

Precocious Readers: Past, Present, and Future

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Precocious readers represent a small portion of children who enter school each year. Researchers have investigated the environmental characteristics, acquisition process, psycholinguistic and neuropsychological characteristics, and academic skills of these children. Despite the research findings in the area, researchers and clinicians are still unable to predict who these children will be, describe how precocious readers fit into our current theories of emergent literacy and reading development, and confidently state whether this knowledge could be generalized beyond the precocious reader to the typically reading child. Forty years of research in this area is reviewed. Suggestions for improving the accessibility and generalizability of knowledge about precocious readers are provided.

Each year, approximately 1% of children known as early or *precocious* readers enter preschool, kindergarten, and first-grade classes with the ability to read (Clark, 1976; Durkin, 1966). An unusual characteristic of most members of this group is that they had no formal instruction in phonics or decoding. Furthermore, the reading ability of these children does not appear to be influenced primarily by exceptional intellectual ability or socioeconomic status (Clark; Durkin; Patel & Patterson, 1982; Stroebel & Evans, 1988; Thomas, 1984). Research in this area has spanned nearly 40 years and has looked at a number of variables including environment, reading processes, psycholinguistic and neuropsychological characteristics,

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and academic skills. Despite the amount of research, the phenomena remains elusive. This article intends to provide a thorough literature review of what we know about precocious reading abilities, as well as the recommended direction of future research.

Definition of Early Readers

As with many other psychological phenomena, the literature does not provide a universal definition or set of guidelines for identifying precocious readers. Close examination of the research, however, reveals that, to a greater or lesser degree, researchers acknowledge three core concepts as features of precocious readers. First, and most obviously, the very young child must demonstrate ability to decode words. The ability to decode has been diversely operationalized. Some researchers used less rigorous and objective definitions. For instance, Anbar (1986) considered a youngster an early reader if he or she was able to read six simple sentences consisting of three to five words; comprehension was never assessed. Other researchers specified a criterion level of reading ability based on norm-referenced, standardized measures of word recognition (Burns & Collins, 1987; Clark, 1976).

Second, in order to rule out hyperlexia, the ability to decode without comprehension, a majority of researchers required that children also demonstrate comprehension of written material. While some researchers presumed any degree of comprehension is synonymous with reading (e.g., Anbar, 1986), others required that children perform at a given criterion level using norm-referenced measures of reading ability (Durkin, 1966; Plessas & Oakes, 1964; Stroebel & Evans, 1988; Thomas, 1984). Many researchers who used norm-referenced reading tests defined precocious reading as the ability to decode and comprehend items at or above the second-grade level for preschoolers (Plessas & Oakes; Stroebel & Evans; Thomas).

Finally, several research studies also considered the role of instruction in reading acquisition as an important element in defining precocious reading. Some studies exclude those who have participated in "formal" or systematic reading instruction (Salzer, 1984; Teale, 1978). Throughout the literature, the concept of formal

instruction is diversely operationalized. Most researchers categorize instruction as formal if it occurred within a structured school environment but acknowledge that most early readers in their studies received some sort of *informal* instruction from parents, caregivers, or siblings (Durkin, 1966). Inspection of past research identified a wide variety of informal means used to facilitate reading among subjects. Some instructional methods were described as “spontaneous, intuitive, and unplanned” (Anbar, 1986, p. 78). In general, this type of help tended to be more responsive and less directive than formal instruction, and descriptive accounts indicated that children apparently learned to read because of their ability to ask the right questions rather than being directly taught (Clark, 1976; Torrey, 1969). Other informal types of help have been more structured and consist of reading kits, preprimers, association of letters and sounds, use of picture dictionaries, alphabet games, flash cards, and teaching sounds of letters (Burns & Collins, 1987; Plessas & Oakes, 1964). What appeared common among research findings, with the exception of a study by Briggs and Elkind (1977), was that the help provided by parents, siblings, and caregivers most often was initiated by the child’s demonstration of reading ability rather than the desire of the helper to initiate reading skills development (Clark; Torrey, 1969). It should be noted, however, that it is possible that more formal reading instruction was provided. Most of the information was gathered through interviews with parents and none of the above-mentioned studies asked the children how they learned to read. It is likely that retrospective, subjective reports provided by parents do not provide an accurate account of how the child actually learned to read.

Psychological Aspects of Precocious Readers

Durkin (1966) pioneered the first large-scale study of precocious reading ability and investigated reading, intellectual, and environmental correlates of two groups of early readers, one from New York and one from California. Much of the research in the area has followed her model and can be divided into three general categories: descriptions of the personal and environmental correlates of early

readers, the process of early reading, and the academic and psycholinguistic skills of the precociously reading child.

General and Environmental Characteristics of Precocious Readers

Individual Characteristics. Research identified and investigated a number of individual characteristics hypothesized to be correlates or possible causal factors of precocity. Intelligence represents one such characteristic. While Cox (1926) and Gross (2004) report that many gifted children are reading at early ages, research investigating precocious readers indicates that an average to superior level of intelligence may be a necessary accompaniment of early reading but does not guarantee spontaneous reading skill. That is, many gifted, but nonprecociously reading, preschoolers require formal instruction before they begin to read (Burns & Collins, 1987; Clark, 1976; Torrey, 1969). Most between-group studies found average to superior full scale IQ, with reported mean or median levels often in the superior range of intelligence (Burns, Collins, & Paulsell, 1991; Durkin, 1966; Patel & Patterson, 1982; Thomas, 1984). IQ scores of subjects of these studies are found in Table 1. Single case studies of precocious readers also reported a range of intellectual skills, but the majority reported superior levels of intelligence (Krippner, 1963; Lass, 1983; Pennington, Johnson, & Welsh, 1987).

