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ABSTRACT

An interactive/cognitive model can account for the acquisition of a graphophonemic system by young children and be compatible with the cuing explanation, which posits that readers use their graphophonemic knowledge in coordination with their knowledge of language and the world to make sense of print. Explanations in the research literature of how young children learn to make sense of print vary in the extent to which they account for how readers recode unfamiliar print words without assistance from another reader. Two studies compared the explanatory power of the analogy (learning print words holistically from an experienced reader) and the blending (identifying unfamiliar print words by learning grapheme-phoneme correspondences) explanations. Results indicated that the analogy explanation accounted for children's correct recodings of pseudowords better than the blending explanation. A model based on existing literature and the results of the two studies suggests that children learning to read an alphabetic script first learn to recognize holistically the print forms of some words in their oral language. First words are acquired through cues from environmental print or from more experienced readers. Then as children recognize more print words they can figure out more from the context and from orthographic cues. Children then recognize letters and strings of letters in new print words and strings of letters representing onsets and rimes in familiar print words. (Three tables of data, one figure of data, and a figure representing the model are included; 20 references are attached.) (RS)

An Interactive/Cognitive Model of the Acquisition of a Graphophonemic System by Young Children

by

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The cueing explanation posits that readers use their knowledge of the graphophonemic system in coordination with their knowledge of the language represented in the text and their knowledge of the world to make sense of print. Although the cueing explanation posits the *use* a graphophonemic system, it does not explain the *acquisition* of a graphophonemic system. Today, I'd like to present an interactive/cognitive model of the acquisition of a graphophonemic system by young children which is compatible with the cueing explanation.

I began the model by placing the various explanations of how children learn to recode along two continuum: context and productivity. Let's look at context first. I have called all the explanations where one reader tells another reader what a word is, the informant explanation. As Table 1 shows, the informant explanation may be context embedded as in predictable text or Language Experience Stories or it may be context free as on word lists or word cards. The context and cueing explanations involve situational or linguistic context. The blending and analogy explanations do not involve situational or linguistic context.

Table 1 Interface of the Various Recoding Explanations with Context and Productivity

	No Accounting for Productivity	Partial Accounting for Productivity	Full Accounting for Productivity
Context Embedded	-Informant explanation .predictable text .Language Experience Approach ."What's that?" questions	-Context explanation .environmental print .continuous text -Cueing explanation	
Context Free	-Informant explanation .word lists .word cards		-Blending explanation -Analogy explanation

These explanations vary in the extent to which they account for how recoding becomes productive, that is, how readers recode unfamiliar print words without assistance from another reader. The informant explanation, by itself, gives no accounting for productivity. The *context and cueing explanations* give a partial accounting for productivity. While they account for how readers

recode unfamiliar print words in their oral language, they *do not account for how readers recode unfamiliar print words not in their oral language*. The blending and analogy explanations give a full accounting for productivity. They account for how readers recode both print words in their oral language and print words not in their oral language.

The next step in building the model was to ask: *What is the relative viability of these explanations* for how children learn to recode? *First I will make vertical comparisons* within the table. Then I will make horizontal comparisons.

What is the relative viability of the context-embedded vs the context-free informant explanation? Goodman's 1965 research showed that it is easier for children to recode words in meaningful contexts than in word lists. This suggests that the context-embedded informant explanation is more viable than the context-free informant explanation. The context and cueing explanations are sister explanations. Both explanations posit that readers use their knowledge of language and their knowledge of the world to recode unfamiliar print. Neither explanation requires knowing the sounds represented by all the letters to recode print.

While the context and cueing explanations are similar the *blending and analogy explanations are quite different*. The blending explanation posits that children learn to identify unfamiliar print words by learning grapheme-phoneme correspondences. It is a parts-to-whole process. The analogy explanation, as articulated by Smith, posits that children first learn print words holistically from another, more experienced reader; then they make analogies between familiar and unfamiliar print words to recode unfamiliar print words. It is a whole to parts process.

