Learning to Read Words: Individual Differences in Developmental Sequences

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Developmental sequences provide a valuable tool for analyzing individual differences in how children develop various cognitive skills, including the early reading of words. With methods adapted from the study of cognitive development, a set of school-based tasks were designed to test developmental sequences in phonological and visual-graphic domains for single words. The methods allowed detection of individual differences in developmental sequences. A total of 120 first-, second-, and third-grade children (30 of whom were low readers) were assessed on six tasks for each of 16 words. The profiles of task performances were used to detect developmental sequences by means of statistics based on Guttman scaling, called partially ordered scaling and pattern analysis, as well as by more traditional statistics. The results showed three developmental sequences. Most common was a "normal" sequence, which was consistent with a traditional model of reading acquisition involving the integration of visual-graphic and phonological domains. The other two sequences, which were associated with reading problems, involved a lack of integration of these domains. One sequence showed two independent branches—one for reading skills and one for rhyming—which occurred in both low and normal readers. The other showed three branches—reading, letter identification, and rhyming—and occurred primarily in low readers. The findings suggest not only an analysis of developmental pathways in reading, but a way of analyzing diversity in developmental pathways more generally.

An important analytic tool for understanding individual differences in cognitive development is the description of the sequences through which skills develop. Although much research and theory has focused on hypothesized universal patterns of cognitive development (Case, 1985; Piaget, 1983), there is growing interest in diversity, including hypotheses that cognitive development, when

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examined carefully, typically shows diverse pathways in virtually all domains (Chi & Rees, 1983; Fischer, Knight, & Van Parys, 1992; Fogel & Thelen, 1987).

Reading is a domain where many researchers assume that there is one basic developmental pathway for learning to read a given language. Yet the prevalence of major reading problems suggests the existence of diverse pathways, and the detection of such sequences would have important implications for reading instruction. It should be possible to predict pathways for development of both normal and problematic reading from models of how the reader interacts with the reading environment (e.g., Ehri, 1984; Morton, 1969; Rumelhart, 1977; Stanovich, 1986). Despite these possibilities, there has been surprisingly little research directly assessing developmental sequences in early reading (Hiebert, Cioffi, & Antonak, 1984; Mason, 1980; Stuart & Coltheart, 1988).

In a classic view, typical reading in an alphabetic system encompasses the use and integration of skills in several domains, such as visual-graphic, phonological, and semantic (e.g., Adams, 1990; E.J. Gibson & Levin, 1975; LaBerge & Samuels, 1974; Mason, 1980). The visual-graphic domain generally includes the perception and analysis of visual input related to writing, including the discrimination of graphic forms and letter identification (Ehri, 1984). The phonological domain includes the perception and analysis of sounds related to language, including rhymes, syllables, and phonemes (Bradley & Bryant, 1985; Stanovich, 1988; Stuart & Coltheart, 1988). The semantic domain encompasses basic language competence and word meaning (Kolers, 1970; LaBerge & Samuels, 1974).

Normal reading involves both acquisition of skills within these domains and integration across the domains. One popular hypothesis is that early reading problems arise from difficulties in specific skill development in the phonological domain (Bradley & Bryant, 1985; Lindamood, 1985; Lundberg, Olofsson, & Wall, 1980; Pennington, Smith, McCabe, Kimberling, & Lubs, 1984; Stanovich, 1988; Wagner & Torgeson, 1987). A straightforward prediction from the phonological hypothesis is that children with early reading difficulties will show a different sequence for development of integration of phonological and visual-graphic skills from children who read well. An alternative prediction, of course, is that these children will simply remain stuck at an early stage in the normative sequence of development.

Of course, difficulties in reading may arise from numerous other factors as well (e.g., Adams, 1990; Jenkins, 1979; Spiro & Myers, 1984; Stanovich, 1986; Stuart & Coltheart, 1988). But whatever the influences, an important starting point is characterization of the developmental sequences of reading skills shown by young readers. Even while arguments rage about whether normal and dyslexic readers share the same reading processes (Fletcher, 1981), there has been little effort to describe developmental sequences, which should provide a relevant index of process differences and similarities.

All individuals might show the same developmental sequence, with poor readers never moving to higher steps in the sequence, as in the traditional view
that all children follow the same developmental stages; or, different individuals might move through different developmental sequences in learning to read (Stuart & Coltheart, 1988; Vellutino & Scanlon, 1988). If such diverse sequences were found, they would provide important information for understanding individual differences in the processes of reading development.

To begin to address these questions regarding developmental pathways of reading skills, we devised a simple model of the development of some of the skills related to reading of single words, outlined in the developmental sequence in Figure 1, with development proceeding from the top to the bottom of the page. This sequence was based on LaBerge and Samuels's (1974) theory of reading and Fischer's (1980) theory of skill development. Each item in Figure 1 represents a type of task involving a single word, such as defining the word (Word Definition), identifying the letters in it (Letter Identification), or recognizing a rhyme with it (Rhyme Recognition). The specifics of each task and the model will be elaborated below.

**Methods for Assessing Developmental Sequences**

The most commonly used statistical techniques, such as analysis of variance and regression, provide neither direct assessments of developmental sequences nor analysis of individual developmental patterns (Appelbaum & McCall, 1983; Collins & Cliff, 1990; Longeot, 1978; Tatsuoka, 1986). More powerful techniques for assessing sequences are available, but to our knowledge they have not been used in reading research. These techniques involve examination of the

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**Figure 1.** Hypothesized developmental sequence for six tasks.
performance profiles of individual children on a series of tasks designed to assess developmental sequences. Table 1 shows the profiles for the sequence in Figure 1.

The method of testing developmental sequences is based on the logic of scalogram analysis (Fischer et al., 1992; Green, 1956; Guttman, 1944). A separate task is used to assess each step in the sequence, and then the profile of performances across tasks for each individual child is analyzed, as illustrated in Table 1. In the simplest type of scalogram, all profiles fit a simple, linear sequence: Every child passes every task up to some point and fails all tasks beyond that, with different children passing a different number of steps (as in Steps 1, 3, 4, 5, and 6 in Table 1). That is, the items are scaled in difficulty such that passing a given item is equivalent to passing all easier items. With this technique, investigators can use either cross-sectional or longitudinal research to rigorously test a developmental sequence. Of course, there is a major practical advantage to using a cross-sectional design, and prior studies have shown that sequences tested with scalogram analyses in cross-sectional research typically replicate in longitudinal tests (e.g., Kitchener & Fischer, 1990).