In addition to intellectual skills, a number of researchers investigated personality correlates of precocious readers. Among these studies, all relied on parental interview data to describe personality characteristics of early readers (Durkin, 1966; Salzer, 1984; Thomas, 1984) rather than objective measures of personality traits, such as child behavioral checklists. In her first studies, Durkin found that parents of her California group described their children as more "persistent," "perfectionistic," "curious," "competitive," and having a "good memory." These results were not replicated with her New York group where parental descriptions of characteristics did not differentiate readers from nonreaders. Likewise, Salzer, using qualitative analysis of both direct observation of structured and unstructured parent-child and examiner interactions and interview data collection procedures, found no consistent personality factors among early readers. During interviews performed by Thomas, mothers

Table 1
Summary of Intelligence Levels of Precociously Reading Children

Author	Measure	N	Mean IQ Score	IQ Ranges	Median IQ Score
Backman, 1983	WISC-R	24	129.79	112-149	*
Burns et al., 1991	*	11	137	120-159	*
Caldwell, 1985	Stanford Binet	13	148	138-158	*
Clark, 1976	Stanford Binet	32	*	138-158	*
Clark, 1976	WPPSI	32	*	98-146	*
Durkin, 1966 (CA)	Stanford Binet	49	*	91-170	121
Durkin, 1966 (NY)	Stanford Binet	30	*	82-170	133
Evans & Smith, 1976	Slosson	19	138	*	*
Stroebel & Evans, 1988	WPPSI	21	15.5 ^a	*	*
Jackson & Biemiller, 1985; Jackson et al., 1988	WISC-R	97	128	100-154	*
Jackson & Myers, 1982	Stanford Binet	23	147	*	*
King & Friesen, 1972	Lorge-Thomdike Intelligence Test	31	111	*	*
Patel & Patterson, 1982	WISC	20	128	107-148	*
Plessas & Oakes, 1964	WISC	20	128	*	*
Thomas, 1984	McCarthy	56	128	103-150	*

Note. ^aBased on subtest score with a mean of 10 and a standard deviation of 3. *Not reported.

of early readers tended to use more “cognitive/creative” words, such as “positive” and “intellectual,” to describe their children, while parents of nonreaders used more “emotional/social” descriptors to describe their children. Hence, no consistent personality correlates of early readers have been identified. The failure to identify common correlates may reflect the use of subjective and open-ended means of gathering data, or it may suggest that early readers are a heterogeneous group of children who share exceptional reading skills.

Investigations of play or toy preferences have failed to identify consistent play patterns among early readers. Durkin (1966) found that early readers enjoyed solitary and quiet play. Thomas (1984) found that readers enjoyed more reading readiness toys while nonreaders enjoyed a diversity of toys throughout early childhood. Briggs and Elkind (1977), however, found no differences in preferences for toys among readers and nonreaders.

Some researchers identified the amount of television watched by early readers as a variable of interest, but, again, few have found consistent patterns among early readers. Durkin (1966) found that precocious readers tended to watch television less than 6 hours per week. Other researchers, however, reported that the children watched up to 2 hours per day (Briggs & Elkind, 1973; Plessas & Oakes, 1964).

Like the amount of television watched, reported television preferences also varied across studies. Durkin (1966) found that the precociously reading children in her study did not prefer nursery-school-kindergarten type programs (e.g., “Sesame Street,” “The Electric Company,” etc.) but preferred commercials, quiz programs, and weather programs. Other researchers reported that many early readers preferred educational-type programs with some watching a particular show up to four times per day (Salzer, 1984). Jackson, Donaldson, and Cleland (1988) found that a majority of precocious readers whose parents responded to their questionnaire started watching educational programs before the age of 2 years (81% watched “Sesame Street” and 67% watched the “The Electric Company” before 2 years). Although some researchers found no differences among readers and nonreaders in the amount of time spent watching “Sesame Street” (Briggs & Elkind, 1973; Thomas, 1984), Briggs and Elkind (1973) reported that early readers watched “The Electric Company” significantly more than nonreaders.

Environmental Factors. Researchers have also investigated a number of environmental factors as possible correlates of early reading abilities. For example, socioeconomic status has been studied. Research has not supported socioeconomic status as a primary factor associated with early reading skills regardless of whether father's occupation or parental educational level is considered. Studies of early readers have indicated that a variety of socioeconomic backgrounds are represented among precocious readers. Among her two groups (California and New York), Durkin (1966) found that early readers emanated from blue collar families in the California group, but were more evenly distributed among upper lower, lower, middle, and upper middle classes in the New York study. A few researchers reported that mothers of early readers had higher educational levels and socioeconomic standing (Briggs & Elkind, 1973, 1977; Durkin). Other researchers found that early readers were from mid-range socioeconomic status (Anbar, 1986; Patel & Patterson, 1982). In a qualitative analysis of 40 early readers, Plessas and Oakes (1964) found that these children often came from families who were clerical or professional workers. However, most between-group studies of readers and nonreaders found no differences between the two groups on socioeconomic variables such as income and father's occupation (Thomas, 1984). The fact that socioeconomic factors play such a minimal role in precocious reading is surprising; most studies in the field of giftedness overall usually find socioeconomic status to be a significant factor in the development of gifted children (Konstantopoulos, Modi, & Hedges, 2001).

Durkin (1966) had hypothesized that socioeconomic status would interact with parents' attitudes toward early reading. According to Durkin, however, failure to find a relationship between socioeconomic status and early reading abilities may not be a reflection of socioeconomic status alone but may represent a change among middle-class attitudes toward accepting and encouraging early reading. Other researchers posited that parental attitude toward education may influence a child's ability more than either parental income or father's occupational status (Clark, 1976). No other studies, however, have investigated parental attitude toward early reading as a possible contributor to early reading skills.

A few studies investigated parental characteristics such as reading habits. These researchers reported that one or both parents of early readers considered themselves avid readers (Durkin, 1966; Krippner, 1963; Teale, 1978). The modeling provided by parents may have provided an impetus for their child(ren)'s interest in reading.

