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**Longitudinal study of English and Hebrew reading abilities in
5-7 year old Hebrew day school students**

Gutman, Renée H., Ph.D.

City University of New York, 1990

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A

LONGITUDINAL STUDY OF ENGLISH AND HEBREW
READING ABILITIES IN 5-7 YEAR OLD
HEBREW DAY SCHOOL STUDENTS

by

Renee H. Gutman

A dissertation submitted to the Graduate
Faculty in Psychology in partial fulfillment
of the requirements for the degree of Doctor
of Philosophy, The City University of New
York.

1990

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This manuscript has been read and accepted for the Graduate Faculty in Psychology in satisfaction of the dissertation requirement for the degree of Doctor of Philosophy.

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This work is dedicated to

Jonathan,

Benjamin,

and

Rachel

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CHAPTER I

INTRODUCTION

Statement of the Problem:

This study was designed to investigate the relationship between reading approaches and achievement in English and in Hebrew among Hebrew Day School students. The students were initially assessed during kindergarten, where they were tested using reading "predictors." Subsequent assessments in first and second grades used reading measures in both English and Hebrew.

The specific subskills which were examined in kindergarten included English measures of fluency, expressive and receptive vocabulary, morphology, phoneme awareness, syllable awareness and syntax, and English and Hebrew auditory discrimination. First and second graders were tested, in addition to the previous tests, on letter-sound identification in English and Hebrew, single word reading in English of regular and exception words, single word reading in Hebrew of vowelized and unvowelized words, and nonsense word reading in English and Hebrew.

Purpose and Significance of the Research:

Over the past few decades, a vast literature on reading

has accumulated in educational, psychological, neurological and artificial intelligence journals and texts. Sophisticated technological techniques have been added to the diverse methodologies used to decompose, model, map, and artificially simulate reading behavior. A seemingly endless variety of permutations on such basic questions as prerequisites of reading achievement, predictors of reading achievement, necessary and sufficient processes involved in reading, and neurological substrates of reading behavior have been presented, challenged, defended, and further argued.

Yet, one very relevant question has hardly been touched upon. What effect does the orthography, or writing system, have on the act of reading? Reading occurs in a diversity of orthographies that bear varying degrees of similarity to our own English script. Might not the orthography itself present task demands that could influence the prerequisites, predictors, processes, and even brain substrates involved in reading? Furthermore, is reading failure (dyslexia) particular to the language of instruction, or does it reflect a disorder that would be apparent regardless of script? Though these questions have been raised in the literature (Kavanagh and Mattingly, 1972; Tzeng, 1980; Henderson, 1984), they have been addressed only superficially. No systematic, detailed investigation comparing reading acquisition in two diverse orthographies by the same persons has been reported in the literature.

It is possible that a comparison of children's reading development in two different orthographies may yield substantial insight into the very questions that have plagued reading researchers for many years. In fact, very different conclusions about reading may be arrived at if 1) processing strategies appear similar in both orthographies, particularly if they differed in their degree of phonetic transparency, or 2) processing strategies differ in the two orthographies. For example, current reading models, inspired by the particularities of English orthography, include pathways for both analytic and wholistic decoding routes. If orthographies were found that did not appear to require alternative reading strategies and also elicited dual reading processes, then one might be encouraged to consider that reading, regardless of the particularities of any given orthography, may involve universal processing functions and may depend upon universal brain substrates to support these functions. One would be encouraged to investigate further evidence of reading "universals." In contrast, if singular or different reading strategies were used when different orthographies were being read, then one would have to consider that the processes involved in reading are orthography-specific, and the brain substrates which support them might depend upon the particular demands of the orthography in question. Evidence to support these hypotheses would then be sought.

Similarly, different hypotheses regarding reading

disorders would have to be considered if 1) individuals were dyslexic in one orthography and not another, 2) if they had analogous symptoms of dyslexia in each orthography, or 3) if they were dyslexic in both languages, but demonstrated different patterns of symptoms in each. Finally, one might consider that reading is dependent upon universal cognitive processes if "predictors" of reading achievement in one language correlated significantly with reading achievement in an orthographically different language, as well.

CHAPTER II

LITERATURE REVIEW

Introduction:

There are virtually no published investigations of the relationship between reading achievement in the two languages of biliterates. However, several bodies of literature bear on this issue.

Models of normal reading have proliferated in the literature and will be briefly reviewed because it makes little sense to compare reading ability across languages without first considering the processes that occur in single-language reading. While not explicitly stated, these models are generally based on English reading. Literature dealing with theories of reading disorders has raised such questions as brain localization of reading functions, the relationship between acquired and congenital reading disorders, and correlates of reading dysfunction. All such issues lend insight into the processes involved in normal reading.

The biliteracy literature addresses the question of the relative difficulty of learning to read in the various orthographies. It also encompasses issues dealing with the similarities and differences among deficits and recovery in the various languages of multilingual individuals following

brain damage. Such findings may suggest the relative similarities of language processing across languages, including reading functions.

Finally, the literature on reading predictors has focussed on the identification of necessary and/or sufficient prereading skills that a child must possess in order to read. An interesting question, which will be addressed in the body of this dissertation, is whether or not those factors that predict to reading success in English are also prerequisite skills for reading achievement in another orthography.

Models of Normal Reading:

The literature is replete with models of reading that implicitly use English orthography as their frame of reference. This is evident from the pathways and allowances that are made for properties particular to English orthography. By not explicitly stating their orthographic basis, these models imply that they would accommodate other orthographies as well. Such assumptions have not been tested and have certainly not been proven.

A central concern expressed in the reading literature is identification of the necessary and sufficient processes that are used to access meaning from the script. Many investigators agree that phonetic decoding plays an important role, particularly in beginning reading (Liberman and

Shankweiler, 1979; Mattingly, 1972; Crowder, 1972; Wagner and Torgesen, 1987). While some continue to emphasize the importance of phonetic processes in later stages of reading development (Conrad, 1972; Liberman, 1982; Perfetti, 1985; Shankweiler and Crain, 1986), others claim that the process of reading changes over the course of development towards an increasing reliance on whole-word recognition (Gibson and Levin, 1975; Seidenberg, 1985; Stanovich, 1986).

Some reading theories support a "dual route" system, whereby reading may proceed via phonetic decoding or via whole-word processes. Although both processes may operate in parallel, they are considered independent (Morton and Patterson, 1980; Coltheart, 1981; Henderson, 1984). Others cite evidence to support a sequential model whereby most words are recognized lexically, and phonetic decoding only enters in postlexically, with low-frequency words (Seidenberg, 1965; Stanovich, 1986).

The single route models claim exclusive reliance on lexical processing to detect familiar words, letters, and letter strings (e.g. Glushko, 1979, 1981). New words and non-words are read by analogy with familiar letter clusters.

The interactive models pool the information that is derived from knowledge of phonetic "rules" with lexical knowledge to obtain a final "reading" of the script (Barron, 1986). Other, more sophisticated, dynamic interactive models also take into account knowledge of (experience with) syntax,

context, and frequency of occurrence (McClelland, 1987). Clearly, the latter models more easily accommodate the mixed strategies that are observed both in beginning reading stages (Marcel, 1980; Jorm and Share, 1983), and at levels of full proficiency (Barron, 1981; Beck and Carpenter, 1986).

Theories of Reading Disorders:

Early theories of acquired and developmental reading disorders:

Much of the reading literature has arisen out of a need to explain reading failure. Reading disturbances resulting from brain damage in adults have been reported since as early as 30 C.E. (Benson, 1981). Attempts to localize brain areas associated with acquired reading dysfunction began in earnest with two thoroughly documented cases of reading disturbance presented by Dejerine in 1891 (reviewed in Heilman and Rothi, 1982). Post-mortem examination of a patient who had suffered alexia with agraphia revealed a large infarct of the left angular gyrus. A second patient, who had alexia without agraphia and a right homonymous hemianopia, was shown, at post-mortem, to have suffered infarction in the left medial occipital area plus destruction of the splenium of the corpus callosum. Dejerine reasoned that this second patient received visual stimuli in the right visual cortex but that this

information was not transferred to the left hemisphere where linguistic information was interpreted. In contrast the first patient had lost an area necessary for both interpretation and production of written language.

In 1896, Dr. Morgan, an English school doctor, read a description of acquired alexia by a Scottish eye specialist, James Hinshelwood, and suggested that such a disorder might also be congenital (Doehring, Trites, Patel and Fiedorowicz, 1981). Hinshelwood described "visual word blindness" as an inability to recognize words following brain damage to the left angular gyrus, an area which he called the "visual memory center for words." Hinshelwood himself authored a book in 1917 entitled Congenital Word Blindness in which he described cases of "otherwise sharp and intelligent" children who could not learn to read. The assumption was that a single type of reading disability could occur as an isolated disorder in an otherwise perfectly normal child, and that this disorder was entirely analogous to acquired adult cases.

The only other major theory of developmental reading disorders prior to 1950 was that of Samuel Orton (Orton, 1925; 1937), an American neurologist and psychiatrist. While he agreed with Hinshelwood's claim that there was a brain center for the storage of visual word images, he felt that the disorder was not so pure and isolated. Rather, he described a developmental lag in the establishment of left-hemisphere dominance for all language functions. Therefore, reading

disability was often accompanied by writing problems, difficulty in recognizing spoken speech and expressive disorders including stuttering. Furthermore, this lack of dominance was often signaled by left or mixed handedness and general clumsiness. A prominent symptom of dyslexia was letter reversal, which Orton termed "strephosymbolia." He explained that visual images stored as mirror images in the nondominant hemisphere were not suppressed by hemispheric dominance, and interfered with the perception of correctly oriented images stored in the dominant hemisphere. Both Orton and Hinshelwood believed that reading disability was a unitary disorder, and that it was caused by disruption of the normal functioning of the visual memory center for words.

Additional single-syndrome theories of dyslexia:

Other proponents of a single-syndrome view of dyslexia have attributed the disorder to poor perceptual-motor integration (Drew, 1956; Kephart, 1960; Cruikshank, 1968; Frostig and Maslow, 1973), a maturational lag (Bender, 1975; Delacato, 1959; Smith and Carrigan, 1959), directional confusion (Hermann, 1959) and temporal missequencing of verbal stimuli (Bakker, 1970).

Multiple-subtype theories of dyslexia:

Much of the reading disability literature suggests that there are multiple subtypes of dyslexia. Developmental dyslexia subtypes have largely been based on associated symptoms outside of the reading behavior itself. Thus one

finds dyslexia in the presence of visuospatial disorders, language disorders, and motor disorders (Mattis, Rapin, and French, 1975; Mann and Suiter, 1978; Petrauskas and Rourke, 1979). While Boder has formulated subtypes based on spelling errors, no dyslexia subtyping scheme has been based on actual reading errors. This is curious, and may account for the lack of common agreement regarding subtypes among clinicians. There is a wide variation in the number and nature of subtypes claimed by investigators (Birch, 1962; Kinsbourne and Warrington, 1963; Johnson and Myklebust, 1967; Boder, 1973; Mattis, French and Rapin, 1975; Doehring and Hoshko, 1977; Pirozzolo, 1979). Many investigators, unable to fit all the subject profiles into their subtype schemes, have included "mixed" subtypes (e.g. Ingram, Mann and Blackburn, 1970; Denckla, 1972; Boder, 1973; Petrauskas and Rourke 1979).

Criticisms of multi-syndrome theories:

Jorm (1979) has argued that in the absence of reliable evidence for subgroups, it is more parsimonious to view dyslexia as a unitary syndrome. Vellutino (1979) has argued that language deficits underlie all subsets of dyslexia, and that assorted associated symptoms are simply co-occurrences, but are not causally related. Liberman et al (1971) and Vellutino (1987) have presented evidence that even so-called "visuo-spatial" errors are language based. Fletcher and Satz (1980), in a longitudinal study, have demonstrated that the symptoms of dyslexia are age-related, rather than stable

entities. They found that sensorimotor-perceptual skills were far more critical to normal reading development at ages 5-7 than ages 10-12; whereas, verbal-conceptual skills were far more critical to normal reading achievement at ages 10-12 than at ages 5-7.

Alexia subtype theories:

The adult alexia literature appears to portray more consistent sub-syndromes (Coltheart, 1980; Marshall and Newcombe, 1980), including deep dyslexia and surface dyslexia, which are based on a "dual route" model of reading. Deep dyslexia, characterized by the ability to read concrete nouns, limited ability to read abstract nouns and function words, inability to read nonsense words and semantic errors, is thought to indicate exclusive reliance on "whole word" approaches to reading, due to impairment in the phonetic decoding route. Surface dyslexia, characterized by an ability to read phonetically regular and nonsense words and the regularization of irregular words, is thought to indicate exclusive reliance on phonetic decoding due to impairment in the "whole word" route to reading. Other alexic subtypes that have been proposed include phonological dyslexia, in which there is impairment of the phonological route but no deficit for any particular class of words (Shallice and Warrington, 1980); literal alexia, the inability to read letters with relative preservation of ability to read words; verbal alexia, the inability to read words, with relative preservation of

ability to read letters; and global alexia, the inability to read letters or words (Albert, 1979). Over the course of recovery from brain injury, the symptoms of alexia may change from one subtype to another (Obler, 1984).