Are the blending and analogy explanations alternate strategies, equally viable, or is one more viable than the other? Let's look at some phonological and cognitive processes related to the two explanations.

The blending explanation assumes that children can hear sounds in phonemic units. The work of Liberman, Shankweiler, Fischer, and Carter (1974) and of others has pointed to preliterate children's inability to perceive sounds in phonemic units. On the other hand, the work of Treiman (1985, 1983) and of Goswami and Bryant (1990) point to preliterate children's ability perceive onsets and rimes. According to onset-rime theory the natural units of a syllable are onsets and rimes. Onsets are any consonants which come before the vowel and rimes are the vowel and any consonants which come after it. The word <u>beak</u>, for example, consists of an onset /b/ and a rime /ek/.

The discovery of onsets and rimes and young children's natural ability to hear them raises the *possibility that children*

do not have to use phonemic units to acquire an alphabetic system. It could be that children's knowledge of onsets and rimes *is* the phonological ability they use to acquire an alphabetic system. A reanalysis of Goswami's 1986 and 1988 studies and Wylie and Durrell's 1970 study suggests just that.

In her 1986 and 1988 studies Goswami found that the children she studied made significantly more analogies between her test words with analogous endings than between her test words with analogous beginnings. Goswami's test words with analogous endings such as beak and peak had analogous rimes while her test words with analogous beginnings such as beak and bean had analogous phonemes where one phoneme was embedded in a rime. Hence, we can say the children made significantly more analogies between letter strings representing analogous rimes than between letter strings representing analogous phonemes where phonemes were embedded in rimes.

In their 1970 study Wylie and Durrell presented 230 children at the end of first grade with letter strings representing rimes such as ack, ick, ock, eck and uck. They gave the children instructions such as "Circle the one that says ock" and "Circle the one that has an /o/ in it". They found the children were significantly more successful in identifying letter strings representing whole rimes than in identifying letters representing phonemes embedded in the rimes.

Glushko (1981) suggests that when we store print words in memory, we store the orthographic and phonological representations together. Then, when a letter string is later identified, it "activates the stored orthographic and phonological representations of the words that contain them." *If children perceive onsets and rimes rather than phonemes, we can posit that they store and activate letter sequences which represent onsets and rimes rather than letter sequences which represent phonemes.*

There is another problem with the blending explanation. Smith points out that we cannot see words and letters at the same time, only sequentially. He uses an optical illusion to illustrate his point. *The blending explanation assumes that readers can reverse their perceptions from that of a word to that of letters and from that of separate phonemes to that of a spoken word*. Elkind, Koegler and Go (1964) showed children drawings where both parts and wholes had independent meanings, such as a picture of different types of candy arranged to make a picture of a tricycle. They found more than 1/2 of the seven year olds--that is, children of second- grade age--could not reverse their visual perceptions foam whole to parts or from parts to whole.

In sum, *Liberman et al.'s findings of children's inability to hear sounds in phonemic units and Elkind et al.'s findings of*

children's inability to reverse their perceptions raise doubts about the viability of the blending explanation for children.

On the other hand, research on oral language acquisition by linguists such as Wong Fillmore (1976), Peters (1983), Bowerman (1982), and others can be interpreted to support the analogy explanation. *The process of making analogies between familiar and unfamiliar print words is similar to the process these linguists have found children use to acquire productive oral language.* Both the process of making analogies and the process of acquiring oral language move from acquiring unanalyzed wholes to inducing parts and recombining parts productively. In both processes unanalyzed