Among the home-environment factors investigated, many researchers have examined the child's interaction with reading materials as a possible factor affecting early reading acquisition. Taken together, the studies identified a number of ways children can interact with reading materials. First, several studies indicated that parents and/or siblings read to the precocious reader regularly, many on a daily basis (Anbar, 1986; Briggs & Elkind, 1973; Clark, 1976; Durkin, 1966; Krippner, 1963; Plessas & Oakes, 1964; Stainthorp & Hughes, 2004b; Stroebel & Evans, 1988). Some were read to several times per day (Plessas & Oakes). In studies where a control group was used, early readers were read to more often than nonprecocious readers (Briggs & Elkind, 1973; Stroebel & Evans). Briggs and Elkind (1973) found that fathers of readers read to their children significantly more than fathers of nonreaders.

Second, some research has indicated that these children are exposed to a variety of reading material (Brenna, 1995; Teale, 1978). In several of the investigative studies, researchers found that parents provided their children with a number of children's books from which to read (Clark, 1976; Durkin, 1966; Krippner, 1963; Stainthorp & Hughes, 2004b; Torrey, 1969). In one study, parents of readers took their children to the library more often than parents of nonreaders (Briggs & Elkind, 1977). Books, however, were not the only modality of reading provided. Children used their early reading ability in a number of other situations. For instance, children commonly showed interest in print found on common household objects and other environmental stimuli such as signs, cereal boxes, and products on TV (Clark; Durkin; Krippner; Torrey).

Third, early readers in those studies frequently showed interest in written material by displaying interest in writing skills (Teale, 1978). Several studies indicated that these children's interests and abilities in reading coincided with a desire to write. Durkin (1966), Clark

(1976), and Plessas and Oakes (1964) all indicated that early readers showed a desire to write and print by copying letters and numbers.

Fourth, one research study investigated the social-linguistic environment of early readers. Davidson and Snow (1995) used a qualitative analysis to perform a between-group comparison of the social interactions of parents and their children. Six early readers were matched to six nonearly readers by age, sex, and receptive vocabulary. Variables of interest included language complexity, conversational devices, and topic. Children's decontextualized language was also assessed. Complexity referred to the mean length of the utterance and the mean length of the turn. Conversational devices referred to the speakers' roles and included inquiries, clarification, information, explanation, and topic initiations. Decontextualized language was assessed by requesting definitions of a group of nouns (e.g., knife, diamond), as well as requesting procedural descriptions (e.g., how to play checkers). Results indicated that parents of precocious readers provided a more challenging and rich linguistic environment for their children than did parents of nonprecociously reading children. Fathers, in particular, provided more complex speech patterns. Differences in the children's use of decontextualized language showed that early readers were superior at providing procedural descriptions but not in providing definitions. While the results suggest that early readers have a richer linguistic environment, the authors recognized the need for further research to determine whether the richer environment was a cause of or consequence of the children's reading ability.

Finally, and possibly one of the most important factors correlated with early reading, is the parents' ability and desire to respond to their child's ability. Brenna (1995) noted that parents provided indirect support by spending time with their children, playing, and talking, which provided role modeling of oral and written language skills. Furthermore, several researchers noted parents' response to the child's questions regarding letters, words, and spelling *when* the child needed that help as a primary contributor to the child's reading ability (Brenna; Clark, 1976; Durkin, 1966; King & Friesen, 1972; Krippner, 1963; Plessas & Oakes, 1964). In Brenna's qualitative investigation of the parent-child interaction, she reported that parents encouraged early readers to use a variety of problem-solving

strategies and tended to “go with the child’s common strategies” (p. 59) as the primary means of facilitating progress. According to Teale (1978), parental responsiveness provides children immediate feedback based on the child’s interest.

In summary, despite the number of general and environmental factors investigated, none of the factors (intellectual, personality, or environmental) appear to provide a definitive explanation for the exceptional reading ability of these youngsters (Jackson, 1992; Teale, 1978). Consequently, some researchers have looked beyond the environmental correlates of early reading to processes and psycholinguistic skills in an attempt to understand the expression of early reading more clearly.

Developmental Process of Precocious Reading

Prior to discussing the extant literature on the process of precocious reading, it is important to note that while the last few decades have made important discoveries with regard to emergent literacy (see Elbro, 1996; Snowling, 2002), a single theory does not yet exist (Snowling). However, some brief comments can be made. It is clear that both procedural (e.g., phoneme awareness, letter knowledge) and contextual (e.g., functional aspects of reading) knowledge are necessary, but results of studies vary depending on methodological issues (Korat, 2005). It follows that theories of reading development should account for both aspects. However, none have currently fully explained reading development. Existing theories can be identified into one of four levels: stage models, evolutionary theories based on empirical knowledge, cognitive processing theories, and biological theories (Rack, Hulme, & Snowling, 1993). Additionally, some commonalities can be observed from stage theories, including a logographic or visual approach stage and an alphabetic strategy stage (Snowling).

Just as the literature in typical reading development, the research investigating the process among precocious readers also has looked at these explanatory levels. A few studies have attempted to describe the process of early reading. Forester (1977) reviewed the work of Durkin (1966) and Torrey (as cited in Forester, 1977) in conjunction with other information on teaching reading skills, paralleled reading

acquisition with language acquisition, and, subsequently, identified a number of key factors in their description of the process of reading acquisition. First, she found that precocious reading is learned but not directly taught. Like learning to speak, early readers tended to begin by actually reading familiar material; a sight vocabulary developed. Like the rules of grammar, the rules of the alphabet and decoding were not explicitly known. Second, Forester noted that fluent reading was modeled. (Relatedly, the importance of being read to in the early reading process has been documented by several researchers and was discussed earlier [Anbar, 1986; Briggs & Elkind, 1977; Clark, 1976; Durkin; Krippner, 1963; Plessas & Oakes, 1964; Stroebel & Evans, 1988]). As a consequence of modeling, reading apparently was acquired through a top-down process rather than a bottom-up process. That is, children were not taught the prerequisite skills of reading such as phoneme-grapheme correspondences or letter-naming skills but, instead, learned to read familiar, meaningful sight vocabulary; the rules of reading were not explicitly taught but apparently inferred over time.