The currently popular acquired alexia subtypes make no claims regarding etiology, underlying brain substrates or non-reading-related associated symptoms. Marshall and Newcombe (1980) emphasize that their dyslexia subtypes do not necessarily correlate with particular loci of lesions or aphasia subtypes. They are strictly descriptive labels, based on errors that occur when the individual attempts to read. This is somewhat analogous to current aphasia typologies, which categorize a patient based on his language behavior rather than locus of lesion (though there are strong correlations between the two). In contrast, alexia subtyping which emerged in the earlier literature such as "pure alexia" and "alexia with agraphia," focussed more on neuroanatomical substrates than on particular characteristics of reading behavior.

Biliteracy:

Do orthographies affect reading processes?

Languages are written in a variety of orthographies. What effects might these orthographic variations have on basic reading processes and the acquisition of reading skills? How

different might the cognitive prerequisites be for reading in two different orthographies?

In a widely cited study, Rozin, Poritsky and Sotsky (1971) taught a group of second-grade nonreaders to read English through the use of Chinese characters. This raised several very important questions: Is reading failure particular to a language system? Are some orthographies easier to read than others? Is dyslexia related to the manner in which writing systems represent the spoken languages? What levels of information processing are universal and which are particular to specific orthographies (i.e. feature extraction, letter identification, word recognition, etc.)?

Orthographic Constraints:

Readers of a logography are faced with the problem of memorizing a huge number of distinctive characters, but each has a direct link to meaning. Syllabaries reduce the number of graphemes by representing units at the level of the syllable. While more abstract than the logogram, the syllable is easily perceived and invariant. For a beginning reader, the one-to-one correspondence between each symbol and each perceived sound makes the translation of visual arrays into the familiar speech code much easier. The difficulty arises with the increasing number of symbols that must be learned to establish fluency.

Alphabetic scripts require the fewest symbols, but each may or may not be associated with an invariant sound, and

letters may require blending to form perceivable sound units. Both grapheme-phoneme correspondences and morphology may have varying degrees of stability in relation to the oral language. While this degree of abstraction may be optimal for fluent readers who have mastered the "rules" necessary to extract sound equivalents and meaning from the script, it likely poses more difficulty for beginning readers who must learn to analyze the written language on multiple levels (Tzeng, 1980).

What readers of all types of script have in common is that they must learn the particular script-speech relation embedded in the orthography they are attempting to master. It makes sense then, that linguistic awareness of one's own language is a prerequisite to successful reading acquisition (Liberman et al, 1980).

Normal biliteracy processing: analogous or different?

The key question is whether or not the same brain substrates support multiple languages. Pavio (1971) has convincingly demonstrated that the meanings of words and pictures are recovered using different processing routes. Might it not also be the case that, for example, logographies are processed differently than alphabetical orthographies? Some have argued that logographies, because they are pictures, are processed by the right hemisphere (Coltheart, 1980); whereas, alphabets are processed by the left hemisphere. Others have argued that even among different alphabetic languages, separate brain substrates store and process each

orthography (Kolars, 1978, 1979), while others have insisted that different languages share the same brain areas, and pool semantic stores (McCormack, 1976,1977).

A paradigm that has been used to explore the question of whether different orthographies are read in analogous or different manners is the Stroop Test. The Stroop Test is an interference paradigm which requires the subject to name the color a word is printed in while the word, itself, is the name of a different color (e.g. BLUE is printed in green ink.) In the bilingual versions, the subject must name the color in one language, while the word is written in a different language. The greatest interference (reading the word is more salient than identifying the color of its print) occurs in a monolingual situation. However it has been demonstrated that in a bilingual situation, the degree of interference varies according to the written language (Fang, Tzeng and Alva, 1981). For example, Fang, Tzeng and Alva found that French-English paradigms produced greater interference than Chinese-English. They concluded that the bilingual interference differences reflected the degree of similarity or difference between processing strategies used in the two languages involved. While they clearly demonstrated an interaction between paired orthographies and the bilingual Stroop effect, this paradigm utilizes single words only, and may not involve the same processing strategies utilized in the reading of textual material. For the biliterate individual

it is important to consider what differences he faces when he attempts to read in a second language. Are his reading strategies analogous in both languages, or do the orthographic differences impose different strategy requirements as well?

Childhood dyslexia in Eastern vs. Western language systems:

With regard to childhood dyslexia, Makita (1968) claimed that less than 1% of Japanese children had reading disabilities, as opposed to approximately 10% of Western children. She attributed this finding to orthographic differences between Japanese and Western languages (Kana, which the children learn first, is highly transparent, having a 1-1 correspondence between phoneme and sound). Similarly, Tzeng and Hung (1980) spoke of the rarity of reading disabilities among Chinese children. This finding, together with that of Rozin et al (1971) may be attributed to the straightforward and concrete nature of learning Chinese characters, where each symbol represents a single morpheme, and inflections are not represented in either the spoken or written language. However it should be noted that both Makita's study and that of Tzeng and Hung were simply surveys based on questionnaires sent to classroom teachers, asking them how many children had difficulty reading for reasons other than low intelligence, sensory deficits and behavioral problems. There were no objective measures used to obtain indices of reading achievement. Furthermore, with regard to Rozin et al's study (1971), it is important to note that the

ability to learn a limited number of Chinese characters does not make one a proficient reader of Chinese. The essential difficulty of learning Chinese is the sheer magnitude of distinctive characters that must be mastered to achieve fluency. Thus the "success" of teaching second-grade nonreaders of English to read less than what would be required of a first grade Chinese student does not provide adequate evidence that Chinese is in fact an easier language to read.

As yet there is no convincing evidence to support the rarity of reading disability in one type of orthography over another. It is reasonable to speculate, however, that at different stages of acquisition, reading may be more or less difficult due to the nature and constraints of the orthography in which instruction is taking place.

Bilingual Dyslexia:

Kline and Lee (1972) compared the prevalence of reading disabilities in Chinese and in English among Chinese children simultaneously learning to read both languages using objective reading tests. Among first graders, 78% of the children were judged as reading disabled in either English, Chinese, or both (25%, 21%, and 32%, respectively). While these numbers dropped in each succeeding grade (42% total dyslexics in grade 2; 10% in grade 3), the authors' conclusions were based on a summation of the performances of all "dyslexic" children in the study (i.e. 78% of the first graders, 42% of the 2nd graders, 10% of the 3rd graders). Since it is unlikely that

for example, 78% of the first graders were dyslexic by current standards, the conclusions do not likely reflect the performance of a pure dyslexia group but rather a group of dyslexic and "other" children, consisting of many more seven than nine year-olds. The question must be raised as to the validity of their dyslexia index because of the enormous number of children overall found to have a reading disability, and especially in light of the authors' claim that this was one of the highest performing school districts in Vancouver. Nevertheless, regardless of the criteria they used to determine dyslexia, among children learning to read these two fundamentally different orthographies a subgroup of children who showed impairment in both languages was detected. Possibly, then, at least some form of dyslexia presents across orthographies, regardless of their differences. Furthermore, in Kline and Lee's study, the incidence of dyslexia in Chinese only (13% across all grades) was greater than the incidence of dyslexia in English only (9% across grades), calling into question the claim by others (e.g. Tzeng and Hung, 1980) that the incidence of dyslexia is lower in Chinese. Finally, Salili (1987) claimed that while the nature of reading disability involved in the Chinese dyslexic might be different from that of the English dyslexic, the actual prevalence may not be very different. She stated that the traditional failure to recognize the problem of reading disability in the Chinese community may be related to a belief that failing

children are simply "lazy" and therefore are not included in the surveys of dyslexia.

A comparison of reading errors committed in Tamil, a phonetically transparent orthography, and English was made using 40 high school students in Southern India as subjects (Aaron, 1982). Tamil was their native language and English had been studied for a minimum of three years. Aaron predicted that the students would use the same reading strategies in both languages, which would be apparent from the types of errors they committed in each language. However his broad error categories were probably inadequate indices of reading strategies. For example, all omissions and substitutions of any word or word parts were categorized as "agrammatic" errors. Thus the omission or substitution of a suffix was considered the same error type as the omission or substitution of a word, regardless of the type of substitution (e.g. semantic or phonemic paralexia). Because most reading errors consist of the omission or substitution of part of a word or an entire word, such a category is not discriminatory. Thus, it is not surprising that he found a very high correlation ($r=.92$) between "agrammatic errors" in English and in Tamil. While the author's conclusion that his study demonstrated analogous reading strategies in the two orthographies is unwarranted, his finding that the five boys who committed the highest number of errors in reading English also committed the highest number of errors in Tamil suggests a positive

correlation between reading achievement in the two languages, despite their different orthographies.

Bilingual Alexia:

Several case studies have been reported in brain-damaged Japanese persons that found dissociations between the ability to read in Kana, a phonetic script, and in Kanji, a logographic script (Sasanuma, 1980). In most studies of aphasic patients, a selective impairment of Kana processing is evident, while Kanji reading is largely intact. Some few patients have shown the opposite pattern of impairment. Sasanuma (1980) has interpreted these findings as demonstrating that different information-processing strategies are required depending on the different task demands imposed by the scripts. Coltheart (1980) suggested that Kana processing depends on the left hemisphere, while Kanji processing depends on the right hemisphere.

Not all cases of alexic dissociations reported in the literature involve differences between logographies and phonologic scripts. For example, a case was reported of a Japanese-German bilingual who, three months after suffering a left CVA, read best in Kana, worst in German (despite the fact that it, too, is largely phonetic), and read intermediately in the Kanji script (Obler, 1984). He showed full recovery (except for some comprehension problems in German) at 21 months post-onset. Unfortunately, the exact locus of lesion and ages of acquisition of each language,

manner of acquisition and subsequent use were not reported. These factors may play an important role in the symptomatology and recovery following brain damage (Lambert, 1981; Kinsbourne, 1981; Vaid, 1981; Krashen, 1977).

Evidence against left-vs-right hemisphere hypothesis:

Investigators, using tachistoscopic hemifield techniques, have explored the possibility of left vs. right hemisphere processing of various orthographies. A superior left hemisphere performance with Kana symbols, and right hemisphere performance for Kanji characters was reported by Hatta (1977). However a left hemisphere superiority with Chinese characters was reported by Hardyck, Tzeng and Wang (1977). A follow-up study of Tzeng, Hung, Cotton and Wang (1979) found a right hemisphere superiority for Chinese characters when single characters were presented, and a left hemisphere superiority for two or more characters joined in a phrase. They interpreted their findings as reflecting the function-specific property of each hemisphere rather than the orthography-specific localization hypothesis. Elman, Takahashi and Tohsaku (1981) demonstrated further that even with single characters, only the simple naming task showed a right hemisphere advantage. The same characters, used with a grammatical classification task, produced a left-hemisphere advantage.

Parallel impairment and recovery in bilingual alexics:

A Slavic-German-Hebrew polyglot who suffered a left

posterior cerebral artery AVM, was studied and reported by Sroka, Solsi and Bornstein (1979). The patient developed pure alexia (without agraphia) in all three languages, reading letter-by-letter only in each script. The same types of reading errors occurred in each language, and recovery in all three languages proceeded in parallel. Similarly, a case of Weisenburg and McBride (reported in Obler, 1984) demonstrated phonological alexia in all five of the patient's languages: English, Spanish, French, Italian and German.

While Albert and Obler (1978) cited multiple examples of dissociations in alexia across two or more languages, they claimed that "group studies of polyglot aphasics... suggest that cases of different patterns in the several languages are in fact rare; the average polyglot will lose and recover both languages with the same deficits, and to the extent that she previously knew them" (Albert and Obler, 1978, p.95). They did not specifically cite the studies to which they refer, so one cannot assess the validity of their conclusion. A recent review of all published studies of consecutive unselected cases of bilingual aphasia (Solin, 1989) confirmed that "parallel language impairment and recovery ... predominate statistically over all other modes of restitution combined." The individual studies which report differential impairment and recovery, according to Solin, represent a selection bias in favor of exceptional cases. This point has also been made by Vaid (1983) and Zatorre (1983, cited in Solin, 1989).

In sum, no convincing evidence that fluent reading in the various orthographies involves different brain loci exists, though the processing strategies may or may not differ, and may have at least as much to do with the demands of the task as with the orthographic differences.

Reading Predictors:

Essentially, reading predictors are correlates of reading achievement. Ideally they involve behaviors that are observable or performances on tasks that are easily administered at a prereading stage. They are used primarily to identify children "at risk" for reading disabilities when remediation can be most beneficial. In fact, while many have questioned the necessity and sufficiency of behavioral symptoms associated with dyslexia for subtyping the disorder, these correlates, once validated, are perhaps most useful when viewed as predictors, rather than symptoms, of dyslexia.

Two major viewpoints:

Two major points of view regarding the critical processes involved in reading have led to the development of predictive measures. The most popular viewpoint over the last century has been that reading is primarily dependent upon perceptual abilities; therefore, assessment of the preschooler's perceptual functioning will predict to performance in reading. A more recent, but currently popular model, assumes that

reading is primarily a language-based activity; therefore, measures of language functioning will serve as better predictors of future reading performance.

Perceptual deficit theories:

Three theories stress some form of perceptual deficit as a predictor of reading failures. The most popular has focussed on deficiencies in visual-spatial organization (Orton, 1925, 1937; Bender, 1956, 1957; Silver and Hagin, 1960). Figure drawings and matching tasks have most often been used to assess visual-spatial perception and to predict to future reading achievement (Bender, 1938; Benton, 1955; Frostig, 1961; Koppitz, 1964; Ilg and Ames, 1965; Ayres, 1968; Gardner, 1978). Some investigators have considered auditory processing deficits to be the most critical causes of reading dysfunction and have created predictor tests accordingly (Wepman, 1958; Kirk and McCarthy, 1968). A third offshoot of the perceptual deficit model considers reading to be primarily dependent upon integration of various sensory modalities, and tests of intersensory integration have been developed and used as reading predictors (Birch, 1962; Beery, 1967; Kahn and Birch, 1968; Ayres, 1968; Shipley and Jones, 1969; Lefford, Birch and Green, 1974; Hutchinson, 1983).