Table 2 Text Used in the Analogy Task

Page	Original Text +	Altered Text
1.	Old hat.	Old hat.
2.	Old hat.	Old hat.
3.	New hat.	New hat.
4.		
5.	New hat. New hat. New hat. New hat.	New hat. New hat. New hat. New hat.
6.	Too big.	Too big.
7.	Too small.	Too small.
8.	Too flat.	Too green.
9.	Too tall.	Too black.
10.	Too loose. Too tight.	Too hew. Too little.
11.	Too heavy. Too light.	Too jop. Too light.
12.	Too red. Too dotty.	Too red. Too steen
13.	Too blue. Too spotty.	Too blue. Too prust.
14.	Too fancy. Too frilly.	Too tunny. Too pretty.
15.	Too shinny. Too silly.	Too round. Too rue.
16.	Too beady. Too bumpy. Too leafy. Too lumpy.	Too funny. Too yig. Too smed. Too blound.
17.	Too twisty. Too twirly. Too wrinkly. Too curly.	Too yellow. Too bittle. Too lat. Too grack.
18.	Too holey. Too patchy.	Too foo.
19.	Too feathery. Too scratchy. Too crooked. Too straight. Too pointed.	Too nellow. Too brust.
20.	Wait.	Stop.
21.		
22.	Just right.	Just right.
23.		
24.	Just right? Just right.	Too brown. Just right.
25.	Just right. Just right.	Just right. Just right.
26.	New hat.	New hat.
27.	Old hat.	Old hat.

+ *Old Hat, New Hat* by S. and J. Berenstain (1970).

wholes are acquired through interaction with people who are more experienced with the code.

Based on these phonological and cognitive considerations I (Moustafa, 1990) *hypothesized that an onset/rime-based analogy explanation is a more viable explanation than the phoneme-based blending explanation for how young children learn to recode productively*. To test this hypothesis I asked 75 first-graders attending schools in low SES neighborhoods to recode pseudowords and to do tasks necessary for each explanation. I then compared how well each explanation accounted for the children's correct recodings of the pseudowords.

To test for the analogy explanation, I asked the children to read aloud a picture book which I had modified to consist of 20 conventional print words and 15 pseudo print words. All the conventional print words except hat came from Dolch's list of sight words. The original and modified texts are shown in Table 2. The pseudowords came from the letters representing the onsets and rimes of the conventional words. For example, I used the onset of hat and the rime of new to create the pseudoword hew. I used the onset of brown and the rime of just to create the pseudoword brust.

To test for the blending explanation I asked the children to do three tasks related to the blending explanation: I asked them to 1) identify the parts of eight pseudowords used in the modified book, 2) identify the sounds of letters and digraphs which occurred in these words where the letters and digraphs were presented one at a time on index cards, 3) blend together the phonemes which constituted these words. For example, for the pseudoword lat I said /l/, /a/, /t/. The various tasks were administered in random order across children.

As Table 3 shows, *the analogy explanation accounted for the children's correct recodings of the pseudowords better than the blending explanation*. In the 148 pseudowords the children correctly recoded, the parts were correctly identified 71% of the time, the sounds of letters and digraphs were correctly identified 64% of the time, and the sounds were correctly blended together 76% of the time. In contrast, both conventional words used to create the pseudowords were correctly recoded 95% of the time. There was a significant difference ($p < .001$) between the number of correct recodings of the pseudowords which could be accounted for by the children's sound identification of single letters and digraphs and the number of correct recodings which could be accounted for by the analogy explanation within the words used in the text.

Table 3 Children's Performance on the Blending and Analogy Tasks in Pseudowords Which They Correctly Recoded

	Blending Tasks			Analogy Task
	parts correctly identified	phonemes correctly identified	phonemes correctly blended	analogous conventional words correctly recoded
Words without digraphs + (N = 88)	100 %	72 %	74 %	93 %
Words with digraphs ++ (N = 60)	28 %	52 %	78 %	97 %
Total (N = 148)	71 %	64 %	76 %	95 %
Grand Total	39 % #			95%

\+ *lat, jop, smed, prust*
++ *grack, hew, rue, blound*
\# The grand total of correct responses in the blending tasks is less than the sum of the totals on individual tasks due to multiple incorrect responses in some words.