In a case study, Lass (1983) described the reading process of a 3-year-old early reader. She identified two primary phases of the process. During the first stage, the child demonstrated prereading skills. Prereading skills included a perception of self as a reader, reading preferences, and gaining meaning from reading simple material. From Lass's point of view, however, the child was not yet a "reader" because he not able to decode words or read books independently. During the second stage, the child demonstrated true reading skills. The process proceeded through a number of substages. The child first showed a vast sight vocabulary based on words in favorite and familiar books. Next, the child used word structure to identify new words; words with only differing beginning or ending consonants were identified first, and later the child unsystematically covered letter segments in an attempt to identify the words by parsing the word into random segments, independent of syllables or left to right sequencing. During the next stage, the child demonstrated decoding abilities that he learned through instruction in letter-sound relationships. Use of contextual cues, including previous knowledge of common phrases and visual cues, constituted the final substage of the process. Based on her observations, Lass believed that the early

reader approached reading in an integrated manner, neither top-down nor bottom-up. That is, the child executed the reading process from both a meaning and a phonetic approach.

Anbar (1986) studied six early readers ages 2 years 9 months to 4 years 10 months to determine whether a universal process could be identified among the children. Using an unstructured interview with parents, as well as a more structured interview addressing family background, play experiences, preschool experiences, reading-related activities, progression of reading material, and parental attitudes toward reading, the author identified six to seven sequential stages through which readers progressed. Stage I was characterized by awareness of print and books as evidenced by choosing books and educational television programs as play interests. During Stage II, the children began to name letters and show evidence of a sight vocabulary. Stages III and IV were characterized by learning letter-sound associations and making words with these sounds, respectively. The child began to actively read familiar books during the fifth stage. The ability to sound out new words and subsequently to read unfamiliar books occurred during Stages VI and VII, respectively. Anbar also speculated that an eighth stage, reading for enjoyment, completed the reading process.

Given the subjective nature of the methodologies and the lack of specific criteria defining the stages, it is somewhat difficult to determine whether the stages reported by Anbar (1986) and Lass (1983) corroborate or contradict each other. Anbar, who compared her model to Lass's, stated that the striking similarity between the two models support the basic stages found in her model (see Table 2). She argued that differences in the two models were due to differing designs and methodologies used within each study. No research studies, however, have used more objective means to define the stages, and, without such research, a true understanding of the process of early reading remains subjective. Irrespective of the stages defined by either of the authors, the research does suggest that precocious readers are able to approach reading as mature readers. Early descriptions of reading development indicate that early readers are able to use both a phonemic, skills-based approach and a semantic, meaning-based approach.

Table 2
**A Comparison of Developmental Models
of Early Reading Skills**

Lass's Stages of Reading Acquisition	Corresponding Stages of Anbar's Model
Prereading Skills	Stage I—Awareness of Print
Reading Acquisition Phase	
Sight Vocabulary	Stage II—Letter Identification & Sight Vocabulary
Using Word Structure	Stage IV—Putting Together Words
Decoding	Stage III—Learning Letter Sounds
Active Participation in Reading	Stage V—Active Reading
Context Cues	Stage VII—Reading Easy Unfamiliar Books

Note. Adapted from Anbar, A. (1986). Reading acquisition of preschool children without systematic instruction. *Early Childhood Research Quarterly*, 1, 69–83.

More recently, researchers have attempted to define metacognitive processes used by early readers. In a qualitative study that used a combination of role playing, semistructured interview, and direct observation, Brenna (1995) investigated the metacognitive reading strategies of five early readers ages 4 years 11 months to 6 years. Metacognitive strategies investigated included self-knowledge (i.e., understanding of cognition) and task knowledge (i.e., mechanisms of self-regulation). According to Brenna, early readers used a variety of metacognitive skills. Within the self-knowledge category, early readers were able to vary their approach based on the task and situation. For example, one child relayed that strategies varied when feeling tired. Furthermore, early readers chose reading material based on their understanding of their own skills. Book selection strategies included examining the book jacket, surveying contents, and assessing text familiarity. Within the task-knowledge category, the early readers approached reading as a problem-solving process. Self-regulatory behaviors included rereading the text, asking for assistance, sounding out words, and using contextual cues and previous knowledge. Overall, Brenna concluded that early readers' ability to use a

variety of self-knowledge and task-knowledge metacognitive strategies in a flexible manner contributed to their superior reading skills.

Psycholinguistic Characteristics of Precocious Readers

While stage models and metacognitive approaches help describe the reading process, a number of researchers investigated specific skills, or psycholinguistic abilities, of early readers. Psycholinguistic skills investigated include phonemic awareness, memory, and visual-motor skills, as well as letter, word, and text reading speed.

A great deal of research has investigated phonemic awareness of early readers, a metacognitive skill that involves being sensitive to and able to manipulate the phonological structure of words (Bus & van IJzendoorn, 1999). Early research tended to view phonemic awareness as a monolithic concept and measured single aspects of phonological awareness such as phoneme blending or segmentation. Recent research, however, suggests that phonological awareness is hierarchical in nature. Perfetti, Beck, Bell, and Hughes (1987) divide phonological awareness into phonological synthesis (e.g., phoneme blending) and phonological analysis (e.g., phoneme segmentation). From this perspective, phonological synthesis represents a prerequisite to reading, whereas phonological analysis represents a higher level skill that has a reciprocal relationship to reading (Stainthorp & Hughes, 1998). Although early researchers did not subcategorize phonological awareness in this manner, the division appears helpful in understanding the skills of early readers and will be discussed as such hereafter.