A new order-analytic technique called partially ordered scaling of items (POSI) builds upon scalogram analysis to allow the detection of more complex sequences in cross-sectional and longitudinal research (Krus, 1977; Krus & Blackman, 1988; Krus & Ceurvorst, 1979; Kuleck, Fischer, & Knight, 1990; Tatsuoka, 1986). Instead of all tasks lining up in a linear order, a task can order with respect to some tasks and not others. That is, sequences can have branches where the tasks in each branch form a sequence, but there is no ordering between tasks in different branches, as shown for the tasks of Letter Identification and Rhyme Recognition for Steps 2a and 2b in Table 1. The standard order-analytic method for displaying a developmental sequence is a dendrogram like that in Figure 1, which represents visually the simple branching of Letter Identification and Rhyme Recognition. Ordinary scalogram analysis is limited to pass/fail or zero/one scales, but POSI analyzes Guttman-type profiles with parametric scales, so long as all items use the same scale. The technique analyzes profiles by determining, for all pairs of items, which item has the higher score for each observation or subject. It then uses these item profiles in a parametric analysis of ordering.

Guttman-scale analysis is especially appropriate for developmental phenomena, where often an item will be at floor, or zero, for early age groups, develop during an age period, and then be at ceiling for later age groups. In much psychometric work, such items are considered undesirable because of the absence of variance when they are at floor or ceiling, but in development—and in Guttman scales—they are exactly the kinds of items that are of special interest (Collins & Cliff, 1990; Rasch, 1966).

Methods based on Guttman scales can be thought of as longitudinal measures taken cross-sectionally: Variations in items along some dimension(s) replace
variations in the age of the child tested longitudinally (Fischer et al., 1992). In other words, repeated assessments of each child with task variations replace repeated assessments with age variations. The use of multiple scaled tasks with each individual has important virtues for developmental research. Every child produces a task profile that can be used to assess a developmental sequence for that individual, and examination of groups of profiles can be used to detect differences in developmental sequences among children. With one set of well-chosen tasks, a child's profile can be used to determine which of several sequences he or she is developing through. This property of Guttman-type assessments is especially important in the present research, and it makes them potentially valuable tools in applied settings.

**Designing Tasks to Assess Developmental Sequences**

Historically, one problem with studying developmental sequences has been that researchers have had difficulty accurately predicting either the sequences themselves or the conditions under which they can be readily detected (Fischer & Bullock, 1981; Hoppe-Graff, 1989; Kofsky, 1966; Wohlwill, 1973). Perhaps this difficulty explains the small number of studies testing developmental sequences of reading skills. Skill theory gives a way around this difficulty, because it provides a set of concepts and methods for precisely predicting developmental sequences, including how to design tasks that avoid the methodological pitfalls that undermine detection of sequences (Fischer, 1980; Fischer & Canfield, 1986; Fischer, Pipp, & Bullock, 1984; Knight & Kuleck, 1987). Some of the primary guidelines are as follows:

1. Developmental sequences can be precisely predicted when all tasks in a Guttman-type assessment involve *similar contexts*. Changes in context have such powerful effects on performance that they interfere with detection of
developmental sequences. But tasks for all steps can be designed so that their content and procedure are as similar as possible, except for the minimal differences necessary to capture the important characteristics of differences between steps. For example, with reading of words, each task can use the same word(s) and similar procedures, so that there is no change in word or procedure to alter the skill used and disrupt detection of the sequence. Of course, more than one word can be used for each task, so long as each word is used in each task.

2. Sequences can be predicted more precisely when tasks are ecological, reflecting materials and circumstances commonly encountered by children in school or home (Bronfenbrenner, in press; Fogel & Thelen, 1987; J.J. Gibson, 1979). Data derived from bizarre or rarely encountered stimuli or tasks will force children to generalize skills on the spot; such distant generalization substantially increases the noise or error in the assessment (Fischer & Farrar, 1987). Unusual tasks of this sort, which are commonly used in reading research, clearly have value for testing children's ability to generalize (e.g., Ehri, Wilce, & Taylor, 1988). However, they do not represent what young children do in most everyday reading, and they do not provide reliable assessments of developmental sequences for most behaviors. To be ecological and to assess developmental sequences precisely, tasks and words need to be familiar and natural. Research on early word reading can use familiar words that come from the children's reading curriculum and that are appropriate to their interests and reading level.

3. Development is most consistent within a domain, because context varies strongly across domains, even for the same word. Consequently, children will show developmental sequences primarily within a domain, not across domains. However, when children integrate skills across domains, sequences will then be evident between tasks in the different domains. Beginning reading involves at least the two generally accepted domains of phonological skills (encompassing the sound system of the language to be read) and visual-graphic skills (encompassing the visual stimuli used in reading), as well as semantic skills (knowledge of the lexicon; e.g., Adams, 1990; Chall, 1983; E.J. Gibson & Levin, 1975; Knight, 1982; Knight & Stupay, 1985; LaBerge & Samuels, 1974; Ryan & Ledger, 1984).

The tasks in the model were chosen to assess skills both within and across the phonological and visual-graphic domains. Of the large number of tasks available from previous research (e.g., Bradley & Bryant, 1985; E.J. Gibson & Levin, 1975; Mason, 1980) and from classroom curricula, a few were chosen to represent (a) the outline of the development of integration of these two domains in early reading, and (b) activities that are commonly carried out in early reading in schools and homes. The sequence started with a skill that is usually a prerequisite for reading a word in early development: defining the word (Word Definition).
Language competence is well developed by the time most children enter school and typically precedes reading (E.J. Gibson & Levin, 1975; Ruddell, 1976; Venezky, 1977).