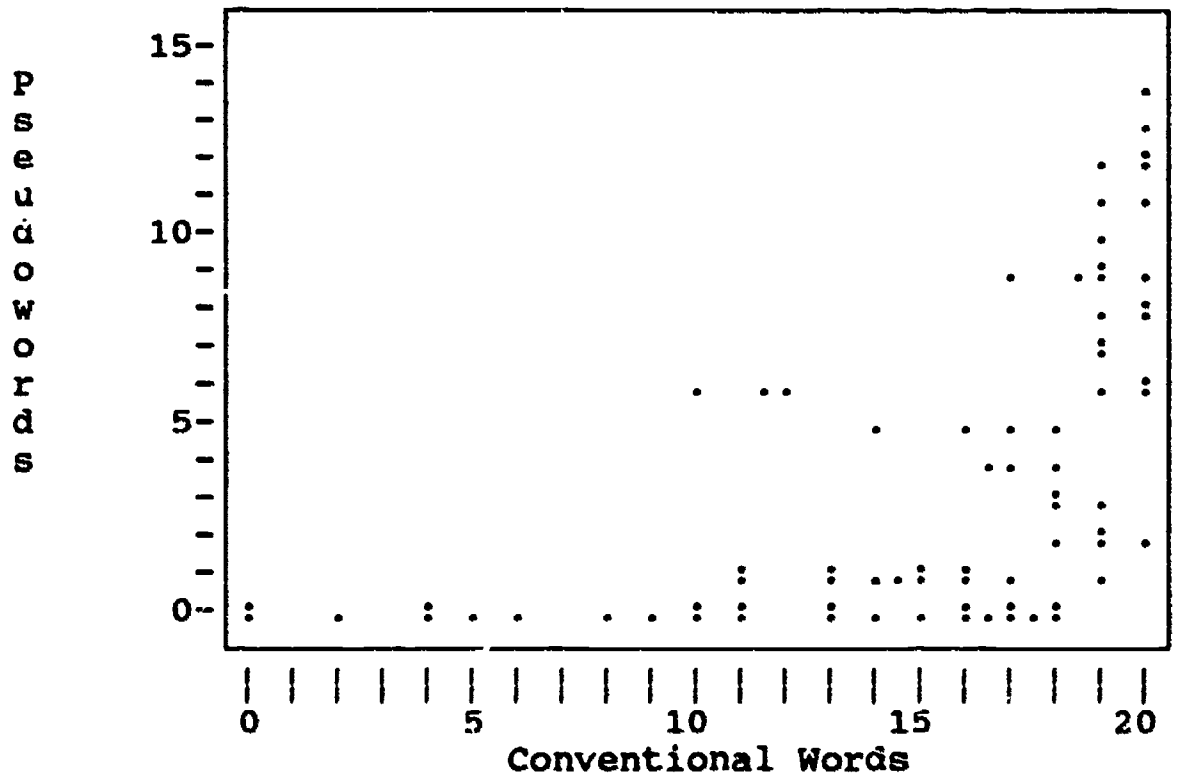
Could this large statistical difference have occurred because the children did not have the context of the print word to help them identify grapheme-phoneme correspondences? In a second experiment, 35 children were asked to identify the sounds of letters within the print words themselves. Even in this condition there was still a significant difference ($p < .001$) between the number of correct recodings of the pseudowords which could be accounted for by the children's sound identification of single letters and digraphs and the correct recodings which could be accounted for by the analogy explanation within the words used in the text.