Evidence against perceptual deficit theories:

During the last 25 years, challenges to the perceptual theories of reading have proliferated. Reexamination of early studies that had purportedly supported perceptual hypotheses

revealed questionable subject selection criteria, methodologies, and interpretation of the data (Vellutino, 1979). With better controlled studies, results have not supported the perceptual hypothesis. For example, the Bender Gestalt Test (Bender, 1938), the Goodenough Draw-A-Person Test (Goodenough, 1954), and the Frostig Test of Visual Perception (Frostig, 1961) were administered to 20 normal and 20 poor 9-10 year-old readers of average to above average intelligence (Nielsen and Ringe, 1969). Groups were matched for age, IQ, sex, and socioeconomic background. Although poor readers received high error scores more often than normal readers on the Bender Gestalt test, 13 poor readers performed within normal limits. The groups performed equally well on the Draw-A-Person and Frostig Tests.

Satz, Taylor, Friel and Fletcher (1978) tested a sample of Caucasian, male kindergarten children on several "predictive" measures which were mostly perceptual-motor in nature. Reading achievement was evaluated annually from first through fifth grades. They hypothesized that dyslexia was caused by a general maturational lag, characterized early in development (ages 5-8) by perceptual dysfunction and only later (ages 9-12) as language and conceptual deficiency. They found that finger localization was their best reading predictor followed by alphabet recitation. However, upon replication with a mixed group of subjects including Black and Caucasian, male and female kindergarten children,

socio-economic-status was the single best reading predictor followed by alphabet recitation. Although they demonstrated that their kindergarten-administered perceptual battery had nearly dropped to chance level at predicting reading failure in 5th grade, they did not examine language function and "conceptual development" to test the other part of their hypothesis.

Jansky and de Hirsh (1972) tested 401 kindergarten children from diverse ethnic and socioeconomic backgrounds on 19 linguistic, visuo-spatial, and auditory processing measures. The best predictors of second grade achievement were letter naming, picture naming, and all measures of verbal functioning. Although results of the Bender-Gestalt Test also correlated significantly with reading achievement in second grade, a test of figure-ground perception did not, which raises the question of whether the Bender was measuring perceptual organization, as has often been claimed, or some other function.

Denckla, Rudel and Broman (1981) administered tests of target detection, temporal-spatial and temporal-temporal matching, Rapid Automatized Naming (RAN), picture naming, and oral reading to 10 dyslexic and 10 carefully matched non-dyslexic learning disabled boys ages 8-10. They found that the best discriminator between groups was the percentage of perceptual errors on the picture naming task (characteristic of non-dyslexic, learning-disabled children).

The dyslexic boys, in contrast, made far more slow, circumlocutory, or paraphasic errors on the picture-naming task, suggesting a language-associated disorder rather than perceptual dysfunction. Furthermore, while dyslexic boys were significantly slower at naming repeating numbers, letters, and pictures on the RAN, the non-dyslexic, learning-disabled boys were significantly worse at temporal-spatial matching. Unfortunately, this study did not include a normal control group with which to compare performances of the two learning-disabled groups. It may be the case that dyslexic boys are impaired on spatial tasks relative to normals, but less so than non-dyslexic learning-disabled boys, or it may be the case that they have normal spatial perception. Results of a comparison with a normal group of children would support or refute a perceptual-deficit theory of dyslexia.

Extensive studies conducted by Liberman, Shankweiler et al (1971) demonstrated that optical shape perception and memory for ordered sequences of visually presented stimuli, while clearly essential for the reading process, are not the primary loci of difficulty in beginning reading. Orientation reversal errors, which are thought to reflect such a failure in visual processing, usually disappear by age eight. Even before that time, reversal errors represent only a small and unstable proportion of all errors, even when subjects are asked to read lists of words designed to provide many opportunities for such errors. Liberman and Shankweiler

found, further, that letter reversal errors did not correlate with other types of reading errors. Sequence reversals, which are less strictly visually based, did, however, correlate with other error measures.

In order to tease apart the visual from the phonemic bases for reversal errors, Liberman et al (1971) presented children beyond the first grade with single, reversible letters (e.g. b,d,p,q) tachistoscopically. Under these conditions they were found to make fewer errors than when reading words. If predominantly visual factors were the basis of reversal confusions, they reasoned, one would have expected more errors to be made in the tachistoscopic presentation. Further evidence to support their contention came from the observation that reversal errors, when they do occur, are phonetically based rather than symmetrical. That is, the letter "b," for example, is often confused with "p" as well as with "d," but "d" is almost never confused with "p."

Vellutino (1987) examined poor readers in second through sixth grades on a copy task. They were asked to copy designs, words, scrambled letters and numerals following tachistoscopic presentation. Afterwards they were asked to name the stimuli that were actual words. He found that while they copied words in the correct sequence and letter orientations, they often named them incorrectly. For example, they correctly copied "was," but called it "saw." He concluded that this was not an error of visuo-spatial functioning, but reflected

difficulty in storing and retrieving the names of printed words. Similar results were found in a study of dyslexic and normal readers who were asked to print unfamiliar Hebrew words and letters in their proper sequence and orientation after a brief exposure. A third group of children, familiar with Hebrew, were also tested as a control. Vellutino found that the dyslexic readers did as well as the normal children, though neither group performed as well as the group that was familiar with Hebrew. Vellutino concluded that when complex, wordlike symbols lacked linguistic associates, the visual recall of those symbols was the same for normal or dyslexic subjects. Since those familiar with the linguistic symbols demonstrated superior recall, it was further concluded that memory for visual symbols which represent linguistic units are mediated by their linguistic properties (meaning and sound-equivalents).

First and third grade American children learning Hebrew as a second language were examined in a study of the importance of visual and language factors as sources of difficulty in beginning reading (Borck, 1983). Because of the high degree of visual confusability among many Hebrew letters, Borck reasoned that if optical shape recognition is a source of difficulty in beginning reading, early readers should make many errors on a Hebrew text, and Hebrew reading ability should be highly correlated with performance on a visual discrimination task. Nevertheless Borck found that success

on visuospatial tasks did not correlate with reading in either Hebrew or English. She then administered a phoneme reversal task, which correlated significantly with reading achievement in both English and Hebrew.

Language deficit theories:

Increasing numbers of well-controlled studies have found that measures of linguistic abilities most consistently correlated with later reading achievement. For example, 54 carefully selected 7-13 year-old dyslexic boys were examined on a variety of measures (Symmes and Rapoport, 1972). Subjects were found to be average to above average in intelligence, as measured by the WISC, above average on tests of visuomotor functioning, and significantly below average on language tests.

Liberman et al (1974) demonstrated that the ability to do a phoneme segmentation task in kindergarten is highly correlated with reading ability in first grade. This correlation has been replicated in a number of subsequent studies (e.g. Helfgott, 1976, Zifcak, 1976). In addition to tasks that measure phoneme awareness (Liberman et al, 1977), performances on several other aspects of linguistic skills have been compared using good and poor readers. For example, Fry et al (1970) found that normal second grade readers used more syntactically complex sentences in their oral language production than did poor readers in the same grade. Significant correlations between reading ability and a

morphology completion task were found among first and second graders (Brittain, 1970). Morphological awareness in good and poor 9-year-old readers and "high-risk" and "low-risk" 4-year-olds was examined (Wiig et al, 1973). Poor readers were not only worse overall in morphology completion, but their responses were more erratic than normal readers, whose errors reflected incorrect rule-generalization. Furthermore, the "high-risk" 4-year-olds were poorer at the task than their "low-risk" peers. The greatest discriminators in both samples were possessives, adjectival inflections and third-person singular verbs. A comparison of normal and poor fifth graders on a Cloze procedure revealed that poor readers not only made more errors on the test than their normal reading peers, but also gave more idiosyncratic responses, demonstrating a poor awareness of syntax (Cromer and Wiener, 1966).

Several studies have pointed to the relatively impoverished vocabulary of poor readers. For example, studies by Fry and Schulte (Fry et al, 1970) demonstrated that poor second grade readers had poorer speaking vocabularies and general fluency than normal readers. The studies by de Hirsh, Jansky and Langford (1966) and Jansky and de Hirsh (1972) found that several verbal measures including vocabulary, tested in kindergarten, predicted to second grade reading achievement. Ravenette (1961) also found significant positive correlations between vocabulary measures and reading, writing, listening and speaking skills.

In sum, evidence supporting the contention that perceptual dysfunction is the basis for reading disorders is less convincing than studies which indicate that reading is primarily dependent upon linguistic functioning. As Vellutino points out (Vellutino, 1979), this is not surprising since three of the five types of featural information contained in a printed word (graphic, orthographic, semantic, syntactic and phonological) are major components of language. Numerous studies have demonstrated that tests of phonological segmentation, morphology, syntax and vocabulary, administered at a prereading level, reliably predict to future reading achievement.

CHAPTER III

RATIONALE FOR CHOOSING ENGLISH AND HEBREW:

To minimize positive and negative transfer of learning between the two languages, it was decided to choose orthographies that differed in their alphabets, phonologies, and grapheme-phoneme correspondences, while still allowing for similar kinds of errors to be available in each script. Errors serve as "windows" through which reading strategies can be inferred. For example, errors can indicate use of phonetic vs. whole word approaches. They reveal classes of graphemes and morphemes that cause particular difficulties, and visuospatial disturbances.

Comparison of English and Hebrew:

Phonetic Characteristics:

English orthography lacks transparency; i.e. the letters of the alphabet are not in a strict one-to-one correspondence with the phonemes of English. The 26 letters, singly and in combinations, represent about 40 different phonemes, though there is considerable overlap (Ward, 1972). For example, "p" has one sound that is usually associated with it (e.g. as in "pip"), but combined with an "h" may sound like an "f", as in "physics." P may also be silent as in "pneumonia" and "raspberry." The digraph "gh" is silent in "dough," sounds

like an "f" in "cough," a hard "g" in "ghost," and a "p" in "hiccough." The five vowel letters in English have even greater variation in their sound correspondences as they represent 12 pure and 9 diphthong phonemes (Ward, 1972). For example, "a" can be long, as in "fate," short, as in "hat", broad, as in "father," and unstressed, as in "about." In general, English orthography preserves morphology over phonetics. Thus "dogs" and "cats" are both pluralized by adding an "s", even though the pronunciation of the "s" differs in the two words. Similarly, "ed" is pronounced differently in "wished" and "wanted."

While phonetic "rules" allow phonetic decoding of many English words, many "exception" words can be pronounced correctly only through recognition of the word as a whole. Therefore, skills in both phonemic decoding and whole word recognition are necessary to become a fully proficient reader of English. Among beginning readers, preferential use of one approach over another (whole-word vs. phonetic) may reflect teaching methods (Chall, 1967) or developmental stages of reading (Fletcher and Satz, 1980; Coltheart, 1983).

In contrast to English orthography, the Hebrew script that is presented to beginning readers is phonetically regular. There is only one sound associated with each vowel, and the few consonants that have two possible sound associations are marked accordingly (Rosen, 1977). Therefore, phonetic decoding skills suffice for the beginning reader of

Hebrew.

Visual Characteristics:

The manner in which consonants and vowels are represented differs significantly in the two orthographies. In English both consonants and vowels are represented by letters, but in Hebrew most of the vowels are signified by small diacritical marks, printed mainly below the letters but sometimes to the left or diagonally above the letters. The letters, in turn, carry mostly consonantal information. The full writing system is taught in the first and second grades of school and is used mostly in prayer books, children's books, and poetry. Most other written materials are unvowelized. Toward the end of the primary school years (generally mid-late 3rd grade in American Hebrew Day Schools), the children are introduced to the unvowelized Hebrew textual material. At this point they can no longer rely on phonetic decoding, but must access pronunciation through the visual configuration of the consonant string.

In both English and Hebrew, some sounds have more than one letter equivalent. For example, an "es" sound in English could correspond with either an "s" or a "c". The vowel sound "oo" may correspond to a "u" or an "oo." Whereas in English a given letter only sometimes mimics the sound of an alternate letter, in Hebrew, two or more letters consistently represent

a single sound. For example, the following pairs and triplet group represent a single sound per set:

Similarly, vowel sounds are represented by more than one vowel mark (e.g. ם, ם, ם, ם, ם and, according to some pronunciations, ם, ם, ם, ם, ם) in Hebrew. Thus, while phonetic errors cannot occur in Hebrew reading, they can occur in Hebrew spelling.

Most of the phonemes in Hebrew have equivalent sounds in English, but there are a few that differ significantly. The Hebrew "r" (ר) is pronounced with a trill. Three letters (ך, ך, ך) are pronounced like the ch in the German Bach. Two letters (צ, צ) are pronounced "tz." Certain letters or letter-dot combinations may signify a glottal stop (ך, ך, ך). English sounds that are not present in Hebrew include the "j," (which would be pronounced "y" in Hebrew), "qu," a non-trilled "r," "w," and "x."