To test key parts of the integration model, the tasks for the sequence needed also to include assessments of reading a word, analyzing it visual-graphically, and analyzing its sound. We used two straightforward tests of reading a word that fit what children do in reading at home and in school: looking at the written word and reading it without any help (Reading Production) and looking at the written word and picking a drawing that matched it (Reading Recognition). Likewise, a straightforward test of simple visual-graphic skill was asking the child to name the letters when looking at the word (Letter Identification). Finally, there was the question of how to assess phonological skills in a simple, ecological way. Young children are often interested in rhyming, as evidenced by children’s nursery rhymes, and research indicates that rhyme tasks assess phonological skills (Johnson & Hayes, 1987; Maclean, Bryant, & Bradley, 1988). Consequently, rhyme tasks were used that were parallel to the reading tasks: giving a rhyme for a word after having said it (Rhyme Production) and picking a rhyme for it from several choices (Rhyme Recognition).

Within a domain, it is relatively straightforward to predict general developmental sequences; but, until the child coordinates the domains, detailed sequences cannot be predicted with precision across domains. In the very beginning of reading, according to standard models such as LaBerge and Samuels (1974), children will not coordinate the phonological and visual-graphic domains. Gradually, as they learn to read, they will integrate the domains into a new, single domain within which developmental sequencing can be predicted. Consequently, in the development of early reading, tasks for the different domains should initially order only within their separate domains. That is why the model in Figure 1 starts with independence (no ordering) for the phonological task of Rhyme Recognition and the visual-graphic task of Letter Identification.

The dendrogram in Figure 1, called Pattern A, indicates that performance on a simple semantic task (Word Definition) will be easiest and consequently will occupy the topmost position on the dendrogram. From there the visual-graphic task of Letter Identification will follow one branch, and the phonological task of Rhyme Recognition another branch. These visual-graphic and phonological skills will come together to contribute to skills needed to match printed words with appropriate pictures (Reading Recognition), which in turn will lead to the more advanced skills of spontaneous rhyme and oral reading of words (Rhyme Production and Reading Production).

Skill theory facilitates this sort of analysis, but the developmental sequence tested in the present research is consistent with a number of approaches, not just skill theory. Likewise, the results of the research are relevant to analyses of reading development independent of skill theory.
Individual Differences in Developmental Sequences and Reading Difficulties

One common stereotype of developmental theory holds that "stages" of development must necessarily be monolithic and uniform across children and tasks. Despite this stereotype cognitive development, including reading, does not in fact show this simple uniformity (Biggs & Collis, 1982; Fischer et al., 1992; Stuart & Coltheart, 1988; Vellutino & Scanlon, 1988). Most discussions of diversity in developmental sequences emphasize variation with context, but there are many other factors that produce variation as well (Fischer & Farrar, 1987). One important factor is the strategy with which a child approaches a task. A child who uses a different strategy for reading a word is using a different skill and consequently can be expected to show a different developmental sequence.

In reading, as in many skills, certain strategies produce more rapid learning and more powerful skills, and others produce less rapid learning and more difficulties (Armbruster & Brown, 1984). For example, different strategies in dealing with the relations between the visual-graphic and phonological domains will result in different sequences and different degrees of reading skill. Strategy use can arise from many causes, ranging from specific genetic factors (Pennington et al., 1984) to type of experience with reading (Chall, 1967).

One individual difference in strategy that has been discussed extensively in the reading literature involves the phonological domain. A number of investigators have reported that most children with dyslexia, or specific problems with reading, show deficiencies in sound-analysis skills (Bradley & Bryant, 1985; Lindamood, 1985; Lundberg et al., 1980; Olson, 1985; Pennington et al., 1984; Stanovich, 1988). Similar sound-analysis difficulties have been reported in adults with reading problems (Pratt & Brady, 1988). A possibility, then, is that many children with reading problems will show a different ordering of their sound-analysis skills (assessed by Rhyme Recognition and Rhyme Production in this study) with the other reading tasks.

There is some controversy about what other possible strategies or deficits may be involved in specific reading problems. Some investigators hypothesize that strategies for dealing with the letters in words may be relevant (Chall, 1983; Ehri, 1979; Walsh, Price, & Gillingham, 1988). Others hypothesize more general deficits, such as coordination, or some combination of factors (Bauer, 1987; Nicolson & Fawcett, 1990; Shankweiler & Crain, 1986; Tallal & Stark, 1982).

These considerations suggest two possible basic outcomes to the present study. First, there may be one general developmental sequence for the tasks in Figure 1. This sequence could reliably describe development in most beginning readers, with poor readers simply progressing more slowly through the sequence than skilled readers. In contrast, there might be several developmental sequences, with poor readers showing one or more sequences that are different from the normal one. Of course, there are other possibilities as well, including a total absence of developmental sequencing of the tasks.
The sample of children used in the present study included both normal and below-grade-level readers in first, second, and third grades. After the general model was assessed on the entire sample, the children were divided into groups of normal and low readers to see if different developmental patterns were evident. Finally, an even closer look was taken at individual profiles in each group to assess individual differences within groups.

**METHOD**

**Design**
In this study, first, second, and third graders were tested on six tasks, as shown in Figure 1. For each task, the children did 16 words, ranging in difficulty from preprimer to third-grade levels. The design thus involved two between-subjects factors, grade and sex, and one within-subjects factor, task. Words could also be considered a within-subjects factor, but for most analyses a child’s zero/one scores for each of the 16 words were summed to give a total score for each task.

A cross-sectional design was chosen because with scalogram-type measures such designs provide powerful tests of developmental sequences. A longitudinal design will be appropriate for a future study to follow individual subjects after the modal developmental sequences have been identified.

**Subjects**
The participants were 120 middle-class Anglo and Hispanic-American children (60 boys, 60 girls) entering first (38 children), second (43), and third (39) grades in elementary schools in central Arizona. The children had completed levels of reading instruction appropriate to grade level. The sample included 30 children (8 first graders, 13 second graders, and 9 third graders) whose reading levels were below average in comparison to others in the same grades.

Children’s reading levels were determined by teachers’ ratings, reading-group placement, and reading-test performance in the classroom. Means and standard deviations describing children’s ages and their teacher-assigned reading levels are presented in Table 2 (p. 386). The mean ages and reading levels generally corresponded with the children’s grade levels.