Stainthorp and Hughes (1998) provided a developmental perspective to early reading skills. In an attempt to understand the development of phonological awareness including synthesis and analysis, Stainthorp and Hughes (1998) administered a group of nonstandardized stimulus items to two groups of children whose mean age was 5 years. One group consisted of 17 early readers who were matched by verbal intelligence to same-aged nonreaders. Instruments were administered three times over a 3-year time span (Time 1 = 5 years, Time 2 = 5 years 11 months, and Time 3 = 6 years 11 months). Results indicated that early readers were significantly more profi-

cient at phonological synthesis tasks (rhyming, phoneme addition, phoneme deletion, and blending) at all testing periods. Based on a nonsignificant discrepancy between early readers on previous testing and nonearly readers on the following year's testing, researchers inferred that nonearly readers displayed phonological synthesis skills approximately 1 year behind the early readers. While early readers did not perform at ceiling levels at 5 years of age, they had reached ceiling levels by the time they were 7 years old. On the task of phoneme analysis (i.e., phoneme segmentation), which required participants to separate words into component phonemes, Stainthorp and Hughes (1998) found that although early readers significantly outperformed the nonearly readers on each administration, at 6 years 11 months, early readers had still not completely mastered the phoneme segmenting task. As on the phoneme synthesis tasks, comparisons between early and nonearly readers on phoneme analysis tasks indicated that nonearly readers lagged behind the early readers by 1 year. The authors interpreted this result as evidence that phoneme analysis represents the more difficult task that has a reciprocal relationship with reading. Integrating of the developmental results of the tasks of phonological synthesis and analysis, Stainthorp and Hughes (1998) concluded that the hierarchical sequence of phonological awareness is rhyming, blending and phoneme addition, phoneme deletion, and segmentation of words into phonemes.

Backman (1983) examined early readers' ability to identify the number of phonemes in a word (phoneme segmentation). According to the author, phoneme segmentation facilitates decoding and therefore the ability to sound out new words. In a comparison study of early readers, nonearly readers matched for age, and older readers matched for reading level, Backman measured segmentation skills through a tapping test and a sound deletion task. The tapping test required students to tap on the table for each individual phoneme in a given word. The sound deletion task required children to say a new word formed when a sound had been deleted from the word. Results indicated that early readers were no better than nonreaders at indicating the number of phonemes in a word, and neither the early readers nor the nonreaders were significantly different from older readers at the task. Further, results on the tapping test were not significantly

correlated with spelling or reading achievement. In contrast, early and older readers were equally proficient and both were significantly better than nonreaders at identifying new words in the sound deletion task. This was the only psycholinguistic skill measured that significantly correlated with spelling and reading achievement (sound blending and speech-sound discrimination were not considered and will be discussed later). Within-group results, however, were variable, with some early readers performing below the 30th percentile on the sound deletion task. According to Backman, these results indicate that although both tasks appear to measure phoneme segmentation, the tapping test represents an abstract task that is not a prerequisite for or a consequence of early reading ability. Sound deletion, on the other hand, while not a prerequisite for reading, may provide a contextual reading strategy that facilitates word recognition.

However, Backman's (1983) results could be interpreted in the light of and as support for Stainthorp and Hughes's (1998) description of the hierarchical order of phonemic awareness. Backman found that early readers outperformed nonearly readers and performed like older readers on the sound deletion task. Furthermore, results of the sound deletion task correlated with reading and spelling achievement. This would support Stainthorp and Hughes's (1998) contention that phoneme deletion is a skill of phoneme synthesis, as well as a requisite skill for reading. Furthermore, Backman reported that early readers were not as proficient as older readers at phoneme segmentation and that phoneme segmentation was not correlated with reading and spelling achievement. These findings provide further support for Stainthorp and Hughes's (1998) belief that phoneme segmentation represents a higher level skill that has a reciprocal relationship with reading, rather than a prerequisite.

A number of studies investigated sound blending, the ability to combine phonemes into words. Results of Evans and Smith's (1976) study indicated that all 19 children in their study scored at or beyond three standard deviations above the mean on the measure. Briggs and Elkind (1977) also found that early readers performed significantly better than nonreaders on the sound-blending subtest and concluded that sound blending represents a requisite skill for early reading. Stroebel and Evans (1988) found that early readers

performed significantly better than nonreaders on tasks requiring sound blending. Backman (1983) assessed syllable and phoneme blending skills of three groups (early readers, age-matched nonreaders, and older readers). Backman found that while older readers were significantly more proficient at phoneme blending and syllable blending than both early and nonreaders, early readers were significantly better at phoneme blending than nonreaders. Syllable blending was significantly correlated with reading and spelling skills only in older readers. Based on these results, she concluded that sound blending is neither a prerequisite nor a consequence of reading and suggested that it may represent a developmental skill that is related to a third variable, such as working memory. In light of current research on phonological awareness, it is also possible that the third variable may be related to the complexity of the task and requires additional reading experience. Earlier, it was noted that Perfetti et al. (1987) found a reciprocal relationship between phonetic awareness and reading ability. The fact that older readers are more skilled at phoneme blending and syllable blending may then be a result of additional experience in reading.

Auditory discrimination, the ability to discriminate between speech sounds, is also considered an important skill for reading, but results do not unequivocally support its importance as a necessary skill for reading (Backman, 1983). Clark (1976) compared the skills of early readers to those of nonreaders. She found that early readers had few difficulties with an auditory discrimination task while nonreaders usually had significant difficulties with the task (59% had invalid scores). Backman's study investigated auditory discrimination using a measure that contained both a background noise and a quiet subtest. Backman reported that the older readers performed significantly better on the noise subtest than early readers, and early readers did not differ significantly from nonreaders on either subtest.