Returning to Table 1, we can say that the onset/rime-based analogy explanation is a more viable explanation of how children learn to recode productively than the blending explanation. We now have left basically three distinct explanations: *the context-embedded informant explanation, the context and cueing explanations, and the onset/rime-based analogy explanation*. Are these

explanations alternate explanations or are they different aspects of the same process? I will argue that *they are different aspects of the same process.*

In her 1986 study of young children using analogy, Goswami found no significant correlation in children's ability to use analogy across age or across reading levels when she provided the basis for the analogy. Consequently she argued that *the ability to make analogies is available at all reading levels.* She suggests that *what develops is not the ability to use analogy but the number of print words in the child's mental lexicon from which analogies can be made.*

Figure 1 Numbers of Conventional Words and Analogous Pseudowords Recoded in the Analogy Task



Goswami's hypothesis is supported by my own study. Figure 1 shows the relationship between the number of conventional and pseudowords each child recoded when they were reading the modified text. As the figure shows, no child recoded any of the 15 pseudowords without recoding at least 10 conventional words and every child who recoded 19 conventional words recoded at least 1 pseudoword. The data suggest that *children need a corpus of print words in their mental lexicon before they can make analogies between familiar and unfamiliar print words. The more print words in a child's mental lexicon, the more opportunities that child has to make analogies.*

Tunmer and Nesdale (1985) studied six first-grade classes, three which did not teach grapheme-phoneme recoding skills and three which emphasized instruction in grapheme-phoneme recoding skills. In their study, the children's conventional word recodings accounted for 78% of the pseudoword recodings, while instruction in grapheme-phoneme recoding skills accounted for only 17% of the pseudoword recodings. This suggests that recoding via analogy may be so natural to children that if they have enough print words in their mental lexicon, direct instruction in recoding via analogy may not be necessary, or, at most, minimally necessary.

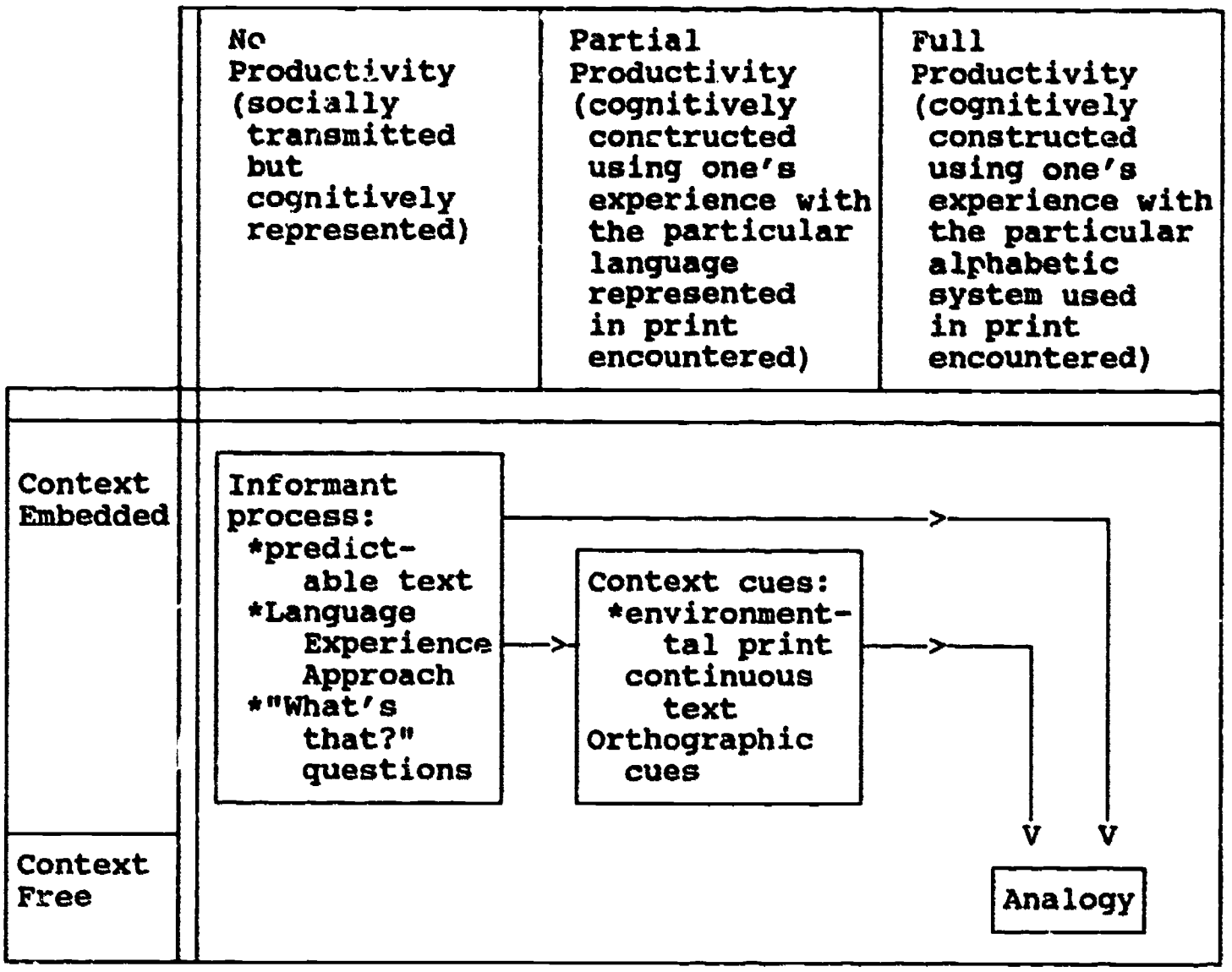
If it is the number of print words in a child's mental lexicon which develops rather than a child's ability to make analogies, the question then becomes: What is the best way to encourage the growth of children's mental lexicon of print words? Recall Goodman's 1965 finding that children were better able to recode print words in context than in isolation. Similarly, research by Rhodes (1979) and by Kucer (1985) has shown that children recode print words better when the text uses natural syntax than when the text uses distorted syntax. This body of research suggests that *comprehensible text with natural syntax facilitates children's acquisition of print words.*