Of the sample of 120 children, 30 were identified as low readers, who read below grade by one or more grade levels and were considered by their teachers to be poor readers. Children were considered to be normal readers if they read at or above grade level and were considered normal readers by their teachers. In contrasts of normal and low readers, only normal readers in first and second grades were included in the comparisons so that there would be less disparity between the reading levels of the two groups. Those in the low group were distributed over the three grades, including eight first graders who were at a prereading level. The mean reading level for low readers in second grade was similar to that for normal readers in first grade, and similarly the level for low
TABLE 2
Mean (Standard Deviation) of Age and Teacher-Assigned Reading Level for Sample

<table>
<thead>
<tr>
<th>Grade</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>N</td>
<td>Age</td>
<td>Level</td>
</tr>
<tr>
<td>Total sample</td>
<td>38</td>
<td>6.6(0.4)</td>
<td>1.0(0.5)</td>
</tr>
<tr>
<td>Low readers</td>
<td>8</td>
<td>6.7(0.4)</td>
<td>0.2(0.4)</td>
</tr>
<tr>
<td>Normal readers</td>
<td>30</td>
<td>6.5(0.4)</td>
<td>1.2(0.3)</td>
</tr>
</tbody>
</table>

*aBased on teachers’ ratings and placement in reading groups.

third graders was similar to that for normal second graders. For comparisons of normal and low groups, then, there were 90 children, 60 normal and 30 low readers.

Tasks
Six tasks were used for this study, one for each step listed in Figure 1.

1. **Word Definition.** There were two parts to this task. In Verbal Definition, the child produced a verbal definition or indicated the meaning of the word. If the child could not produce a verbal definition for a word (a rare event), he or she was given Picture Definition, in which a picture of the object was presented and the child was asked to name the object and then define it.

2. **Letter Identification.** The child named the letters comprising the word when it was presented visually.

3. **Rhyme Recognition.** The child selected from four orally presented words the one that rhymed with the stimulus word.

4. **Rhyme Production.** The child verbally produced, without prompts, a word that rhymed with a stimulus word.

5. **Reading Recognition.** The child matched a printed word to an appropriate picture from four other distractor pictures.

6. **Reading Production.** The child orally read a word without prompting.

Materials
Based on the ecological argument, words were selected from each level of the children's own reading series from preprimer through third grade. The words were chosen to rhyme easily with other words in the children's vocabulary (as in frog/dog) and to be easily represented in line drawings.

A pilot study was conducted to assess appropriateness of words and procedures. First, second, and third graders other than those in the final study were tested with 24 words. Several words proved to be difficult to rhyme or define. In
addition, the testing session took over 30 min, causing several children to tire. Consequently, the number of stimulus words was reduced to 16. These words were administered in the following order: boat, frog, cake, tree, fish, train, string, bread, nest, shell, rock, toys, letter, dress, cherry, and thought. A constant order was used so that variation in order would not be confounded with individual differences in reading skills. Because the words represented the entire range of the reading series, older children were expected to pass all tasks for most of the words. This fact would not be a problem because (a) the Guttman-type analyses assume that developing items will show such patterns at later ages, and (b) inclusion of several more difficult words would allow discrimination of task ordering even for these older children.

For the Reading Recognition task, simple black-and-white line drawings were prepared for each target word—one portraying the target word concept and four foils portraying other familiar, concrete concepts (chosen from a set of 12 drawings). Examples of foil drawings were a leaf, a clock, an apple, and a stairway. For the Rhyme Recognition task, three choice words were selected for each target word—one rhyming with the stimulus word and two foils that contained the same number of syllables and were familiar to the children but did not rhyme. For example, Rhyme Recognition words for boat were quack, bump, and goat. The actual target words to be rhymed in Rhyme Recognition and the drawings to be identified in Reading Recognition were counterbalanced in position in the array of stimuli in order to minimize position effects.

**Procedure**

All children were tested individually in one session during the second month of the school year. Each child was shown into a quiet room and seated next to the examiner. There were three different examiners, each a doctoral student in educational psychology with extensive experience with children. The child and examiner engaged in a few minutes of conversation to establish rapport and allow a check on the child's concepts of rhyming and defining words. The examiner asked the child to listen to a sample common word not in the experimental list and then to say a word that rhymed with it. The examiner demonstrated rhyming, if necessary. Similarly, she asked the child to tell what the word meant. If the child had difficulty, the examiner demonstrated the appropriate task a second time. No child demonstrated difficulty in defining the common word. Some children were unsure of rhyme initially, but after talking with the examiner were able to produce a rhyming word spontaneously or to recognize a rhyming sequence (e.g., "cat, hat, rat... "). A few children (approximately 5%) were unable to produce or recognize rhyme even with the help of the examiner. They were nevertheless retained in the study so that reading skills in poor rhymers could be analyzed. It was later determined that all these children had been identified as poor readers by their teachers.

Consonant with the ecological orientation of the study, the testing procedure
was devised to produce a natural flow through the six tasks for the child. Equally important, the order of tasks was designed to assess a child's highest level of skill development with minimal cuing of lower levels and to have the child (not the examiner) be the one who emitted the word. In general, the most complex level was tapped first; then the easier, more supportive task was presented. The general order of administration was Reading Production, Reading Recognition, Word Definition, Rhyme Production, Rhyme Recognition, and Letter Identification.

At the start of the procedure, each child was shown each stimulus word (printed on a card) and asked, “What is this word?” (Reading Production). The examiner wrote down the response verbatim and scored it as correct or incorrect. When the child read the stimulus word correctly, he or she was asked, “What does this word mean?” (Word Definition). An example of an adequate response for “red” would be “a color, like an apple.” If the child was able to define the word, then he or she was asked, “Can you think of a word that rhymes with this word?” (Rhyme Production). Up to this time, the examiner had never actually spoken the stimulus word. The use of both production and recognition tasks meant that when the child could not deal with a production task for a word, there was a recognition task to provide more support to the child. For example, when the child failed the Reading Production task for a word, then she or he could often match the printed word with a picture illustrating the word concept from a group of five pictures: “Can you match the picture that goes with this word?” (Word Recognition). Again, the stimulus word was not spoken by the examiner.