A few studies investigated speed and accuracy of letter, word, and text-naming skills. A 6-month longitudinal study performed by Jackson and Myers (1982) investigated the role of letter-naming speed on the reading achievement of early readers. Results indicated that overall, letter-naming times were slower for early readers than for older nonprecocious readers of the same reading level. Further,

in comparing two age levels of precocious readers (mean ages 49 and 56 months), the authors found that the older group was more proficient at letter naming than the younger group regardless of current reading level. That is, even the best readers in the younger group performed worse than readers of equal or lower reading ability in the older group. According to Jackson and Biemiller (1985), these results suggest that rapid letter identification skills are not a prerequisite of successful reading. Jackson and Myers did find, however, that letter-naming speed was a significant predictor of concurrent and future (approximately 6 months latency period) reading achievement. These results, moreover, corroborate the finding of Perfetti et al. (1987), who noted a reciprocal relationship between phonemic awareness and orthographic knowledge. It is possible that precocious readers are more mature in their reading abilities but have not yet had the experience and interaction with written material necessary to some readiness skills (i.e., letter-naming skills).

In a study designed to expand these findings, Jackson and Biemiller (1985) investigated the letter, word, and text reading times of early readers as compared to older readers in the second and third grades. The authors found associations between letter, word, and text reading speed and comprehension. Like Jackson and Myers (1982), results showed that precocious readers performed letter-naming tasks more slowly than older children at the same reading level. They did discover, however, that precocious readers read words at the same level and read text faster than the group of second- and third-grade readers. Because of correlations between speed and comprehension, the authors interpreted these results as offering some support for extending bottom-up theories of reading, which would predict that letter and word reading skills are prerequisite to reading comprehension skills. The authors, however, do acknowledge that the relationships were modest and seem to imply that precocious readers somehow compensate for their relatively slower letter-naming speed by using orthographic information more efficiently and that superior text reading speed and comprehension is the result of more balanced top-down and bottom-up skills.

Using the same sample of precocious readers as Jackson and Biemiller (1985), Jackson et al. (1988) investigated the reading struc-

ture of precocious readers. Jackson et al. hypothesized that, like average individuals and individuals with reading disabilities, precocious readers would demonstrate a uniform reading structure consisting of a conceptual dimension, which represented global comprehension skill, and an analytic dimension, which consisted of the basic skills necessary for reading. Results of the study did not support the hypothesized two-factor simple structure. Although the hierarchical structure was supported, results indicated that with regard to specific skills and reading style, precocious readers show no single pattern but are variable in their abilities; that is, early reading ability was only moderately correlated with verbal ability, short-term memory, and name-retrieval speed. Subsequently, the authors concluded that for early readers, no specific prerequisite skills or reading style is necessary, but, rather, the current level of reading ability reflects the child's ability to effectively use knowledge and reading strategies appropriately. It is also possible, however, that the conclusion made by the authors is erroneous and that the true prerequisite skills for reading were not measured.

In a study that further explores the precursors to precocious reading, Silven, Poskiparta, and Niemi (2004) found that precocious reading was 30 times more common among Finnish-speaking children than among English-speaking children. In their study of 61 Finnish-speaking children, 18 (30%) children were identified as precocious readers before entering the first grade, as measured by a specified reading criterion. The authors suggest linguistic factors such as the nearly perfect grapheme-to-phoneme correspondence in Finnish, together with later school entry than experienced in the United States (7 years 3 months), increase the prevalence of precocious readers in Finland. The authors' analysis of their results indicated that, on the basis of vocabulary size at 2 years and mastery of inflections at 3 years, they could identify the correct reading status of 56% of their sample.

Neurological Correlates of Precocious Reading

A number of researchers have also investigated the neurological correlates of precocious reading, including memory and vision-related

skills of early readers. Evans and Smith (1976) and Jackson and Myers (1982) found that performance on tasks of visual memory were correlated with early reading skills. However, Clark (1976) found that there was variability in immediate visual memory among precocious readers, ranging from below average to average. Furthermore, precocious readers were advanced in skills required for proficient reading, such as faster text reading (Jackson & Biemiller, 1985). Thus, these latter results could suggest that some early readers may perform at advanced levels on measures of reading because they are using a visual approach toward reading rather than a phonological approach, which is consistent with previous descriptions of early readers (Forester, 1977).

The few studies investigating visual-motor skills among precocious readers have not supported superior visual-motor skills among this group. The performance of precocious readers on tests of visual-motor integration vary from below average to comparable to their reading skills (Clark, 1976; Evans & Smith, 1976). Clark hypothesized that the ability to read requires the ability to recognize spatial orientation but not the ability to motorically reproduce a geometric figure.

In an attempt to define some neuropsychological correlates of early reading, Stroebel and Evans (1988) matched 21 early readers with 21 control subjects based on intelligence test scores. The authors used a series of neuropsychological assessment techniques believed to assess function of differing brain areas. In contrast with the prediction that early readers would show superior development in posterior left hemispheric functioning, the authors found that precocious readers scored significantly higher on tests associated with right hemispheric functioning (left hand tapping) and left frontal functioning (verbal fluency). According to Stroebel and Evans, because most left hemisphere measures were highly correlated with general intelligence, this unforeseen finding may have been a result of the subject matching process rather than a true phenomenon. Most left hemisphere measures used may have provided an indication of overall intellectual ability rather than having any unique relationship to reading skills. As a result, differences in left hemispheric functioning were not found between these precocious and nonreaders matched on IQ. No studies have further tested this hypothesis.