Figure 2 shows a model of the acquisition of a graphophonemic system by young children which is compatible with the literature and the data. It is not a model of how reading is acquired. Rather it is a model of one aspect of reading acquisition.

The model suggests that children learning to read an alphabetic script first learn to recognize holistically the print forms of some words in their oral language. *The first print words can be acquired through more experienced readers interpreting print words to inexperienced readers* as in predictable text and the Language Experience Approach and through situational clues as in environmental print. *As children recognize more print words they can figure out print words from print context as well as from orthographic cues in meaningful contexts. As the corpus of print words children recognize grows, they recognize letters and strings of letters in new print words analogous to letters and strings of letters representing onsets and rimes in familiar print words. Then, they appropriate onsets and rimes to new print words they encounter through analogy to print words they already recognize.*

While the first part of the model is socially transmitted but cognitively represented, the latter parts of the model are cognitively constructed by the child on the basis of experience with the language represented in print encountered and experience with the particular graphophonemic system used in print encountered.

Figure 2 An Interactive/Cognitive Model of the Acquisition of an Alphabetic System by Young Children



* = possible starting points

Once some print words are recognized, all the parts of the model can occur. That is, in reading a given passage children can be making analogies between familiar and unfamiliar print words while they are learning to recognize even more print words holistically.

The process is not obligatory for recoding when familiar print words are encountered. However, it is constantly available to the child to the extent that the child has analogous print words in his or her mental lexicon.

At the instructional level the model implies that experienced readers play a critical role in children's acquisition of a graphophonemic system by interpreting print words in whole, meaningful contexts. At first most children will be dependent on more experienced readers to interpret print words holistically to

them. Then, as they acquire a larger mental lexicon of print words they recognize they can use their knowledge of the language and the context to recode unfamiliar print words already in their oral language. This even larger *mental lexicon of print words along with their natural ability to use onsets and rimes and their natural ability to use analogy will enable them to induce the alphabetic system encountered.* Eventually this will lead to their ability to recode print words out of context as is characteristic of, but seldom done by, very experienced readers.

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