The word was spoken only if the child was unable to produce it even when shown a picture of the correct object alone (Picture Definition), which occurred in only six children for one or two words per child. In the Rhyme Recognition task, the examiner said, “Listen carefully. Which of these words rhymes with (stimulus word): _______, _______, or ______?” After the rhyme tasks, the child was asked to name the letters in the word, “What are the letters in this word?” (Letter Identification).

This procedure was followed for each stimulus word. No responses were specifically praised or corrected. However, the examiner actively encouraged each child’s efforts to “do the best job you can.”

**Partially Ordered Scaling: Background**

Partially ordered scaling of items (which Krus, 1977, called by the general name of order analysis) describes Guttman-type scaling applied to all pairs of items so as to produce a map of ordering that may include separate branches, as shown in Figure 1 (Kuleck et al., 1990). In addition to the sequencing of tasks, POSI also provides a measure of the magnitude of the ordering between tasks, which is called the dominance. In this study, the technique was used to analyze developmental pathways, but it can be applied to other types of orderings as well, such as those involving preference, prevalence, or frequency.

The dominance is the variance of the difference between two items, with the
direction of difference taken into account. It can be used to provide one estimate of what we call the developmental distance between ordered items (Fischer et al., 1984). For example, the question “How closely related is reading recognition to letter identification?” may be at least partly answered using this method, so long as ages are distributed evenly in the sample. The developmental distance between two items is the proportion of the dominance for that specific pair of items compared to the total dominance for the dendrogram’s longest developmental chain (the distance from the item at the very top of the dendrogram to that at the very bottom). This index of developmental distance is usually closely related to age differences between ordered items.

POSI is primarily a descriptive statistic, but the orderings are dependent on a probability level. Pairs of items that do not meet the probability level selected are rejected as not ordered. The decision about whether two items, A and B, form an ordering is determined by first calculating the dominances of all item pairs. From the dominances for each pair A and B, a z score is calculated for the likelihood that the true proportion of A > B is different from the true proportion of B > A. Through the probit distribution, the z score gives a probability that the two items are ordered. For the ordering to be accepted as reliable, Krus (personal communication, 1982) recommends a probability of .84 as providing an appropriate balance between false positives and false negatives. A probability of .84 was used in all analyses, which means that the probability of erroneously identifying a pair of tasks as related, when in fact they were unrelated, was .16 or less.

RESULTS

Although partially ordered scaling is more appropriate for analyzing developmental sequences, analysis of variance (ANOVA) was also performed to provide an additional test of differences between task performances. In general, most children fit the predicted developmental sequence. At the same time, there was evidence that a minority of children fit two other developmental sequences, which were primarily associated with reading problems.

Entire Sample

A dendrogram describing the partially ordered scaling for total performance on the 16 stimulus words is presented in Figure 2 (p. 390). This empirical dendrogram closely matched the hypothesized dendrogram in Figure 1. The hierarchy of tasks revealed that the Word Definition task started the sequence, as predicted. Next came both Rhyme Recognition and Letter Identification, which were approximately parallel to each other. That is, these two tasks produced different, independent pathways, as predicted. Both of these tasks ordered with Reading Recognition, Rhyme Production, and Reading Production, in that order, as predicted.

The developmental distance (dominance) for adjacent pairs of items is indi-
Figure 2. Dendrogram of six tasks for entire sample.

cated by the proportion listed next to the line connecting each pair. The largest
developmental distance was .44 between Reading Recognition and Rhyme Pro-
duction, indicating that 44% of the dominance in the longest developmental
chain was accounted for by the ordering of these two tasks. The next largest was
.28 for the step from Rhyme Production to Reading Production. The earlier steps
showed smaller distances, because most second and third graders passed them
with most words.

In addition to POS1, an ANOVA for repeated measures was also performed on
the number of words correct, with grade and sex as between-subjects factors and
task as a within-subjects factor. As predicted, there were main effects of grade,
$F(2, 110) = 47.01$, and task, $F(5, 550) = 73.55$, and an interaction of task with
grade, $F(10, 550) = 31.29$, all highly significant, $p < .001$ (see Figure 3). No
other main effects or interactions were significant. Huynh-Feldt adjustments for
covariance produced no differences in the results, and multivariate analyses
produced nearly identical results.

Post-hoc analyses were performed for the interaction of grade by task with the
Duncan multiple-range test, with $p < .05$. Within grade, first graders showed
significant differences between all pairs of tasks, except for the following: The
three highest scoring tasks (Word Definition, Letter Identification, and Rhyme
Recognition) did not differ, nor did Rhyme Recognition and Reading Recognition.
Second graders showed differences of Rhyme Production and Reading Production
with the four highest scoring tasks in Figure 3. Third graders showed
no significant differences among the tasks. Within task, the first grade differed from the second and third grades for all tasks but Word Definition, where there were no differences. Second and third grades did not differ for any task.

The orderings of task means were generally consistent with the dendrogram in Figure 2, although the ANOVA did not explicitly test for Guttman orderings, nor could it detect ordered branches. For the six tasks ordered by their means, each task was significantly different from all tasks separated from it by at least one other task. No adjacent pairs were different except for Reading Recognition and Rhyme Production, which also showed the largest developmental distance in the dendrogram.

**Normal and Low Readers**

To determine whether low and normal readers showed different developmental sequences, separate POSI analyses were performed for the two groups. The two dendrograms in Figure 4 (p. 392) show very different sequences for low and normal readers.

The dendrogram for normal readers was similar to that for the whole sample (Figure 2) and to predictions from the general model (Figure 1). The major difference was in the ordering of the first few tasks. Letter Identification did not order with Word Definition, and both of them ordered independently with Rhyme Recognition, with the magnitudes of the developmental distances small. In addition, the magnitudes later in the sequence showed some differences from Figure 2; for example, the largest distance was now for the step from Rhyme Production to Reading Production instead of the prior step.