Hebrew print does not have spatially reversible letters as in English (p,b,d,q), but some of the letters are quite visually similar to one another (ך, ך, ך, ך, ך), allowing for visual confusability. Furthermore, the vowel marks, consisting mainly of dots and dashes, differ only in the number, configuration, and orientation of the symbols, allowing for "spatial" confusions (ם, ם, ם, ם, ם, ם, ם, ם, ם). English and Hebrew are read in opposite directions; English is read left to right, while Hebrew is read right to left.

Morphologic Characteristics:

Most Hebrew words are formed by inflection of a root which usually consists of three consonants. Thus there is a high degree of orthographic similarity among semantically related words, some of which are identical without vowels to distinguish them. Therefore in an unvowelized text, correct pronunciation is often dependent upon contextual cues. In fact, while reaction time studies have demonstrated that in English naming is faster than lexical decision, the inverse relation occurs in unvowelized Hebrew (Bentin and Bargai, 1984). Furthermore, Hebrew is extremely polymorphic, i.e. a single noun may encode an entire phrase including preposition, subject and object, and a single verb encodes person, gender and tense. One might speculate that the combination of a lexicon based on root-word semantic networks and an unvowelized script would encourage a direct, lexical access strategy, rather than a phonetic approach which may have been preferred during initial reading stages.

In sum, both Hebrew and English are alphabetic scripts, though the letters in Hebrew represent consonants only, and they and the vowel marks are more visuospatially confusable than the letters of English. In its vowelized form, used in the early elementary school grades, Hebrew is phonemically transparent; whereas, English is morphophonemic, and many common English words do not follow phonetic "rules." In its

unvowelized form, Hebrew becomes more opaque than English, and many words require meaning to be accessed before pronunciation can be determined.

English and Hebrew orthographies have enough in common to allow for similar reading errors, yet are different enough in their orthographic demands that one might expect to observe different strategies used in beginning reading and at a more proficient level of reading.

HYPOTHESES

1. Reading achievement in English and reading achievement in Hebrew are positively correlated with each other.
2. A phonetic approach to reading in English and a phonetic approach to reading in Hebrew are positively correlated with each other.
3. A "whole word" approach to reading in English and a "whole word" approach to reading in Hebrew are positively correlated with each other.
4. English linguistic awareness tasks administered in kindergarten will predict to English reading achievement in first and second grades.
5. English linguistic awareness tasks administered in kindergarten will predict to Hebrew reading achievement in first and second grades.
6. Average readers will make more vowel errors in English than in Hebrew. However, children who make significantly more than average spatial errors in English will make more vowel errors in Hebrew than in English.

CHAPTER IV

PILOT STUDY

Introduction:

A comparison of reading and spelling performance in English and Hebrew was conducted as a pilot study. Twenty-three Hebrew Day School students in grade 4 were tested in single-word reading, passage reading and spelling in English and Hebrew. Fourth graders were chosen as subjects because they were experienced in reading and writing Hebrew both with and without vowels. Because vowelized Hebrew is highly phonetic and unvowelized Hebrew requires whole-word strategies to decode, it was thought that a comparison between reading and writing in the two forms of the script might yield significant insight into individual reading strategy preferences. For example, if real words were read equally well in both vowelized and unvowelized scripts, one might hypothesize either equal proficiency in phonetic and whole-word approaches or proficiency in whole-word approaches that were applied to both types of scripts. This question could be further investigated by contrasting reading proficiency of real words with nonsense words. If nonsense words (vowelized) were read proficiently, one could surmise that phonetic skills were intact, and were therefore available for use with real vowelized words as well. If real words were

read better than nonsense words, one could surmise that a whole-word approach was favored for reading both vowelized and unvowelized real words. Similarly, English reading strategies could be surmised through an examination of relative reading achievement with real words and nonsense words. In addition, the ratio of phonetic to non-phonetic English reading errors would lend insight as to the reading strategy favored when confronted with an unfamiliar word. It was hypothesized that phonetic errors would occur when a phonetic reading strategy was used. Other reading errors, including real word substitutions and spatial errors, which occur in both English and Hebrew, were hypothesized to occur more frequently in the presence of "whole word" strategies.

Subjects:

Subjects were 12 girls and 11 boys, ages 9.0 - 10.3 years, who were tested during December of their fourth grade year. All were American-born children, living in middle to upper middle class suburbs of New York City. The predominant language spoken in all homes was English, although one child had an Israeli father and another spent summers in Israel. All children had attained a minimum IQ of 115 on the WPPSI, administered between kindergarten and first grade as part of the school's admissions procedure. Five children used their left hands to write, and their left handedness was confirmed

by self report.

Materials and Procedure:

Reading:

English words consisted of regular, exception, and nonsense words (Woodcock Reading Mastery Tests, 1973: Word Identification; Word Attack). Hebrew words were vowelized real and nonsense words, and unvowelized real words. English oral and silent reading passages were part of the Durrell (1955). Oral and silent Hebrew reading passages were taken from Hebrew readers (Roan, 1965).

Spelling:

English spelling words consisted of regular, irregular, and nonsense words (Goldman-Fristoe-Woodcock Auditory Skills Test Battery, 1974: Spelling of Sounds). Hebrew spelling words were selected from Hebrew elementary readers and consisted of familiar vocabulary words ranging from one to three syllables in length. Vowels were required for half the words and were optional for the other half. The Hebrew nonsense words were the same as those given in English and they had to be written in vowelized form.

Predictor Tests:

These tests examined English and Hebrew auditory discrimination, phonemic analysis of nonsense words (Goldman-Fristoe-Woodcock Auditory Skills Test Battery, 1974:

Sound Analysis), English and Hebrew fluency, English homonyms (using the word in a sentence to show its meaning), and English syntax and relational terms.

Except for the 10-minute group administered spelling test, subjects were tested individually by the same examiner in a private area of the school on the 65-75 minute battery. The testing was completed in one session for 20 students; three children required two sessions.

Error Subtypes:

Error categories were determined a posteriori from the data in order to describe the types of errors made. **Phonetic errors** included regularizations of irregular English words according to the rules of pronunciation that normally apply. Examples included: "anarchee" for "anarchy," "sulfuric" for "sulphuric," and "balmy" (pronouncing the "l") for "balmy." **Real word substitution errors** were errors that resulted in the substitution of a real word for the target word. Examples included: "product" for "produce," "soupy" for "soapy," and "clearly" for "clerical." **Non-phonetic errors** included all errors that were neither phonetic nor real word substitutions. Spatial errors were included in this category as were otherwise unclassifiable errors such as: "que-le-flower" for "cauliflower" and "causatin" for

"causation." **Spatial errors** were misreadings of a target word due to the rearrangement of letters or syllables within words or the omission of a syllable entirely. Examples included: "radiocativity" for "radioactivity," "vecle" for "vehicle" and "managese" for "manganese." Some responses qualified as both real word substitutions and spatial errors, e.g. "form" for "from," "replace" for "relapse" and "caution" for "causation." A **vowel error** was the misreading of a vowel, as in "lagon" for "lagoon" or "instegutor" for "instigator." A **consonant error** was the misreading of a consonant, as in "physikin" for "physician" and "frigid" (hard "g") for "frigid."

A misread word usually qualified for more than one type of error. All spatial errors were non-phonetic errors. Phonetic, non-phonetic and real word substitution errors could be the result of a misread vowel or consonant which qualified them as a vowel error or consonant error as well. While "total number of words read correctly" was quantified, total number of errors was not, as it was the relative types of errors that was considered important. A comparison of types of reading errors in the two orthographies was the main interest.

Similarly, spelling errors in the two orthographies were divided into phonetically plausible (both languages), nonphonetic, spatial and consonant vs. vowel errors. In Hebrew, it was of considerable interest as to which reading

and spelling profiles might correlate with the use of optional vowels in spelling. It was hypothesized that children who showed a more phonetic approach to reading and spelling would use vowels even when they were optional.

Results:

Achievement: Single Word Reading

English:

On the Woodcock Word Identification Test, which consisted of 150 words, scores ranged from 96 to 140 correct responses. The mean raw score was 128.2, which is equivalent to grade 7.1. On the Woodcock Word Attack Test, which consisted of 50 nonsense words, scores ranged from 36 to 50 correct responses with a mean of 46.3, which is equivalent to grade 12.9.

Hebrew:

On the 66 Hebrew vowelized single words, the range of correct scores was 52 to 66 ($x=63.3$, $s.d.=3.5$). The range of correct responses in reading 55 unvowelized words was 25-51 ($x=43.5$, $s.d.=7.1$). On the 46 nonsense words, the range of correct responses was 21-46 ($x=39.8$, $s.d.=6.8$).

Correlations between English and Hebrew single word reading:

Raw scores achieved on reading English real and nonsense words and Hebrew single word reading measures were correlated

using the Pearson r statistic (Table 1). Both English measures were significantly correlated with each other and with Hebrew single word reading of vowelized, unvowelized and nonsense words. These strong interrelationships suggest that proficient English readers were also proficient users of both whole-word and phonetic approaches in Hebrew. Poor English readers were likely poor in both whole-word and phonetic approaches to reading Hebrew. On the basis of overall achievement, there were no obvious trends towards favoring a particular reading approach in single word reading of English or of Hebrew.

Achievement: English and Hebrew Passage Reading

English:

On the oral passage, mean time to completion was 38.8 seconds (s.d.=9.4, range=24-68). Reading errors ranged from 0-7 ($\bar{x}$ =1, s.d.=1.7) and the number of details recalled ranged from 6-20 ($\bar{x}$ =13.7, s.d.=4.4).

On the silently read passage, mean time to completion was 32.5 seconds (s.d.=12.2, range=15-60). Recall ranged from 5 -20 details ($\bar{x}$ =11.9, s.d.=3.7).

Hebrew:

On the vowelized oral passage, mean time to completion was 86.7 seconds (s.d.=28.1, range=53-180). Reading errors ranged from 0-16 ($\bar{x}$ =3.2, s.d.=4.6). Recall ranged from 2 to 20 details ($\bar{x}$ =7.7, s.d.=4.5).

On the unvowelized oral passage, mean time to completion

TABLE 1
Fourth Grade Single Word Reading: Pearson Product-Moment Correlation
Coefficients between English and Hebrew Measures

(n=23)

	<u>Eng</u>	<u>Eng nons</u>	<u>Heb vowel</u>	<u>Heb unvowel</u>	<u>Heb non</u>
English real words	.84**		.69**	.81**	.85**
English nonsense			.74**	.77**	.89**
vowelized Hebrew				.59*	.84**
unvowelized Hebrew					.68**
Hebrew nonsense					

* p<.01

** p<.001

was 110 seconds (s.d.=37.6, range=61-180). Reading errors ranged from 0 to 9 ($\bar{x}$ =4.1, s.d.=4.2). Recall ranged from 0 to 22 details ($\bar{x}$ =9.5, s.d.=7.1). The difference between vowelized and unvowelized oral passage reading time to completion was significant [$t(21)=p<.05$]. This is consistent with expectations, as unvowelized text is more difficult to read than vowelized text.

On the vowelized silently read passage, mean time to completion was 106.3 seconds (s.d.=45.9, range=33-210). Recall ranged from 0 to 18 details ($\bar{x}$ =8.5, s.d.=5.8).

On the unvowelized silently read passage, mean time to completion was 89.8 seconds (s.d.=41, range=17-213). Recall ranged from 0 to 21 details ($\bar{x}$ =10.7, s.d.=12.6). The difference between vowelized and unvowelized silent reading time to completion was not significant [$t(21)=p>.05$], nor was the difference between vowelized oral and silent reading significant [$t(21)=p>.05$].

Correlations between English and Hebrew passage reading measures:

English oral reading time to completion, errors and recall were significantly positively correlated with all corresponding measures in vowelized Hebrew [time: $r(21)=.77$, $p<.001$; errors: $r(21)=.74$, $p<.001$; recall: $r(21)=.49$, $p<.01$]. Time to complete a silently read English passage was significantly positively correlated with time to completion of a silently read vowelized Hebrew passage [$r(21)=.54$,

$p < .01$]. Unvowelized Hebrew passage reading measures were not significantly correlated with corresponding English measures except for oral recall [$r(21) = .58$, $p < .01$].

Correlations between single word reading and passage reading in English and Hebrew: (Table 2)

Time to completion and errors on both English and Hebrew oral passages were significantly negatively correlated with most single word reading measures in both languages. With silent passage reading, recall of Hebrew passages was significantly positively correlated with all single word reading measures. English silent reading recall was non-significantly correlated with single reading measures.