Finally, in a similar attempt to identify some neuropsychological correlates of early reading, Suldo, Olson, and Evans (2001) compared peak frequency in the alpha band of 15 children with precocious reading ability to that of two control groups. The first control group consisted of 15 age-level matched children who were similar in cognitive functioning and age, but reading at grade level. The second comparison group consisted of 15 reading-level matched children with similar intelligence and reading level scores, except that they were 2.5 years older. The researchers compared electroencephalogram (quantitative electroencephalogram) data on each participant obtained from 19 scalp electrode sites. The peak frequency in alpha did not differ significantly between the precocious readers and the reading-level matched control group. In contrast, the authors found that the early readers had significantly higher alpha peak frequency than the age-level matched group at 16 of the 19 electrode sites examined. Thus, this study suggests that peak frequency in the alpha band may be associated with precocious reading ability, possibly an indicator of advanced brain maturation. However, each of the two control groups and the experimental group was relatively small ($n = 15$) providing limited generalization of this study at the present time.

Academic Skills of Precocious Readers

Few researchers have investigated the present and/or future academic skills of early readers. Clark (1976) reported the spelling, writing, and arithmetic skills of the 32 precocious readers that she investigated. Group scores were variable, but all spelled above age expectancy for their chronological ages of 4.5 to 6.5 years (spelling performance ranged from 5–12 years; median = 7 years). She made two primary observations. First, the children were cognizant of words they did and did not know; they tended to respell difficult words indicating dissatisfaction with what they produced. Second, misspellings were often consistent with irregular English spellings (e.g., “fihgt” for “fight”). With respect to writing skills, and in accordance with visual-motor skills previously addressed, Clark found that early readers tended to have average and below average writing skills

(e.g., legibility). Furthermore, Clark found that math skills tended to be in the superior range (> 95th percentile).

Durkin (1966) followed reading achievement of her California and New York groups throughout 6 and 4 years, respectively. Results indicated that, as expected, early readers demonstrated a significantly higher mean level of achievement than IQ-matched nonearly readers. Furthermore, achievement was greater for those children who were double promoted. Both studies also revealed that more intelligent early readers (median IQ = 146.5) failed to maintain the earlier large gap between their skills and those of nonearly readers. The gap between more intelligent early readers and IQ-matched nonearly readers tended to decrease over time. In contrast, precocious readers of average intelligence tended to increase the gap between their performance and that of nonprecocious readers. That is, although precocious readers with higher intelligence tended to maintain higher overall reading achievement, their reading achievement test scores failed to increase at the same rate as the nonearly readers. Durkin explained this phenomena in terms of regression toward the mean, the natural tendency of extremely high (or low) test scores to regress toward the mean over time, and ceiling effects, the tests' limited ability to accurately assess the progress of the precocious readers due to scores that were already near the tests' ceiling on initial assessments.

In a unique study comparing cognitive skill patterns of bilingual and monolingual early readers, Jackson and Lu (1992) found a number of interesting differences between the two groups. Overall, bilingual precocious readers performed slightly below monolingual early readers on all cognitive measures but displayed a similar pattern of functioning on all measures. Significant differences occurred only on measures of oral English where bilingual early readers scored lower. Interestingly, despite difficulties with oral English, bilingual precocious readers did not read orally more slowly than monolingual readers. Based on the aforementioned results, Jackson and Lu concluded that difficulty in fluent oral language should not preclude bilingual precocious readers from participating in advanced reading programs.

Mills and Jackson (1990) performed a longitudinal study investigating reading abilities of a group of 59 precocious readers 5–6 years after initial assessment. Using standardized measures of reading

achievement, the authors compared reading performance to the four reading factors (general ability, speed, decoding rule use, and graphic precision) identified by Jackson et al. (1988) and to verbal and non-verbal reasoning measures of intelligence. Comparative results of the reading measures indicated that although children continued to perform well above average, scores did not remain extraordinarily high on tests of verbal intelligence and language achievement; less than 20% of the children scored more than one standard deviation above the mean on three of the intelligence subtests, and 36% of the children performed within the average range on the language mechanics test of the reading achievement test. In addition, reading ability 5–6 years later was predicted equally well by initial reading measures and verbal ability portions of the intelligence test.

In a follow-up study, Burns et al. (1991) investigated the reading and writing skills of a group of early readers after 4 years. In the original study, Burns and Collins (1987) investigated the home environments of 30 intellectually superior children (Full Scale IQ of 120 or above). In their follow up study, Burns et al. administered reading and writing standardized achievement tests to assess academic skills of 19 of the original 30 subjects. Results indicated that overall there were significant between-group differences on reading achievement, with accelerated readers outperforming nonreaders. However, when individual subtests were considered, the accelerated readers only outperformed nonearly readers on measures of decoding and spelling. On tasks of word identification and comprehension, nonreaders and early readers did not perform differently.

In a small-group longitudinal study, Stainthorp and Hughes (2004a) tracked 14 precocious readers along with a comparison group of 14 nonearly readers, assessing their literary performance at the ages of 5, 6, 7, and 11. In an attempt to identify the pattern of literary progress of precocious readers in the later primary years, the writers measured reading accuracy, speed, and comprehension and phonological processing. Stainthorp and Hughes (2004a) found that the early readers maintained their significant advanced abilities above the comparison group at age 11 on reading accuracy, speed, and comprehension, as well as phonological processing. While the precocious readers' advantage on reading accuracy declined slightly over the comparison group

from age 5 to 11, it remained significantly higher. However, on tests of reading speed and comprehension, as well as phonological processing, the differences between the two groups remained steady through age 11. Though limited in subjects, this study suggests that precocious readers maintain most of their literacy advantages through their later primary years. In a further description of their study, Stainthorp and Hughes (2004b) describe one of their early readers in an illustrative case study as having a balance in her advanced abilities across various academic assessments measuring literacy development. While the writers mention how other case studies of precocious readers have shown deficits in some literacy abilities such as spelling and phonological awareness, their case study illustrates advanced abilities in all of the literacy abilities assessed by the researchers, including phonological awareness, spelling, and writing.