---

**Table:**

<table>
<thead>
<tr>
<th>Letter Identification</th>
<th>Rhyme Recognition</th>
<th>Reading Recognition</th>
<th>Rhyme Production</th>
<th>Reading Production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
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<td></td>
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</tr>
</tbody>
</table>

**Figure 3.** Mean number of words correct for each task and grade.
In contrast, the dendrogram for the low readers did not fit the predicted sequence, as shown in the right half of Figure 4. Instead of a mostly linear sequence like that for Normal readers, the dendrogram was complex and not tightly organized, with multiple branches for the six tasks. One especially notable result was that for low readers the two rhyming tasks did not order with as many other tasks as they did for normal readers: Rhyme Recognition did not order with Letter Identification or Reading Recognition; Rhyme Production did not order with Reading Production, even though those two tasks produced the strongest ordering for Normal readers. Thus for low readers, unlike normal readers, the phonological tasks did not order strongly with the other tasks.

ANOVA was also performed for low versus normal readers. Reading status (low and normal) was a between-subjects factor, and task was a within-subjects factor. As expected, there was a main effect of reading status, $F(1, 114) = 9.48$, and task, $F(5, 570) = 49.81$, and an interaction of task with reading status, $F(5, 570) = 4.33$, all $ps < .01$. Post-hoc analyses for the interaction, with $p < .05$, indicated that two of the tasks were not reliably different between low and normal readers: Word Definition was near ceiling for both groups (15.97 and 16.00, respectively), and both groups passed about 15 out of 16 words for Reading Recognition (14.57 and 15.05). The other four tasks were all reliably different between low and normal readers: Letter Identification (14.63 and 15.91), Rhyme Recognition (14.50 and 15.53), Rhyme Production (11.47 and 13.57), and Read-
ing Production (9.83 and 12.79). These results do not contradict the ordering in the dendrograms in Figure 4, although, of course, they do not give the specific ordering information in the dendrograms.

Pattern Analysis of Individual Differences in Profiles

The complexity of the dendrogram for low readers suggested that their task profiles should be examined to see if there were order in the apparent chaos. If different low readers showed different developmental sequences, then a dendrogram like that in Figure 4 could result. A method was needed to determine whether there were systematic patterns in the profiles. Through the same logic as that used in partially ordered scaling, children's response profiles across tasks were analyzed for differing developmental sequences. The first step was to find all profiles that did not conform to those for the hypothesized sequence. These nonconforming profiles were then examined to determine whether the children exhibited patterns consistent with particular developmental sequences or if they were instead disorderly.

First, to increase the sensitivity of the analysis, the profile for each word for each child was analyzed. Each child produced 16 profiles (1 for each of the 16 words) yielding a total of 1,920 response profiles for the 120 children. Of all these profiles for individual words, 12% did not conform to the hypothesized sequence. Of the nonconforming profiles, 96% fell into the eight types shown in Table 3 (p. 394), with each profile having an incidence of at least 4%. Thus, virtually all empirically obtained profiles fit only 16 of the 64 possible profiles for these six tasks (8 for the hypothesized sequence plus these 8).

The 8 nonconforming profiles fell into two basic patterns, each involving problems with a specific task or set of tasks. The originally hypothesized group of profiles (Table 1) was called Pattern A, and the new patterns were called B and C (Table 3).

The three defining profiles for Pattern B in Table 3 showed failure of rhyming tasks when reading tasks were being passed. That is, children had problems with rhyming. The large majority of children (83 out of 120, including 24 of 30 low readers) showed one of the Pattern B profiles on at least one word. Most common was profile B3, in which all tasks were passed except Rhyme Production. This finding suggests that even while Rhyme Production ordered overall with Reading Production in the POSI analysis (Figure 2), there was some independence of the two skills, even for normal readers.

The five defining profiles for Pattern C fell into two subgroups. The three in subgroup C1 were characterized by failure of Letter Identification with success on Rhyme Recognition, Reading Recognition, Rhyme Production, and/or Reading Production. This pattern thus involved difficulties with identifying letters in words. Twelve children produced profiles fitting this pattern. Most of them (10) were low readers, and all were in the first or second grade.

The two profiles in subgroup C2 showed failure of both Letter Identification
TABLE 3
Response Profiles for Developmental Sequences B and C for Reading Words

<table>
<thead>
<tr>
<th>Profile</th>
<th>Word Definition</th>
<th>Letter Identification</th>
<th>Rhyme Recognition</th>
<th>Reading Recognition</th>
<th>Rhyme Production</th>
<th>Reading Production</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Pattern B (Read and Rhyme Independent)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>B1</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>B2</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
<tr>
<td>B3</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td></td>
<td>Pattern C (Independence of Read, Letter Identification, and Rhyme)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Subgroup C1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C1</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C2</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>-</td>
</tr>
<tr>
<td>C3</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
</tr>
<tr>
<td>Subgroup C2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>C4</td>
<td>+</td>
<td>-</td>
<td>-</td>
<td>+</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>C5</td>
<td>+</td>
<td>-</td>
<td>+</td>
<td>+</td>
<td>-</td>
<td>+</td>
</tr>
</tbody>
</table>

Note. + = pass; - = fail.

and rhyming tasks while reading tasks were being passed. This pattern thus involved co-occurring problems in both identifying letters and rhyming. Ten children produced profiles with this pattern. Most of them (7) were low readers, and all were in the first or second grade.

To determine whether these profiles were independent or correlated, the co-occurrence of profiles was examined for the 16 different words presented to each child. The co-occurrence of profiles for different words in the same child was taken as evidence that the profiles belonged to the same developmental pathway. Pattern B profiles usually occurred independently of subgroups C1 and C2, with 85% (69 of 83) showing B profiles only. On the other hand, C1 and C2 profiles typically co-occurred not only with each other, but also with Pattern B profiles. Of the 15 children producing C1 and C2 profiles, 14 produced co-occurrences with B profiles, and 11 of the 14 were low readers. The most common co-occurrence configuration involved all three patterns (7 children).

The nonconforming profiles and the co-occurrence patterns indicate that children appeared to show two alternative developmental pathways. Pattern B involved its own discrete pathway, as shown in Figure 5: There were two separate branches, one for reading tasks and one for rhyming tasks. That is, unlike the normal sequence, the rhyming tasks (assessing the phonological domain) did not order with the reading tasks and were delayed. This pathway was characteristic of both normal and low readers. The full set of profiles that define the B sequence includes not only those in Table 3 but also Numbers 1, 2a, 3, 4, and 6 in Table 1.