Errors:

Correlations between single word reading errors and single word reading achievement in English and Hebrew:

Correlations between English and Hebrew single word reading errors and English and Hebrew single word reading measures are shown in Table 3. The only significant positive correlations found were between English phonetic errors and reading English nonsense words, Hebrew vowelized words and Hebrew nonsense words (which are also vowelized). This finding suggests that those children who erred in favor of phonetic regularizations in English were also particularly sensitive to the phonetic attributes of Hebrew. This is a

TABLE 2

Pearson Product-Moment Correlation Coefficients between Passage Reading
and Single Word Reading

PASSAGE READING	SINGLE WORD READING		
	<u>English</u>	<u>Vowelized Hebrew</u>	<u>Unvowelized Hebrew</u>
Eng Oral Time	-.75**	ns	-.66**
Eng Oral Errors	-.69**	-.57*	-.66**
Eng Oral Recall	ns	ns	ns
V Heb Oral Time	-.74**	-.57*	-.82**
V Heb Oral Errors	-.75**	-.62**	-.80**
V Heb Oral Recall	ns	ns	ns
U Heb Oral Time	ns	-.52*	-.58*
U Heb Oral Errors	ns	ns	ns
U Heb Oral Recall	.53*	ns	.62*
Eng Silent Time	ns	ns	ns
Eng Silent Recall	ns	ns	ns
V Heb Silent Time	ns	ns	ns
V Heb Silent Recall	.59*	.50*	.66**
U Heb Silent Time	ns	ns	ns
U Heb Silent Recall	.55*	.56*	.64**

* $p < .01$

** $p < .001$

TABLE 3

English and Hebrew Reading Errors: Pearson Product-Moment Correlations with
English and Hebrew Reading Measures
(N=23)

READING ERRORS	READING MEASURES				
	<u>Eng</u>	<u>Eng Nons</u>	<u>Vow Heb</u>	<u>Unvow Heb</u>	<u>Heb Non</u>
English Phonetic	ns	.64**	.53*	ns	.60*
English Spatial	-.66**	-.56*	-.48*	-.68**	-.65**
Hebrew Spatial	ns	-.49*	-.76**	ns	-.56*
English Subst	-.61**	-.56*	-.58*	ns	-.58*
Hebrew Subst	-.55*	-.65**	-.87**	ns	-.74**

* p<.01

** p<.001

subtle indication that reading strategy preferences may be consistent across languages.

Correlations between single word reading errors in English and in Hebrew:

Spatial errors and real word substitution errors were not only associated with the poorer readers of both languages, but the specific error types were also correlated across languages. English spatial errors were significantly correlated with spatial errors in unvowelized Hebrew [$r(21)=.63$, $p<.001$]. Real word substitution errors in English words were significantly correlated with real word substitution errors in vowelized Hebrew words [$r(21)=.60$, $p<.01$], unvowelized Hebrew words [$r(21)=.56$, $p<.01$], and Hebrew nonsense words [$r(21)=.55$, $p<.01$].

Division of Group into Superior and Average Readers:

Single word reading

On English single word reading, 18 subjects scored near or above the group mean of grade 7.1, as their grade equivalent scores ranged from 6.4 to 12.9 (superior), while the remaining five subjects scored well below the group mean with grade equivalency scores of 3.6 to 5.6 (average; Table 4). These five children also scored lowest on the Hebrew reading measures (Table 5). The differences between groups on all single reading measures in English and Hebrew were

TABLE 4
Fourth Grade English Reading: Grade Equivalencies (National) and
Standardized Scores (Self-referenced, N=23; X=100, S.D.=15)

Superior Readers (N=18)			
Subject #	Real Words		Nonsense Words
	<u>Grade Eq</u>	<u>Standardized Score</u>	<u>Standardized Score</u>
2.	7.6	103.2	110.1
3.	6.9	98.6	98.9
4.	6.4	96.4	113.9
5.	11.8	114.5	106.4
6.	12.9	118.0	106.4
10.	8.3	105.5	106.4
11.	9.9	111.1	113.9
12.	9.9	111.1	110.1
14.	6.8	107.0	113.9
15.	9.6	110.0	95.1
16.	11.0	113.4	110.1
17.	12.9	100.9	106.4
18.	7.8	104.3	106.4
19.	8.6	106.6	110.1
20.	10.6	112.3	95.1
21.	7.4	102.0	106.4
22.	7.8	104.3	102.6
23.	7.2	100.9	98.9
	X=8.6	X=106.7	X=106.2
Average Readers (N=5)			
1.	3.6	63.4	72.6
6.	4.2	75.5	61.4
7.	3.6	63.4	65.1
9.	5.2	86.1	91.4
13.	5.6	89.5	95.1
	X=4.4	X=75.6	X=77.1

TABLE 5

Fourth Grade Hebrew Reading: Standardized Scores (self-referenced, N=23
X=100, S.D.=15)

Superior Readers
(N=18)

<u>Subject #</u>	<u>Vowelized</u>	<u>Unvowelized</u>	<u>Nonsense</u>
2.	103.0	111.6	111.5
3.	107.3	98.9	100.4
4.	107.3	94.7	104.9
5.	107.3	109.5	109.3
8.	98.7	105.3	107.1
10.	103.0	109.5	100.4
11.	103.0	111.6	111.5
12.	111.6	98.9	113.7
14.	111.6	111.6	113.7
15.	111.6	109.5	109.3
16.	107.3	111.6	111.5
17.	103.0	111.6	96.0
18.	107.3	101.1	107.1
19.	111.6	107.4	111.5
20.	111.6	115.8	100.4
21.	107.3	111.6	98.2
22.	107.3	105.3	109.3
23.	94.4	73.6	98.2
	X=106.3	X=105.5	X=106.3

Average Readers
(N=5)

1.	81.6	79.9	85.0
6.	51.6	75.7	58.5
7.	90.1	60.9	67.4
9.	98.7	82.0	87.2
13.	68.7	101.1	78.4
	X=78.1	X=79.9	X=75.3

significant (Mann-Whitney U Tests: English: $p < .001$ on all measures; Hebrew: $p < .001$ on vowelized and nonsense word measures, $p < .01$ on unvowelized word measures).

Errors

English:

The numbers of English phonetic, spatial and real word substitution errors and the percentages of each error type differed significantly between superior and average readers (Mann-Whitney U Tests: $p < .05$ for each of phonetic, spatial and real-word substitution errors). As shown in Table 6, superior readers made almost twice as many phonetic errors as average readers, while average readers made more than twice as many spatial and three times as many real word substitution errors as superior readers.

Hebrew:

As shown in Table 7, the number of Hebrew spatial and real word substitution errors differed significantly between groups (Mann-Whitney U Tests: $p < .01$ for spatial and real word substitution errors). Average readers made four to five times as many spatial and real word substitution errors with both vowelized and unvowelized Hebrew words than superior readers. The percentages of each error type did not differ significantly between groups.

TABLE 7

Vowelized and Unvowelized Hebrew Reading Errors Among Superior Reader and Average Reader Groups: Numbers and Percentages of Spatial and Real Word Substitutions

Superior Readers
(N=18)

Subject #	Vowelized Hebrew				Unvowelized Hebrew			
	Raw Scores		Percentages		Raw Scores		Percentages	
	Spat.	R W Sub.	Spat.	R W Sub.	Spat.	R W Sub.	Spat.	R W Sub.
2.	1	0	100	0	0	1	0	100
3.	0	1	0	100	2	2	50	50
4.	0	0	0	0	0	2	0	100
5.	0	0	0	0	0	2	0	100
8.	1	1	50	50	0	1	0	100
10.	0	1	0	100	0	1	0	100
11.	1	1	50	50	0	0	0	0
12.	0	0	0	0	0	0	0	0
14.	0	0	0	0	0	0	0	0
15.	0	0	0	0	0	0	0	0
16.	1	1	50	50	0	0	0	0
17.	2	0	100	0	3	0	100	0
18.	0	0	0	0	0	0	0	0
19.	0	0	0	0	0	0	0	0
20.	0	0	0	0	0	0	0	0
21.	0	1	0	100	0	0	0	0
22.	0	0	0	0	2	0	100	0
23.	0	0	0	0	1	1	50	50
	X=0.34	0.33	43.8	56.2	0.45	0.66	33.3	66.7
	s.d.=0.58	0.47			0.89	0.81		

Average Readers
(N=5)

1.	2	2	50	50	2	4	33	67
6.	4	4	50	50	4	4	50	50
7.	0	1	0	100	3	3	50	50
9.	0	0	0	0	0	0	0	0
13.	1	2	33	67	2	1	67	33
	X=1.4	1.8	33.2	66.8	2.2	2.4	50	50
	s.d.=1.5	1.3			1.3	1.6		

Spelling:

Correlations between English and Hebrew spelling errors:

Hebrew consonant errors were significantly correlated with English vowel [$r(21) = .52, p < .01$] and consonant errors [$r(21) = .59, p < .01$]. Interestingly, Hebrew vowel errors were not correlated with either vowel or consonant errors in English, which may be due to the fact that Hebrew vowels are represented so differently from both Hebrew consonants and English vowels and consonants. The phonetic/nonphonetic distinction between spelling errors was not correlated across languages.

Correlations between spelling errors and single word reading achievement in English and Hebrew:

English and unvowelized Hebrew single word reading achievement were significantly negatively correlated with English non-phonetic, consonant and vowel errors, and with Hebrew consonant errors (Table 8). English single word reading measures were also significantly negatively correlated with Hebrew non-phonetic spelling errors. Vowelized single word reading correlated significantly negatively with Hebrew non-phonetic and consonant spelling measures, but not with any English spelling errors. The stronger relationship demonstrated between English spelling and English and unvowelized Hebrew reading achievement may reflect the "whole-word" strategy requirements of English spelling, English reading and unvowelized Hebrew reading as

TABLE 8
 Pearson Product-Moment Correlation Coefficients between English
 and Hebrew Reading Measures and Spelling Errors

SPELLING	READING		
	<u>English</u>	<u>Vowelized Hebrew</u>	<u>Unvowelized Hebrew</u>
Eng Phonetic	ns	ns	ns
Eng Non-Phonetic	-.74**	ns	-.73**
Eng Consonant	-.82**	ns	-.64**
Eng Vowel	-.75**	ns	-.74**
Heb Phonetic	ns	ns	ns
Heb Non-Phonetic	-.54*	-.52*	ns
Heb Consonant	-.69**	-.55*	-.62**
Heb Vowel	ns	ns	ns

* $p < .01$

** $p < .001$

opposed to vowelized Hebrew reading which may rely entirely on phonetic skills.

Optional Vowels:

Five fourth graders used optional vowels (Table 9). Four were female; one was left-handed. All five children were among the superior English readers, based on grade equivalency, and were in the average to high average range of standardized scores (based on the 23 subjects, $X=100$; $s.d.=15$) on all English and Hebrew single word reading measures. All five children made many more phonetic reading errors than all other errors combined, which suggests that they favored a phonetic reading approach. This finding is consistent with the prediction that children who used optional vowels would favor a phonetic reading approach, and is also consistent with the greater amount and percentages of phonetic errors committed by superior English readers in general. As a group, they did not show a phonetic approach to spelling. Only two children made more than an average number of phonetic spelling errors in English, and two made above average phonetic spelling errors in Hebrew.

Reading Predictors:

English auditory discrimination errors were significantly positively correlated with Hebrew auditory discrimination errors [$r(22)=.64$, $P<.001$]. English phonetic

TABLE 9

Optional Vowel Cases: Sex, Handedness, and Standardized Scores ($\bar{X}=100$
s.d.=15) on Reading Measures and Phonetic Reading and Spelling Errors

(N=5)

	<u>CASE #s</u>				
	<u>4</u>	<u>8</u>	<u>12</u>	<u>14</u>	<u>15</u>
Sex	F	M	F	F	F
Handedness	R	R	L	R	R
English Reading	96.4	118.0	111.1	107.7	110.0
English Nonsense Reading	113.9	106.4	110.1	113.9	95.1
Vow Hebrew Reading	107.3	98.7	111.6	111.6	111.6
Unvow Hebrew Reading	94.7	105.3	98.9	111.6	109.5
Hebrew Nonsense Reading	104.9	107.1	113.9	113.7	109.3
Eng Phon Reading Errors	131.4	97.6	102.4	112.1	112.1
(% of total errors)	(87%)	(100%)	(100%)	(64%)	(90%)
Eng Phon Spelling Errors	139.8	93.0	93.0	93.0	116.4
Heb Phon Spelling Errors	119.2	127.5	94.2	102.5	102.5

fluency was significantly positively correlated with Hebrew phonetic fluency [$r(22)=.58$, $p<.01$]. None of the predictor variables, including tests of auditory discrimination, phoneme analysis, fluency, homonyms and syntax correlated significantly with reading achievement in English or Hebrew.

Conclusions:

This pilot study of 23 fourth grade Hebrew Day School students revealed significant correlational relationships between reading and spelling proficiency in English and in Hebrew. In general, good readers in English and in Hebrew showed proficiency in the use of both phonetic and whole word approaches to reading in both languages. Error analysis suggested that a strong phonetic bias in English was correlated with stronger phonetic than whole-word skills in Hebrew. Significant correlations between passage reading and single word reading measures were also obtained in both Hebrew and English. Users of optional vowels in Hebrew spelling made significantly more phonetic than any other kinds of errors in reading English, suggesting, as was hypothesized, that they favor a phonetic reading approach. Language "predictors" did not correlate significantly with reading achievement in either language. In fact, the best predictors of reading achievement in either English or Hebrew were the measures of reading achievement in the alternate language.

Pilot Study as an Impetus for Current Study:

One might consider that the similarities observed in English and Hebrew reading in the pilot study were due to a transfer of strategies from one language to the other. It seemed logical, therefore, to examine next a group of children at a pre-reading stage who would learn to read in English and in Hebrew simultaneously. By following them over the course of three years, one could observe whether such similarities evident in fourth grade were present at the beginning stages of reading. Furthermore, though the reading "predictors" were not significantly correlated with reading achievement in the pilot study, it was thought that by administering the predictor tests at the kindergarten level, the point at which they are supposed to be given, they would more likely predict to later reading achievement in English and in Hebrew.

Based on the findings of significant correlations between single word reading and passage reading time, errors and comprehension, it was thought that single word reading measures would likely predict to higher levels of reading achievement as well. This contention is further supported by results of other studies that have found a high correlation between single word reading and passage comprehension (Shankweiler and Liberman, 1972; Lesgold and Resnick, 1982).

