niles, *Reading: Process and program.* Urbana, Ill.: NCTE, 1970. Pp. 3-33.

Gough, P.B. One second of reading. In J.F. Kavanagh & I.G. Mattingly, *Language by ear and by eye: The relationships between speech and reading.* Cambridge, Mass.: MIT Press, 1972.

Guthrie, J.T. Models of reading and reading disability. *Journal of Education Psychology,* 1973, *65,* 9-18.

Guthrie, J.T., & Seifert, M. Letter-sound complexity in learning to identify words. *Journal of Educational Psychology,* 1977, *69,* 686-696.

Hawkins, H.L., Reicher, G.H., Rogers, M., & Peterson, L. Flexible coding in word recognition. *Journal of Experimental Psychology: Human Perception and Performance,* 1976, *2,* 380-385.

Johnson, N.F. A pattern-unit model of word identification. In D. LaBerge & S.J. Samuels (eds.), *Basic processes in reading: Perception and comprehension.* Hillsdale, N.J.: Erlbaum, 1977.

Johnson, N.F. On the function of letters in word identification: Some data and a preliminary model. *Journal of Verbal Learning and Verbal Behavior,* 1975, *14,* 17-29.

Jorm, A.F. Effect of word imagery on reading performance as a function of reader ability. *Journal of Educational Psychology,* 1977, *69,* 46-54.

Juel, C.L. A cognitive model of reading for elementary school students. Paper presented at the American Educational Research Association. Toronto, Canada, March, 1978.

Kolers, P.A.
Three stages of reading.
In H. Levin & J.P. Williams *Basic studies on reading.*
New York: Basic Books,
1970.

Krulee, G.K., Heisey, J.A., & Eliot, J.
Word recognition: A developmental analysis.
Perceptual and Motor Skills, 1977,
44, 163-174.

LaBerge, D.
Beyond auditory coding. In J.F. Kavanagh & I.G. Mattingly, *Language by ear and by eye.*
Cambridge, Mass.: MIT Press, 1972.

LaBerge, D., & Samuels, S.J.
Toward a theory of automatic information processing in reading.
Cognitive Psychology, 1974,
6, 293-323.

LaBerge, D., & Samuels, S.J.
Basic processes in reading: Perception and comprehension.
Hillsdale, N.J.: Erlbaum, 1977.

Levy, B.A.
Reading: Speech and meaning processes.
Journal of Verbal Learning and Verbal Behavior, 1977,
16, 623-638.

Marslen-Wilson, W.D., & Welsh, A.
Processing interactions and lexical access during word recognition in continuous speech.
Cognitive Psychology, 1978,
10, 29-63.

Mason, J.M.
Overgeneralization in learning to read.
Journal of Reading Behavior, 1976,
8, 173-182.

Mason, J.M.
Questioning the notion of a stage processing model of reading.
Journal of Educational Psychology, 1977,
69, 288-297.

Mason, J.M.
Role of strategy in reading by mentally retarded persons.
American Journal of Mental Deficiency, 1978,
82, 467-473.

Massaro, D.W.
Perception of letters, words, and nonwords.
Journal of Experimental Psychology, 1973,
100, 349-353.

Mattingly, I.G.
Reading, the linguistic process, and linguistic awareness.
In J.F. Kavanagh & I.G. Mattingly (eds.), *Language by ear and by eye*
Cambridge, Mass.:
MIT Press, 1972.

Mehan, H.
Structuring school structure.
Harvard Educational Review, 1978,
48, 32-64.

Mehan, H., & Wood, H.
The reality of ethnomethodology.
New York: Wiley-Interscience,
1975.

Meyer, D.E., Schvaneveldt, R.W.,
& Ruddy, M.G. Functions of graphemic and phonemic codes in visual word-recognition.
Memory and Cognition, 1974,
2, 309-321.

Minsky, M.
A framework for representing knowledge.
In P. Winston, *The psychology of computer vision.*
New York: McGraw Hill, 1975.

Morris, C.D., Bransford, J.D., & Franks, J.J. Levels of processing versus transfer appropriate processing.
Journal of Verbal Learning and Verbal Behavior, 1977, *16,* 519-535.

Mosenthal, P.
Children's metacognitive reproductive and reconstructive comprehension in listening, reading silently, and reading aloud: A problem of psychosocial development. Paper presented at the National Reading Conference.
New Orleans, December, 1977.

Newell, A., & Simon, H.A.
Human problem solving.
Englewood Cliffs, N.J.: Prentice-Hall, 1972.

Norman, D.A.
The role of memory in the understanding of language. In J.F. Kavanagh and I.G. Mattingly, *Language by ear and by eye.*
Cambridge, Mass.: MIT Press, 1972.

Norman, D.A., & Bobrow, D.G.
On the role of active memory processes in perception and cognition.
In C.N. Cofer, *The structure of human memory.*
San Francisco: W.H. Freeman, 1976.

Oaken, R., Wiener, M., & Cromer, W.
Identification, organization, and reading comprehension for good and poor readers.
Journal of Educational Psychology, 1973, *62,* 71-75.

Postman, L., & Krusei, E.
The influence of orienting tasks on encoding and recall of words.
Journal of Verbal Learning and Verbal Behavior, 1977, *16,* 333-370.

Rubenstein, H., Lewis, S.S., & Rubenstein, M.A. Evidence for phonemic recording in visual word recognition.
Journal of Verbal Learning and Verbal Behavior, 1971, *10,* 647-657.

Rumelhart, D.E.
Toward an interactive model of reading.
In S. Dornic, *Attention and performance VI.*
Hillsdale, N.J.: Erlbaum, 1977.

Samuels, S.J., Begy, G., & Chen, C.C.
Comparison of word recognition speed and strategies of less skilled and more highly skilled readers. *Reading Research Quarterly,* 1975-1976, *11,* 72-86.

Smith, F.
Understanding reading: A psycholinguistic analysis of reading and learning to read.
New York: Holt, Rinehart, & Winston, 1971.

Smith, F.
Psycholinguistics and reading.
New York: Holt, Rinehart, & Winston, 1973.

Spiro, R.J.
Remembering information from text: the "state of schema" approach.
In R.C. Anderson, R.J. Spiro, & W.E. Montague, *Schooling and the acquisition of knowledge.*
Hillsdale, N.J.: Erlbaum, 1977.

Steiner, R., Wiener, M., & Cromer, W.
Comprehension training and identification for poor and good readers.
Journal of Educational Psychology, 1971, *62,* 508-513.

Thompson, M.D., & Massaro, D.W.
Visual information and redundancy
in reading.
Journal of Experimental Psychology, 1973,
98, 49-54.

Winograd, T.
A framework for understanding discourse.
In M.A. Just and P.A. Carpenter,
Cognitive processes in comprehension.
Hillsdale, N.J.: Erlbaum, 1977.