The profiles in subgroups C1 and C2 co-occurred with those in Pattern B to produce a third developmental pathway C, shown in Figure 5. This pathway
involved independent branches for reading, rhyming, and letter identification, as well as delays in rhyming and letter identification. It was similar to the dendrogram for the low readers (Figure 4), except that here Letter Identification was independent of reading and rhyming tasks. Indeed, the C pathway was characteristic of low readers and included the first- and second-grade children with the most serious reading problems in the sample. The full set of profiles defining this sequence combined the five C profiles with all the A and B profiles in Tables 1 and 4.

In summary, the results supported the hypothesized normal sequence (Sequence A in Figure 1) but also showed two alternative sequences (B and C in Figure 5). Reading problems were common in the alternative sequences, especially Sequence C.

**DISCUSSION**

The main purpose of this study was to describe the development of skills for reading words in beginning readers through the use of scalogram-type methods. A model of reading development was proposed that predicts a particular sequence in the development of six tasks representing visual-graphic and phonological skills involved in reading single words. The design allowed the use of
the scalogram-type technique of partially ordered scaling (Krus, 1977; Kuleck et
al., 1990; Tatsuoka, 1986) to test for developmental sequences with the six tasks.

The task profiles for the 120 first- to third-grade children produced a dendro-
gram that fit the predicted sequence well (Figure 2). Separate analyses of normal
and low readers revealed fundamental differences in their developmental se-
quences, with normal readers fitting the sequence well and low readers not fitting
it (Figure 4). The POSI for low readers produced a disorderly dendrogram
suggesting that several different developmental sequences might be occurring in
this group. Analysis of the patterns of performance profiles demonstrated two
developmental sequences besides the predicted one, and these were associated
with reading difficulties.

Three Different Developmental Sequences

The detection of three different developmental sequences for six simple, every-
day reading tasks is the most important result of this study. This finding calls into
question the common assumption, built into many research designs and standard-
ized tests, that virtually all children learn to read in the same way. It also suggests
that research on the development of early reading skills will facilitate understand-
ing the processes of reading and contribute to better methods of teaching reading
and remediating reading problems. It also implies that children with reading
problems will show distinct developmental sequences depending on the bases of
their problems with reading.

The normal sequence (Pattern A) was by far the most commonly exhibited by
children in all grades. This sequence was predicted based on the common view
that early reading involves integration of visual-graphic and phonological do-
 mains (Figure 1). There was some independence of visual-graphic and pho-
nological domains early in the sequence, evidenced in the absence of consistent
ordering between the Letter Identification and Rhyme Recognition tasks. The
rest of the sequence showed the kind of simple ordering of all tasks that is
predicted by the integration of visual-graphic and phonological domains hypothe-
sized in the model. Consonant with the model, the normal sequence seemed
usually to lead toward competence in reading skill development. Most children
who consistently exhibited the sequence read at or above grade level and were
perceived by their teachers as good readers.

The two additional sequences were associated with reading problems. The
most common alternative sequence, called Sequence B (Read and Rhyme Inde-
pendent), suggested a fundamentally different way of using phonological skills in
reading single words. Instead of using analysis of word sounds to help with
reading, children seemed to use sound-analysis skills independently of reading.
The sequence was characterized by independent pathways for rhyming and read-
ing, as shown in Figure 5, as well as delayed performance in rhyming compared
to reading. The pattern was the most common alternative sequence and was
found at all grades and reading levels. It was partly associated with reading
problems, but at the same time it was characteristic of some words for many normal readers. The identification of an alternative sequence that sometimes results in poor reading and sometimes in good reading is clearly important for both research on the reading process and educational practices with young readers.

The third sequence, called Sequence C (Independence of Read, Letter Identification, and Rhyme), was characterized by independence of Letter Identification, rhyming, and reading skills, as well as general deficiencies in letter identification and rhyming, as shown in Figure 5. Children exhibiting this sequence were among the poorest readers tested and were markedly deficient in reading skills when compared with their peers. It was rare among children who teachers identified as normal readers. Thus, very poor readers showed the distinctive pattern of deficient rhyming and letter-identification skills with lack of integration of rhyming, reading, and letter-identification skills.

By third grade, Sequence C could no longer be discriminated from the other sequences in the children in this study. Third graders passed most tasks for most words, and consequently there was an absence of distinctive profiles for that age. To test the reliability of these pathways in older children, replications will need to include more difficult words, in order to increase the rate of task failure and, thus, the discrimination of pathways in older children.

In general, the sequences suggest that integration of visual-graphic and phonological domains does facilitate skilled reading. The normal sequence, which typically led to good reading, involves a simple, direct pathway in which skills from the visual-graphic and phonological domains are integrated. The two sequences associated with reading problems (Sequence B, Read and Rhyme Independent; and Sequence C, Independence of Read, Letter Identification, and Rhyme) both involve lack of integration of skills in different domains. The sequence with the greatest lack of integration (C) strongly predicted reading problems. Only five low readers showed the normal pattern (A), suggesting that most low readers do have difficulty integrating visual-graphic and phonological domains.

On the other hand, the findings also suggest that educators and researchers should not assume that alternative pathways will necessarily lead to poor reading. Although Sequence B—Read and Rhyme Independent—was associated with reading problems, it occurred most commonly in normal readers, who appeared to show different pathways (A and B) for different words.

The three sequences suggest a way of relating apparently divergent findings of previous researchers. A number of researchers have documented a lack of phonologically based skills in poor readers (Bradley & Bryant, 1985; Lindamood, 1985; Lundberg et al., 1980; Olson, 1985; Pennington et al., 1984; Pratt & Brady, 1988; Stanovich, 1988). These findings are clearly consistent with both alternative patterns. Other findings show how letter-identification problems contribute to reading difficulties (Chall, 1967; de Hirsch, Jansky, & Langford, 1966;
Sequence C—Independence of Read, Letter Identification, and Rhyme—shows both that visual-graphic difficulties occur with serious reading problems and that they usually co-occur with phonological problems. In addition, arguments that severe dyslexics have some more general problem, such as a difficulty in general coordination or in rapid response, may be consistent with a sequence like C (Bauer, 1987; Nicolson & Fawcett, 1990; Shankweiler & Crain, 1986; Tallal & Stark, 1982).