Other investigators have claimed that most comprehension failures were due to failures to recognize the words correctly (Treiman and Baron, 1981), while Perfetti (1985), also suggested that efficiency in single word reading led to higher-order reading skills including comprehension. Therefore, only single word reading tests were used to assess reading achievement in English and Hebrew. Finally, because primary grade children have had more limited experience in writing than reading in the two orthographies, it was decided to focus on the reading measures and eliminate the spelling subtests for the study of first and second graders.

CHAPTER V

METHODS

Subjects:

All kindergarten students at the Westchester Day School in Mamaroneck, N.Y. were invited to participate in the study. These children share a similar economic and social background, and have received similar schooling techniques. The kindergarten curriculum, including prereading skills, was essentially the same across all three classrooms. In all, 22 kindergarten children volunteered for the study. Those kindergarten participants who remained at the school were invited to continue in the study in grades 1 and 2 to obtain longitudinal data. Fifteen of the original subjects continued in the study in first grade. Two new students joined the study in first grade. Thirteen of these 17 subjects continued in the study in second grade. Attrition was due to children leaving the school. During the third year of the study, when the original group was being tested in second grade, 16 additional first graders were tested.

Although this study had no preselection bias, sex and handedness were recorded to investigate their relationship with the factors being measured. Also, a minimum IQ score of 115, as measured by the WPPSI, was required for children to continue at the Westchester Day School beyond kindergarten. Therefore, one can assume that all children who participated in the study beyond kindergarten were of at least high average

intelligence. While school policy did not permit the identification of individual IQ scores, randomly listed scores were made available for high achievement and low achievement groups so that the possible interaction of IQ with group assignment could be examined.

Subjects ranged in age from 5 years 2 months to 5 years 10 months ($x=5$ years 6 months, $s.d.=2.3$ months) when they were tested in the early spring of their kindergarten year. In first grade ages ranged from 6 years 1 month to 6 years 11 months ($x=6$ years 6 months, $s.d.=2.6$ months) at the time of testing. In second grade ages at testing ranged from 7 years 4 months to 7 years 11 months ($x=7.7$, $s.d.=2.4$ months). All subjects were American-born and members of middle to upper middle class white Jewish families where English was the predominant language spoken at home.

Selection and Development of Measuring Instruments:

Measuring instruments selected for use in this study reflect both depth in testing reading skills in English and Hebrew and breadth in tapping the several linguistic abilities that are reputed reading predictors. Subtest lengths were influenced by the limited attention spans of 5-7 year-olds and the suggestion by administrators at the school that a concise battery would result in greater cooperation from teachers and parents.

Every effort was made to select instruments which have established reliability and validity, and provide normative data. While tests satisfying these criteria were available in English, no "standardized" battery of assessment of Hebrew language skills existed for a Hebrew Day School population. These schools vary considerably across the United States in the emphasis placed on Hebrew language skills, including reading.

Two Hebrew subtests, however, were taken from the Koallen Diagnostic Criterion-Referenced Test of Primary Hebrew Reading (Koallen, 1981), which was designed to determine whether or not a child has proficiency in a particular skill or skills, rather than to establish grade equivalency or percentiles. Because the Koallen tests are simple, straightforward, and have clear face validity, they serve this purpose well. They have also been modelled after well-established English tests.

Some English predictor tests, though described in the literature and used widely, do not have published reliability or validity information or normative data, but were incorporated into this battery because they fulfilled the need to test a particular skill deemed important. Some Hebrew subtests were developed by the examiner as analogs of the English tests. Specific information about the origins, development and use of all tests are detailed following a listing of the materials used.

Materials:

The following individual measures were administered to the kindergarten students in the following order:

Animal Naming**Clothing Naming**

Picture Vocabulary ((from Newcomer and Hammill, Test of Language Development, Primary (TOLD-P), 1982)

Oral Vocabulary (TOLD-P)

Grammatical Completion (TOLD-P)

Nonsense Word Morphology ((modelled after a test of morphological usage, (Berko, 1958))

Auditory Discrimination (English; from Wepman, Wepman Test of Auditory Discrimination, 1973)

Auditory Discrimination (Hebrew)

Sound Analysis (from Goldman, Fristoe and Woodcock, Goldman-Fristoe-Woodcock Test of Auditory Discrimination, 1970)

Syllables (English and Hebrew)

Syntax

In grades 1 and 2 the measures listed above were re-administered, and in addition:

Fluency, Any Words

Fluency ((Benton and Hamsher, Controlled Oral Word Association Test (COWA), 1976))

Sounds in Isolation (from Durrell, Durrell Analysis of Reading Difficulty, 1955)

Single Word Reading (English; from Woodcock, Woodcock Reading Mastery Tests, 1973)

Nonsense Word Reading (English; from Woodcock, Woodcock Reading Mastery Tests, Word Attack subtest, 1973)

Rapid Automatized Naming (Denckla and Rudel, 1974)

Hebrew Letter Identification (from Lowy et al, Koallen Diagnostic Criterion-Referenced Test of Primary Hebrew Reading, 1981)

Hebrew Vowel Identification (from Lowy et al, Koallen
Diagnostic Criterion-Referenced Test of Primary Hebrew
Reading, 1981)

Hebrew Single Word Reading (vowelized. unvowelized,
nonsense)

Discussion of the Instruments:

Fluency tests (Animal Naming, Clothing Naming, Any Words, COWA) are commonly used both with children and adults as an index of vocabulary, facility in generating words and ability to organize or maintain sets. Norms have been established for adults and children. These tests measure the number of words per category or that begin with a particular letter produced in one minute. Because they are of short duration and enjoyable for children, they were given first to ease each child into the testing situation.

Three subtests of the Test of Language Development - Primary (Newcomer and Hammill, 1982) were administered. This test battery was standardized on a sample of 1,836 children from 19 U.S. states and one Canadian province. Norms, available for ages 4.0-8.11, are presented in standard score and percentile rank formats. Test reliability data, including internal consistency, stability and standard error of

measurement, are generally satisfactory. Assessments of content validity and concurrent validity are described favorably. Information and measures pertaining to the specific TOLD-P subtests used in this study are as follows:

Picture Vocabulary

This 25 - item receptive vocabulary subtest provides a measure of a child's understanding of the meaning associated with spoken English words. The child's task is to point to one of four pictures that best represents the meaning of a word. No verbalizations are required. One point is scored for each correct response. Testing is discontinued after 5 consecutive failures.

The test developers report two studies using split-half procedures with Spearman-Brown correction formulas to measure internal consistency. The first study, based on 250 children from the standardization population, resulted in reliability coefficients of .62, .61, and .67 for ages 5, 6, and 7, respectively. A second study of 114 children from Texas yielded coefficients of .71, .90, and .80 for ages 4, 6, and 8, respectively. Another study (Wong and Roadhouse, 1978), used the coefficient alpha procedure with 71 second and third grade children in Vancouver, B.C., and reported a reliability coefficient of .88. Test-retest reliability, based on a study of 21 4-8 year-olds re-tested after an interval of five days,

was .95. The standard errors of measurement were consistently small (based on raw scores, ranging from 2.1 - 2.5 across ages.4-8).

Content validity was reported based on a survey of 50 language professionals, who rated the subtests along two dimensions of language: 1. semantics or syntax and 2. listening or speaking. The results were exactly as the authors had predicted, which they claim provides support for the content validity of their tests. The Peabody Picture Vocabulary Test, used as criterion to determine concurrent validity, correlated significantly with the TOLP-P Picture Vocabulary subtest ($r=.73$ for 6 year-olds). Construct validity was demonstrated by reporting increases in mean raw scores across the ages. The TOLD-P battery was also highly significantly correlated with tests of reading, writing, readiness and achievement, supporting construct validity.

Oral Vocabulary

This 20-item expressive vocabulary test requires the child to give oral definitions to common English words. One point is given for a precise definition (such as a synonym) or for two unrelated descriptive characteristics of an item. Specific acceptable responses are listed in the manual. If a child's response is inadequate, the examiner encourages the child to "tell me more about it" a maximum of two times per

item. Testing is discontinued after 5 consecutive failures.

Internal consistency, as determined by a split-half procedure with Spearman-Brown correction formulas and based on 250 children from the standardization population, was .90, .83 and .80 at ages 5, 6 and 7, respectively. In a second study of 114 children, split-half correlation coefficients were .77, .84 and .88 at ages 4, 6, and 8, respectively. Wong and Roadhouse (1978) reported a coefficient of .88, based on their study of 71 second and third grade children. Test-retest reliability, based on 21 4-8 year-olds retested after 5 days, was .93. The standard error of measurement, based on raw scores, was very low, ranging from 1.3 for 5 year-olds to 1.8 for 7 year-olds.

Content validity was based on the survey of language professionals, described above for Picture Vocabulary. The Vocabulary Subtest of the Wechsler Intelligence Scale for Children, used as the criterion for a measure of concurrent validity, resulted in validity coefficients of .67, .72 and .76 for ages 4, 6, and 8, respectively. Construct validity was determined in the same manner as Picture Vocabulary above.

Grammatical Completion

A subset of 19 of 30 TOLD-P Grammatical Completion items was selected for use in this study. The original set of items

was reduced to save time, and only redundant items and comparatives were eliminated. It was thought that comparatives (e.g. good, better, best; small, smaller, smallest) were less indicative of morpheme sensitivity than the additions and changes to a word required for creation of possessives, plurals (regular and irregular), present and progressive tenses, past tense (regular and irregular) and identity. One point was scored for each correct response. Reliability and validity coefficients for the total set of 30 items given in the TOLD-P manual cannot be assumed to apply to a subset of items.

Nonsense Word Morphology

This 12 - item subtest, modelled after Berko's (1958) test of morphological usage, was constructed by the examiner. The intention was to examine the same morphological constructs as in the Grammatic Completion subtest, using nonsense words in place of real words. The difference between the two morphology tests is that in the former, it is possible for the child to derive the correct response simply from rote learning rather than from an application of morphological "rules." Thus a child might respond that "A person who sings is a singer" because he has learned that specific name rather than applying the rule of "er." With nonsense words, however, the child has not encountered the vocabulary in a wholistic form

before, and must therefore solve the questions using rules. So, when asked, "A person who PRAMS is a ____" (s)he must consciously apply the rule that names a person according to the action performed. Items include regular and irregular pluralization, regular and irregular past tense formation, present and progressive tenses, future tense, and identity. One point was scored for each correct response.

Auditory Discrimination

To save time, 17 of the 40 Wepman Auditory Discrimination Test items (Wepman, 1973) were selected for use. Word pairs that differ by just one phoneme have to be judged as *same*, or *different*. One point is scored for each correct response. The 17 items, including two identical pairs (e.g. lake-lake), were tape recorded onto a Maxwell UD XL II tape, by a professional male speaker using an Onkyo Stereo Casette Tape Deck (Model No. TA-2055) and a Realistic Cardioid Dynamic Microphone (33-1071). Each presented pair was followed by a 5 second interval. The taped subtest was played for each child in the study using a Panasonic tape recorder (Model No. RO-355) and Realistic NOVA 52 Headphones. The tape was stopped when a child was hesitant in responding, and items were replayed upon request. Of the items that were not included from the original 40, six pairs are "same" items, and the others include redundant phoneme-pairs and pairs whose

phonemes differ beyond minimal distinctions.

Hebrew Auditory Discrimination

Ten Hebrew auditory discrimination pairs were constructed by the examiner with minimal pair contrasts that occur in Hebrew. As in the English version, children were instructed to respond "same" or "different," after hearing each stimulus pair on tape. Contrasts included the Hebrew phoneme "ch" (as in "Bach") with "h" (as in "he"), "g" (as in "game") with "k" (as in "came"), "tz" with "s" (as in "sewer"), "z" with "tz", the ending "ch" with the ending "f" (as in "oaf"), the ending "ach" with the ending "ah" and "m" with "n". The items were recorded by the same professional, using the same equipment as in the English version. As in the English subtest, one point was scored for each correct response.

Sound Analysis

These 20 items were taken from the original 28-item Sound Analysis subtest of the Goldman-Fristoe-Woodcock Auditory Skills-Test Battery (Goldman, Fristoe and Woodcock, 1974). This test measures the ability to identify phonemes in the first, middle, or final sound of nonsense syllables. For example, the child is asked, "What is the first sound in chid

... chid?" Twelve correct responses are consonants and eight are vowels. One point was scored for each correct response, and errors were divided into consonant errors and vowel errors. All stimuli, including the entire question and the nonsense word, which is repeated after a two second pause, were recorded on the same tape by the same individual using the same equipment as in the auditory discrimination tests. These 8 items omitted from the original 28 items include redundant and rare (e.g. initial and final "z") phonemes. The G-F-W manual reports content validity, construct validity and split-half reliability, however these favorable coefficients do not necessarily apply to the abbreviated subtest.

Syllables

Ten words, five English and five Hebrew, were selected by the examiner to test the children's awareness of syllables. Children were first given practice items to illustrate what is meant by a "syllable." Then they were asked to "clap out" the number of syllables in each of the four practice items. All subjects completed the practice items without difficulty. They were then asked to "clap out" the syllables in each of the 10 test words. Items ranged from one to three syllables, and one point was scored for each correct response.

Syntax and Relational Terms

Comprehension of passive sentences ("Which makes sense, A man was bitten by a dog, or, A dog was bitten by a man?") and subject-object relationships ("Ron beat Jimmy. Who won?") were used to assess the children's sensitivity to syntax. Questions regarding relational terms (e.g. "Who is your mother's sister?") were also used to assess the child's ability to manipulate language to arrive at a solution. There are 6 items in this brief subtest and one point was scored for each correct response.