Given that few researchers have investigated the academic abilities of precocious readers, it is difficult to determine whether the group as a whole later performs at higher levels than would be expected. The few studies that have provided longitudinal reports of academic skills indicate that early readers outperform normal readers on tasks requiring specific reading skills, particularly early in their academic careers. However, over time as the children get older, and especially with more intelligent early readers, these differences seem to plateau. Many other skills do not seem to be affected by reading ability. Only one study reported academic skills other than reading-related skills. Clark (1976) found that precocious readers also had superior math skills. The generalizability of these findings, however, could be called into question based on the fact that her sample was relatively small ($N = 32$) and two thirds of her sample had IQs greater than 140.

Conclusion

After nearly 40 years of research, precocious reading ability remains a mysterious phenomena. While several factors have been found to correlate with precocious reading abilities, including family environmental factors such as value placed on education and responsiveness to children's questions (Clark, 1976; Durkin, 1966); qualitative

differences in interaction with reading materials (Clark; Durkin; Plessas & Oakes, 1964; Teale, 1978); and psycholinguistic variables including visual memory and word- and text- reading speed (Backman, 1983; Briggs & Elkind, 1977; Evans & Smith, 1976; Henderson, Jackson, & Mukamal, 1993; Jackson & Biemiller, 1985; Patel & Patterson, 1982), current research has limited application and generalizability. Research in this area has not progressed past the descriptive level of understanding to the more practical and applied level. Clinicians are still unable to predict precocious reading ability or confidently discuss how it emerges. Additionally, the ability to generalize knowledge about precocious readers to the typically reading child or even state whether this is appropriate remains limited.

There are several directions both possible and necessary to further understand precocious readers. First, researchers and clinicians need to understand how precocious readers are similar to, or different from, the typically reading child. Perhaps one of the most devastating omissions in the research on precocious readers is the failure to fully integrate current research and knowledge about reading with knowledge about precocious readers. For example, we have not determined why precocious readers do not have the same reading structure as readers with disabilities and average readers (Jackson et al., 1988), nor do we understand the underlying neuropsychological functioning in comparison to average readers (Stroebel & Evans, 1988; Suldo et al., 2001). Consequently, researchers have not provided an understanding of precocious readers from a more theoretical perspective. There are areas of research that could benefit from incorporating precocious readers into their perspective: emergent literacy (precursor reading and writing skills) and reading development (early and later reading and writing skills). Currently there is not a single theory describing either emergent literacy or reading development. Within the field of emergent literacy, current models vary on the degree to which they explain the procedural (e.g., phonological awareness and word reading) and conceptual (e.g., functional knowledge of print) aspects of reading, as well as focus on language and cognitive skills (Korat, 2005). Similarly, current theories of reading development vary to the degree they focus on the mechanical and the conceptual processes. These theories can be categorized into one of four levels: (a)

descriptions of the stages of reading development, (b) the evolution of reading skills based on empirical knowledge, (c) the organization of reading processes, and (d) biological bases of reading development (Rack et al., 1993). In both the case of emergent literacy and reading development, a solid theory should be able to describe an array of performance. From this point of view, precocious readers could be used to validate current theories of reading development. A sound theory of reading development must encompass the full range of reading ability in order to fully explain individual differences in reading development (Jackson, 1992).

Additionally, a clearer understanding of the development, skills, and prognosis of the precocious reader will require a drastic refinement of the research methodology. In the past, several factors made it necessary to use weaker methodologies, including rarity of the phenomena and the lack of understanding of the etiology. As a result, much of the published research on precocious readers involved case studies (e.g., Henderson et al., 1993; Krippner, 1963; Lass, 1983; Mills & Jackson, 1990; Pennington et al., 1987; Teale, 1978; Torrey, 1969; Zirkelbach, 1984). Although case studies can provide a foundation for new hypotheses and provide some understanding of the phenomena, the methodology lacks the controlled conditions that could help provide explanations of the mechanism underlying the ability to read early (Barlow & Hersen, 1984). Furthermore, while retrospective, quasi-experimental studies have investigated a number of environmental, neuropsychological, and personality correlates of early reading, none has shed much light on the phenomena at a more basic causal or predictive level (Backman, 1983; Briggs & Elkind, 1973; Clark, 1976; Durkin, 1966; Evans & Smith, 1976; Stroebel & Evans, 1988; Henderson et al.; Jackson & Biemiller, 1985; Teale). The result of using quasi-experimental and case studies has been that interested parties are left with only a descriptive understanding of the skills possessed by these children.

A refinement of the research methodology will require researchers to move beyond case and retrospective studies to those that are able to predict the occurrence of precocious reading ability (Silven et al., 2004). The recent study by Silven et al. exemplifies the use of longitudinal data to investigate the relationship between language

and early reading skills. These authors were able to provide initial evidence of the precursory skills of precocious readers. Their methodology should be replicated in English-speaking countries.

There are other ways to refine the research methodology. For example, researchers should maximize the use of diagnostic tools to identify early readers and monitor these skills over time. There have been significant improvements in standardized tools for monitoring early literacy skills (e.g., Dynamic Indicators of Basic Early Literacy Skills; Kaminski & Good, 1996). These measures are increasingly being used across schools to identify children who are at risk of reading problems and are administered classwide in most cases. Therefore, precocious readers are already being assessed in many cases. The strong psychometric and diagnostic properties of these measures could be used to more fully understand precocious readers' early reading and language skills, monitor reading skills over time, and accurately document the progression of specific reading skills across time.

Thus, in order to provide more than a descriptive analysis of precocious readers, research and theory needs to integrate and expand current knowledge and research about precocious readers with an effort to make application of the knowledge accessible to clinicians, teachers, and parents. Furthermore, understanding how precocious readers fit into the current theory on reading development and emergent literacy may help illuminate the reading process more clearly and could facilitate greater effectiveness for teachers and early intervention programs. Finally, incorporating diagnostic tools already widely used in clinical practice to identify, at an early age, children's probable reading abilities could greatly improve the ability of clinicians to more fully understand the precocious reader. As research progresses, knowledge needs to be integrated in theory and made available to parents and professionals.

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