Cognitive Developmental Analysis of Diversity

More generally, the research supports the usefulness of cognitive developmental concepts and methods for analyzing the diversity of development. Most obvious is the usefulness of the methods of partially ordered scaling and pattern analysis, which are suggested by skill theory but are applicable independent of any specific theory. These methods facilitated the identification of the three sequences, in contrast to other commonly used concepts and methods, which tend to blend together developmental diversity into a homogenized single portrait, often making it appear as if all people develop through a single common pathway (Fischer et al., 1992).

These methods provide tools for characterizing complex developmental patterns systematically and powerfully. Partially ordered scaling describes complex developmental sequences that include branching and integration instead of forcing all sequences into a simple linear form. It also gives an index of the developmental distance between pairs of skills, showing, for example, that it was a relatively short developmental hop for most readers in this study from Rhyme Recognition to Reading Recognition but a long developmental leap from Reading Recognition to Rhyme Production (Figure 2).

Pattern analysis of developmental profiles facilitates identification of individual differences in sequences. It also can capture important variations within individuals, as when, in the present study, it allowed detection of the fact that many normal readers show the read-and-rhyme independent pattern for some words.

Both skill and ecological perspectives suggest that such complexity is the rule in cognitive development (Bidell & Fischer, 1991; Bronfenbrenner, in press; Carr & Levy, 1990; Fogel & Thelen, 1987). However, researchers have been unable to detect much of the complexity because of the limits of developmental methods and concepts, as well as the common belief that children show monolithic stages of the sort hypothesized by Piaget (1983). With these techniques, researchers can paint a more complete and multidimensional picture of development than with traditional statistics (Appelbaum & McCall, 1983; Fischer et al., 1984, 1992; Tatsuoka, 1986).

Reading is a good example to represent cognitive development more gener-
ally: The interactive nature of reading provides multiple sources of complexity and variation in skill development (Levin & Landsmann, 1989; Spiro & Myers, 1984; Stanovich, 1986; Stuart & Coltheart, 1988). As a consequence, variations affecting the reading process can be overwhelmingly complex and confusing. Readers change in skill and knowledge, especially in the early years. Contexts vary. Skills in different domains interact. Children respond differently to what seem to be similar stimuli. All these sources of variation produce individual differences and other variations in reading outcomes. This complexity in reading is matched by the complexity in cognitive development more generally (Fischer & Farrar, 1987).

The task at hand is to explain reading—and the rest of cognitive development—with a perspective at an appropriate level of understandable complexity, rather than with a monolithic model of typical processes on the one hand and individual differences on the other (Farnham-Diggory, 1978). With an appropriately complex framework of reading development, individual differences and other variations can become central to the framework. Instead of a single model with one developmental pattern, which is where this study began, there can be a model that specifies not only basic patterns of reading development demonstrated by most readers but also individual differences and contextual variations. All possible patterns are, in principle, accounted for by such a perspective of appropriate complexity.

The findings of this research represent a first step toward devising an appropriately complex model of reading development. What is needed eventually is a multidimensional process model (Spiro & Myers, 1984) that has a matrix-type framework which specifies many possible pathways of reading development (Bidell & Fischer, 1991). The framework of this model will need to include not only child differences, but also variations in content, as crucial determinants of skill. With such a model, researchers will be able to work toward a theoretically satisfying and practical understanding of the processes and contributing sources of variation that comprise the complex cognitive act called reading. Individual differences and contextual variations in skill-developmental pathways can then be viewed as less common corollaries of the "normal" patterns. Hence, the differences and variations can be seen as less common forms of the broad spectrum of reading behavior, rather than as differences that are outside a monolithic general model.

What To Do Next
The present study provides only a first step in describing and conceptualizing the development of early reading of words. One need is for additional research to expand the conceptualization of reading and build a broad-based, appropriately complex developmental model. A related need is to both replicate the present results, especially with a longitudinal study, and test out the various hypotheses.
and interpretations coming from the results. For both of these needs, there is previous research that is relevant, but studies focusing on developmental sequences in reading remain to be done.

First, the tasks for assessing each domain in the present study should be expanded. Besides using more difficult words, these tasks should focus on domain-specific deficiencies and cross-domain integration in children's reading difficulties in the phonological and visual-graphic domains.

For phonological skills, there are available an especially large array of possible tasks because of the many other studies linking phonological deficits to reading problems. Several sound-based tasks should be added so that a wide scope of development is represented, such as the range from simple discrimination of sounds to complex judgments of rhyme or manipulations of sound combinations. Segmentation tasks for both syllables and phonemes would be useful.

Additional visual-graphic tasks are also needed, both to replicate and further define the letter-identification-deficiency sequence and to gain more information about developmental relations between phonological and visual-graphic domains. For example, a POSI analysis of several tasks involving letter-name, letter-sound, segmentation, and rhyming skills could be especially helpful for understanding the relations of these skills to oral reading of words.

Second, a longitudinal replication of this study is essential. The scalogram-type design has provided a strong cross-sectional assessment of developmental sequences, which has resulted in new findings of individual differences in sequences of reading single words. But certain follow-up questions can only be answered with the addition of a longitudinal component. How much consistency across words do children show in their type of sequence as they learn to read? Do most children stay with the normal sequence and the read-and-rhyme-independent sequence as they develop? Do some children who start out with the read-and-rhyme-independent sequence in fact become indistinguishable from normal readers by third grade? Do children who start out with the most serious problems (the combination of rhyming and letter-identification deficiencies) continue to show serious reading problems?

Third, the research should be expanded to include preschool and late elementary ages so that reading development can be modeled and assessed from 3 through 11 or 12 years of age. For example, preschool tasks might be designed to tap skill levels more basic than those taught in first grade or even kindergarten (e.g., basic language skills, differentiation of print from other graphic forms). Late elementary tasks might be designed to test how the reading of words is integrated into the reading of sentences and paragraphs.

This study is but the earliest sketch outlining what will eventually be a complex, multidimensional portrait of the development of reading skills in childhood. These initial findings are important, but their main function may well be to encourage more intense efforts toward a comprehensive understanding of diverse pathways of reading and of cognitive development more generally. Only by
studying developmental diversity will scholars be able to construct accurate, useful theories to deal with the development of real children.

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