Sounds In Isolation

This 68 item subtest, taken from the Durrell Analysis of Reading Difficulty (Durrell, 1955), assesses the child's ability to assign sound correspondences to single consonants and consonant blends. While no standardization, reliability or validity information is supplied by the test makers, this subtest is a straightforward inventory of phonetic skills and is useful as an index of phonetic skill development. One point was scored for each correct response.

Single Word Reading

The Word Identification subtest of the Woodcock Reading

Mastery Tests (Woodcock, 1973), contains 150 words ranging in difficulty from primer to twelfth grade levels. Items are arranged in order of difficulty, with irregular words interspersed with regular words from the very beginning of the list. Although the manual states that readers of varying proficiency may begin the test at different levels of difficulty, it was thought that all subjects should begin with the first item and continue until reaching a ceiling level in order to maximize the actual number of words read. One point was scored for each correct item, and total scores were compared with national norms provided by the authors with regard to grade equivalency. For purposes of this study, errors were categorized into phonetic, real-word substitution, nonphonetic, spatial, consonant and vowel errors.

Normative data for the Woodcock Reading Mastery Tests are based on more than 6000 subjects in 60 geographically, socioeconomically, and ethnically diverse U.S. communities. Split-half reliability coefficients with Spearman-Brown corrections were based on all subjects in the norming sample, and are .98 for grade 1 and .97 for grade 3 (grade 2 is not reported). Standard errors of measurement are small: 5.2 for grade 1, and 3.8 for grade 3. With regard to content validity, the authors state that "items were developed with contributions from outside experts" and that "classical item selection techniques were used in the early stages of item development, and the Rasch model was used during later

stages." Concurrent validity was based on correlations of Total Reading Score on the entire Woodcock battery with other reading measures including the Iowa Tests of Basic Skills (Hieronymus, Hoover and Lindquist, 1986), total reading; the Iowa Tests of Educational Development (Lindquist and Feldt, 1980), total reading; the Peabody Individual Achievement Test (Dunn and Marquardt, 1970), Reading Recognition and Reading Comprehension subtests; the Woodcock-Johnson Reading Achievement Test (Woodcock, 1978) and the Wide Range Achievement Test, (Jastak and Jastak, 1965) of reading. Correlation coefficients ranged from .83 to .88 at grade 3 (lowest grade reported).

Nonsense Word Reading

This subtest comprises the first 10 items of the Word Attack subtest, Woodcock Reading Mastery Tests (Woodcock, 1973). All 10 items are one syllable CV, CVC, CVCC, and CVCVC combinations. All subjects read all 10 items, which was thought to be a sufficient sample from which to derive an index of phonetic decoding skills, and one point was scored for each correct response. Errors were categorized into real-word substitution, spatial, consonant and vowel errors. While the original list of 50 items has been normed, validated, and found to be reliable using the same populations and studies as in the single-word reading subtest, these

figures do not necessarily apply to a subset of items.

Rapid Automatized Naming

The Use Objects and Small Letters subtests of the Rapid Automatized Naming tests (Denckla and Rudel, 1974), were used to assess naming speed. Significant correlations between tests of rapid naming and reading disabilities were found by the authors. The first test consists of 10 pictures of each of 5 objects (comb, key, watch, scissors and umbrella), randomly placed into an array of 5 rows. After naming each item individually, the child names the objects as rapidly as possible scanning across rows. The second test requires naming 5 letters (p,o,d,a,s). The dependent measure is time to completion. Normal times are available for ages 5-13.

Hebrew Letter Identification

This subtest, taken from the Koallen Diagnostic Criterion Referenced Test of Primary Hebrew Reading (Lowy et al, 1981), consists of 20 rows of 5 Hebrew letters each. The child is required to circle the letter or letters in each row that "make the sound" that the examiner says. Some sounds have more than one letter equivalent, and the child must circle all corresponding letters in the row to obtain full credit (1 point). Though the manual states that "each row must be

completely right to be considered a correct answer," in this study 1/2 point was awarded if one or more but not all of the letter equivalents for a particular item were correct in a single row. The Koallen authors do not provide reliability, validity, or normative data, but claim to have modelled this test and the Hebrew Vowel Identification test after the English Criterion Reading test (Hackett, 1971).

Hebrew Vowel Identification

This subtest, also taken from the Koallen Diagnostic Criterion-Referenced Test of Primary Hebrew Reading (Lowy et al, 1981), is entirely analogous to the letter identification test except that vowels are used instead of letters.

Hebrew Single Word Reading

This subtest, developed by the examiner, has three parts: vowelized words, 40 items; unvowelized words, 10 items; and nonsense words, 10 items. Both vowelized and unvowelized words, taken from elementary Hebrew readers, range in length from one to four syllables. Though first and second grade Hebrew Day School children have a limited Hebrew vocabulary, most of these words, when spoken, were familiar to them. Because no child made 5 or more consecutive errors in reading vowelized Hebrew words, all subjects read all 40 vowelized

words.

First and second grade children have not yet been instructed in unvowelized Hebrew reading. Since all 10 unvowelized words represent familiar vocabulary, however, the children attempted to read all 10 items.

Ten nonsense words, consisting of from two to four letters (consonants), were created to more closely assess phonetic decoding skills. While Hebrew vowelized words can be read using either phonetic or whole-word approaches, nonsense words must be decoded using phonetic "rules." All children were required to read all 10 words.

On all Hebrew reading subtests one point was scored for each correct response. Errors were categorized into real-word substitution, spatial, consonant and vowel errors.

Procedure:

Consent forms were sent home to parents explaining the nature of the study and requesting written consent for their child's participation. Only those students whose parent(s) granted written permission were permitted to participate in the study. Parents were encouraged to contact the examiner if they had any questions about the study.

Each subject was tested individually, by the same examiner, in a private area of the school. Children were told that they were going to play some language "games" with the

examiner, and the atmosphere was relaxed and friendly. Each kindergarten battery of tests took approximately 45 minutes to administer and was completed over two sessions. First and second grade batteries required between 60 and 75 minutes to administer, and also required two sessions. Tests were administered in a fixed order, as delineated in Appendices B and C. Children were allowed to choose small "prizes" after each testing session.

Statistical Analysis and Research Design:

Scores obtained on animal naming and clothing naming subtests were combined to yield a semantic fluency index. Sound analysis errors were divided into vowel errors and consonant errors. Syllable errors were divided into English syllable errors and Hebrew syllable errors. In addition to the semantic fluency index, first and second graders were scored on fluency: any words and phonetic fluency (C,F, and L combined). Total correct scores for English words, English nonsense words, Hebrew vowelized words, Hebrew unvowelized words and Hebrew nonsense words were obtained. Also each reading category was further subdivided into errors committed, including phonetic (except for nonsense words and Hebrew words), real word substitution, nonphonetic, spatial, vowel and consonant errors, and "Don't Know" responses.

Pearson product-moment correlation coefficients were

computed between reading achievement measures in English and Hebrew to test Hypothesis 1. Hypotheses 2 and 3 were tested by examining indices of reading approaches in the two languages. A high percentage of phonetic errors was considered indirect evidence of a phonetic approach to reading in English. A high percentage of real word substitution and spatial errors was considered indirect evidence of a whole word approach to reading in both English and Hebrew. Better nonsense word reading than real word reading was considered evidence of better phonetic than whole-word reading skills in English. Better nonsense word reading than unvowelized word reading in Hebrew was considered evidence of better phonetic than whole-word reading skills in Hebrew. Conversely, better real word than nonsense word reading in English or Hebrew was considered evidence of a whole word approach to reading in that language. A comparison was made between reading strategy preferences in English and in Hebrew using Pearson product-moment correlation coefficients to determine the significance of these relationships.

Hypotheses 4 and 5 were tested by computing Pearson product-moment correlation coefficients between each predictor variable and English or Hebrew reading achievement, the criterion variables. Despite the small sample, multiple regression equations were computed to ascertain trends in determining the collective prediction of the independent variables for English and Hebrew reading achievement.

Hypothesis 6 was tested by dividing the bimodally distributed total group of subjects into superior and average readers based on English single word reading scores. "Superior readers" were all subjects who scored near or above the group mean, which was one year above grade level according to national norms. "Average readers" were all subjects who scored one or more standard deviations below the group mean. These scores were at grade level according to national norms. Mann-Whitney U tests were performed to determine if the two groups differed in vowel errors committed in English and in Hebrew. To address the second part of Hypothesis 6, subjects were divided according to number of English spatial errors committed. Those who scored one or more standard deviations above the mean for spatial errors were considered the "high spatial error" group. All other subjects were considered the "low spatial error" group. Mann-Whitney U tests were performed to determine if the two groups differed in the number of vowel errors committed in Hebrew and in English.

CHAPTER VI

RESULTS

In this chapter the findings, as they relate to the six hypotheses, are presented. The format followed in this chapter is first to describe the data, then to discuss briefly the method of data analysis used to answer each hypothesis and finally to present the pertinent findings as applied to each one.

Achievement:

Single Word Reading: First Grade

English:

Real and nonsense word raw scores, standardized scores ($X=100$; $s.d.=15$), grade equivalencies, means and standard deviations of each group of first graders tested are shown in Table 10. Mann-Whitney U Tests were performed to determine if these two sample groups were from the same population. Because the differences between groups on real word reading [$p(16,17)>.05$] and nonsense word reading [$p(16, 17)>.80$] were nonsignificant, the groups were combined for all further analyses.

With a maximum of 150 real words presented, scores ranged from 18 to 123 correct responses, which is equivalent to grades 1.6 to 6.1. The mean score was 75.6 ($s.d.=29.8$; grade equivalency =2.7). Of 10 nonsense words presented, scores

TABLE 10
 First Grade English Reading: Real Words, Nonsense Words, Grade Equivalencies,
 Standardized Scores (self-referenced, N=33; X=100, s.d.=15), Means
 and Standard Deviations

Group 1L (longitudinal) (N=17)					
<u>Case</u>	<u>Real Words</u>	<u>Gr. Equiv</u>	<u>Standard</u>	<u>Nons Words</u>	<u>Standard</u>
1.	86	3.1	105.2	10	110.0
2.	80	2.9	102.1	10	110.0
3.	18	1.6	71.0	6	81.4
4.	22	1.6	73.0	6	81.4
5.	77	2.8	100.7	8	95.7
6.	82	3.0	103.2	9	102.9
7.	18	1.6	71.0	1	45.7
8.	24	1.7	74.0	7	88.6
9.	85	3.1	104.7	10	110.0
10.	78	2.8	101.2	10	110.0
11.	71	2.6	97.7	10	110.0
12.	73	2.6	98.7	10	110.0
13.	101	3.9	112.8	10	110.0
14.	96	3.6	110.3	9	102.9
15.	87	3.2	105.7	10	110.0
16.	27	1.7	75.5	6	81.4
17.	104	4.1	114.3	10	110.0
X=	66.4	2.4		8.4	
s.d.=	31.9			2.4	

Group 1X (extra) (N=16)					
<u>Case</u>	<u>Real Words</u>	<u>Gr. Equiv</u>	<u>Standard</u>	<u>Nons Words</u>	<u>Standard</u>
1.	99	3.8	111.8	10	110.0
2.	75	2.7	99.7	10	110.0
3.	29	1.7	76.5	4	67.1
4.	90	3.3	107.2	9	102.9
5.	97	3.7	110.8	10	110.0
6.	97	3.7	110.8	10	110.0
7.	61	2.3	92.7	6	81.4
8.	97	3.7	110.8	9	102.9
9.	107	4.4	115.8	10	110.0
10.	105	4.2	114.8	10	110.0
11.	73	2.6	98.7	9	102.9
12.	116	4.4	120.3	10	110.0
13.	40	1.8	82.0	9	102.9
14.	123	6.1	123.8	10	110.0
15.	79	2.9	101.7	9	102.9
16.	79	2.9	101.7	6	81.4
X=	85.4	3.1		8.8	
s.d.=	25.8			1.8	

Groups 1L and 1X (N=33)			
	<u>Real Words</u>	<u>Grade Equivalency</u>	<u>Nonsense Words</u>
X =	75.6	2.7	8.6
s.d.=	29.8		2.1

ranged from 1 to 10 correct responses, with a mean of 8.6¹.

Hebrew:

Raw and standardized scores for vowelized, unvowelized and nonsense Hebrew words for each of the two first grade groups are shown in Table 11. Mann-Whitney U tests were performed to determine if these two sets of first grade scores were significantly different from each another on Hebrew measures. Differences between groups on vowelized [$p(16, 17) > .10$], unvowelized [$p(16, 17) > .50$], and nonsense [$p(16, 17) > .10$] word scores were nonsignificant, allowing the groups to be merged for analyses involving Hebrew measures as well.

With a maximum of 40 vowelized words presented, scores ranged from 2-40 correct responses ($X=32.9$, $s.d.=8.3$). Of 10 unvowelized words presented, scores ranged from 0 to 10 correct responses ($X=6.8$, $s.d.=2.8$). Of 10 nonsense words presented, scores ranged from 0 to 10 correct responses ($X=7.2$, $s.d.=2.5$).

Single Word Reading: Second Grade

English: (Table 12)

Of 150 real words presented, scores ranged from 47 to 135 correct responses, which is equivalent to grades 1.9 to 8.8. The mean was 104.8, which is equivalent to grade 4.1. Of 10 nonsense words presented, scores ranged from 4 to 10 correct

¹Only the first 10 of 50 Woodcock Word Attack items were presented, thus precluding the use of published grade equivalencies.

TABLE 11
 First Grade Hebrew Reading: Raw Scores, Standardized Scores (X=100;
 s.d.=15), Means and Standard Deviations

Group 1L (longitudinal)
 (N=17)

Case	Vowelized	Standard	Unvowelized	Standard	Nonsense	Standard
1.	38	109.2	10	118.8	8	104.8
2.	40	112.8	10	118.8	10	116.8
3.	24	83.1	3	53.1	5	86.8
4.	27	89.3	4	62.5	5	86.8
5.	33	100.2	4	62.5	4	80.8
6.	39	111.0	9	116.9	10	116.8
7.	2	44.2	1	34.4	0	56.8
8.	25	85.7	0	25.0	4	80.8
9.	18	73.4	5	71.9	4	80.8
10.	38	109.2	9	116.9	7	98.8
11.	39	111.0	7	90.6	10	116.8
12.	28	93.1	6	81.3	6	92.8
13.	37	107.4	7	90.6	9	110.8
14.	36	105.6	9	116.9	8	104.8
15.	35	103.8	10	118.8	7	98.8
16.	22	80.3	3	53.1	4	80.8
17.	38	109.2	10	118.8	10	116.8

X=30.5
 s.d.= 9.8

6.3
 3.2

6.5
 2.8

Group 1X (extra)
 (N=16)

1.	34	102.0	8	100.0	8	104.8
2.	36	105.6	8	100.0	8	104.8
3.	23	82.1	2	43.8	5	86.8
4.	39	111.0	10	118.8	8	104.8
5.	37	107.4	8	100.0	7	98.8
6.	39	111.0	6	81.3	9	110.8
7.	33	100.2	6	81.3	6	92.8
8.	38	109.2	8	100.0	7	98.8
9.	40	112.8	8	100.0	10	116.8
10.	39	111.0	7	90.6	10	116.8
11.	31	96.6	8	100.0	9	110.8
12.	39	111.0	8	100.0	9	110.8
13.	36	105.6	4	62.5	8	104.8
14.	40	112.8	10	118.8	10	116.8
15.	37	107.4	9	116.9	10	116.8
16.	27	89.3	8	100.0	3	74.8

X=35.5
 s.d.= 4.9

7.4
 2.1

7.9
 2.0

Groups 1 longitudinal and 1 extra combined:

X=32.9
 s.d.= 8.3

6.8
 2.8

7.2
 2.5

TABLE 12
 Second Grade English Reading: Real Words, Nonsense Words, Grade
 Equivalencies, Means and Standard Deviations

<u>Case</u>	<u>Real Words</u>	<u>Grade Equivalency</u>	<u>Nonsense Words</u>
1.	108	4.4	10
2.	130	7.4	10
3.	92	3.4	9
4.	95	3.5	10
5.	104	4.1	10
6.	132	7.8	10
7.	47	1.9	4
8.	65	2.4	9
9.	125	6.4	10
10.	113	4.8	10
11.	135	8.8	10
12.	87	3.2	10
13.	129	7.2	10
X=	104.8	4.1	9.4
s.d.=	27.2		1.7

responses ($x=9.4$, $s.d.=1.7$).

Hebrew: (Table 13)

Of 40 vowelized words presented, scores ranged from 21 to 40 correct responses ($x=36.6$, $s.d.=6.2$). Of 10 unvowelized words presented, scores ranged from 7 to 10 correct responses ($x=9.1$, $s.d.=1$). The excellent performance on this subtest demonstrated that the children could read words in Hebrew wholistically, even though all of the Hebrew reading instruction to this point had been phonetic, using vowelized words only. Of 10 nonsense words presented, scores ranged from 3 to 10 correct responses ($x=8$, $s.d.=2.6$).

Correlations between English and Hebrew Single Word Reading:

To address Hypothesis 1, raw scores achieved on English reading real and nonsense words and Hebrew single word reading measures were correlated for grades 1 and 2 using the Pearson r statistic (Tables 14, 15). In first grade both English measures were significantly correlated with each other and with Hebrew single word reading of vowelized, unvowelized and nonsense words. In second grade, English real and nonsense words remained significantly correlated, and both English measures continued to correlate significantly with Hebrew vowelized and unvowelized words. English nonsense words and Hebrew nonsense words continued to be significantly correlated, while English real words were more weakly correlated with Hebrew nonsense words ($p<.07$).

The strong interrelationships between reading measures

TABLE 13
**Second Grade Hebrew Reading: Raw Scores, Standardized Scores ($\bar{X}=10$;
 $s.d.=15$), Means and Standard Deviations**

<u>Case</u>	<u>Vowelized</u>	<u>Standard</u>	<u>Unvowelized</u>	<u>Standard</u>	<u>Nonsense</u>	<u>Standard</u>
1.	39	105.8	9	98.5	10	111.5
2.	40	108.2	10	113.5	10	111.5
3.	39	105.8	9	98.5	6	88.5
4.	37	100.0	8	83.5	10	111.5
5.	39	105.8	9	98.5	9	105.8
6.	40	108.2	9	98.5	9	105.8
7.	21	62.3	7	68.5	3	71.2
8.	38	103.4	10	113.5	9	105.8
9.	38	103.4	10	113.5	5	82.7
10.	40	108.2	8	83.5	10	111.5
11.	40	108.2	10	113.5	9	105.8
12.	25	72.0	9	98.5	4	76.1
13.	40	108.2	10	113.5	10	111.5
X=	36.6		9.1		8.0	
s.d.=	6.2		1.0		2.6	

TABLE 14
 First Grade Single Word Reading: Pearson Product-Moment Correlation
 Coefficients between English and Hebrew Measures
 (N=33)

	<u>Eng</u>	<u>Eng nons</u>	<u>Heb vowel</u>	<u>Heb unvowel</u>	<u>Heb non</u>
English real words		.78**	.71**	.81**	.67**
English nonsense			.81**	.71**	.78**
vowelized Hebrew				.75**	.88**
unvowelized Hebrew					.72**
Hebrew nonsense					

TABLE 15
 Second Grade Single Word Reading: Pearson Product-Moment
 Correlation Coefficients between English and Hebrew Measures
 (N=13)

	<u>Eng</u>	<u>Eng nons</u>	<u>Heb vowel</u>	<u>Heb unvowel</u>	<u>Heb non</u>
English real words		.74*	.72*	.57+	.53(p<.07)
English nonsense			.73*	.61+	.61+
vowelized Hebrew				.57+	.81**
unvowelized Hebrew					.31(n.s.)
Hebrew nonsense					

+ p<.05

* p<.01

** p<.001

in English and Hebrew suggest that proficient English readers were also proficient users of both whole-word and phonetic approaches in Hebrew. Poor English readers were likely poor in both whole-word and phonetic approaches to reading Hebrew. On the basis of overall achievement, there were no obvious trends towards favoring a particular reading approach in single word reading of English or Hebrew, as suggested by Hypotheses 2 and 3.

Errors:

Reading errors in English and Hebrew were used as "windows" through which reading strategies could be inferred, in order to address Hypotheses 2 and 3. First, the types of errors made in English and in Hebrew were correlated to determine whether children made the same types of errors in each language. A significant positive finding would serve as indirect evidence of similar reading strategies in each language. Second, error types in English and Hebrew were correlated with reading achievement measures to determine if any types of errors were more or less associated with reading proficiency in either or both languages. If patterns of error-types in relation to reading proficiency were the same in both languages, this would provide additional evidence of analogous reading strategies in English and Hebrew.

Correlations between single word reading errors in English and in Hebrew:

Real Word Substitution Errors:

Real word substitution errors were significantly correlated across languages. First grade English real word substitution errors correlated significantly with vowelized Hebrew real word substitution errors [$r(31)=.46$, $p<.01$] and with unvowelized Hebrew real word substitution errors [$r(31)=.49$, $p<.01$]. Second grade English real word substitution errors correlated significantly with vowelized Hebrew real word substitution errors [$r(11)=.57$, $p<.05$], but not with unvowelized Hebrew real word substitution errors ($r(11)=.09$).

Spatial Errors:

English spatial errors were not significantly correlated with Hebrew spatial errors [Grade 1: English with vowelized Hebrew, $r(11)=-.33$; English with unvowelized Hebrew, $r(11)=-.13$]; Grade 2: English with vowelized Hebrew, $r(11)=.04$; English with unvowelized Hebrew, $r(11)=-.03$]. This may be due to the different types of spatial errors typically committed in each language. While English spatial errors consisted largely of syllable omissions and displacements, Hebrew spatial errors consisted largely of the misreading of one vowel for another. Since several of the Hebrew vowels differ only by the spatial configuration of the dot or dot-dash symbols, errors substituting one such vowel for another are

considered "spatial." However it is possible that this type of spatial error is qualitatively different from the omission or displacement of whole syllables.

Correlations between single word reading errors and single word reading achievement in English and Hebrew:

Significant correlations between English and Hebrew single word reading errors and English and Hebrew single word reading measures in first grade are shown in Table 16. Correlations between second grade reading and error measures are shown in Table 17. In both first and second grade the only positive correlations found were between English phonetic errors and reading measures in both languages. These correlations were significant for all reading measures in first grade, and for English and vowelized Hebrew reading achievement in second grade, suggesting that those children who erred in favor of phonetic regularizations in English were also particularly sensitive to the phonetic attributes of Hebrew. This is a subtle indication that reading strategy preferences may be consistent across languages. All other error measures were negatively correlated with reading measures in both English and Hebrew except for English spatial errors, which were not correlated with any reading measures in either first or second grade, and unvowelized Hebrew real word substitution errors, which were negatively correlated with only vowelized and nonsense Hebrew words in first grade, and with English nonsense words in second grade.

TABLE 16
FIRST GRADE
 Pearson Product-Moment Correlations between Reading Errors and
 Reading Measures in English and Hebrew
 (N=33)

READING ERRORS	READING MEASURES				
	Eng	Eng nons	vow Heb	unvow Heb	Heb nons
English Phonetic	.57**	.40*	.49*	.47*	.48*
English Spatial	ns	ns	ns	ns	ns
vow Hebrew Spatial	-.57**	-.49*	-.53**	-.48*	-.60**
unvow Hebrew Spatial	-.58**	-.51**	-.67**	-.52**	-.56**
English Substitution	-.41*	-.54**	-.48*	-.46*	-.50**
vow Hebrew Substitution	-.62**	-.50**	-.61**	-.56**	-.60**
unvow Hebrew Substitution	ns	ns	-.36+	ns	-.34+

TABLE 17
SECOND GRADE
 Pearson Product-Moment Correlations between Reading Errors and
 Reading Measures in English and Hebrew
 (N=13)

READING ERRORS	READING MEASURES				
	Eng	Eng nons	vow Heb	unvow Heb	Heb nons
English Phonetic	.56+	.30(ns)	.58+	.34(ns)	.33(ns)
English Spatial	ns	ns	ns	ns	ns
vow Hebrew Spatial	-.68*	-.63+	-.95**	-.50*	-.79**
unvow Hebrew Spatial	ns	ns	ns	ns	ns
English Substitution	-.85**	-.46(ns)	-.65*	-.36(ns)	.41(ns)
vow Hebrew Substitution	-.58+	-.54(p<.06)	-.96**	-.45(ns)	-.77*
unvow Hebrew Subst	-.45(ns)	-.64*	-.48(ns)	-.50(ns)	ns

+ p<.05
 * p<.01
 ** p<.001

Division of First Graders into Superior and Average Readers:**Single Word Reading:**

On English single word reading, 26 first grade subjects scored near or above the group mean of grade 2.7, as their grade equivalent scores ranged from 2.3 to 6.1 (superior; Table 18), while the remaining seven subjects scored well below the group mean with grade equivalency scores of 1.6 to 1.8 (average; Table 18). These average English readers also scored lower on the Hebrew reading measures than their classmates (Table 19). The differences between groups on all single reading measures in English and Hebrew, as determined by Mann-Whitney U Tests of raw scores, were very significant [English Real Words, $p(26,7) < .0001$; English Nonsense Words, $p(26,7) < .0001$; Vowelized Hebrew Words, $p(26,7) < .001$; Unvowelized Hebrew Words, $p(26,7) < .0001$; Nonsense Hebrew Words, $p(26,7) < .01$]. To determine if IQ differences might account for the reading score differences between groups, a Mann-Whitney U Test was performed between groups on their IQ scores. IQ scores were only available for those 11 children who had participated in the study from kindergarten, when IQ scores were obtained. Therefore the mean IQ scores are based on an "average reader" group of 4 children and a "superior reader" group of 7 children. For the average reader group, the mean IQ score, as measured by the WPSSI, was 119.25. The mean IQ score of the superior readers was 126.6. The Mann-Whitney U Test was nonsignificant [$p(4,7) > .20$], indicating

TABLE 18

First Grade English Reading divided into Superior and Average Readers: Raw Scores, Grade Equivalencies, Standardized Scores (X=100; s.d.=15), Means and Standard Deviations

Superior Readers
(N=26)

Case	Real Words	Gr Equiv	Stand Scores	Nons Words	Stand Scores
1.	86	3.1	105.2	10	110.0
2.	80	2.9	102.1	10	110.0
5.	77	2.8	100.7	8	95.7
6.	82	3.0	103.2	9	102.9
9.	85	3.1	104.7	10	110.0
10.	78	2.8	101.2	10	110.0
11.	71	2.6	97.7	10	110.0
12.	73	2.6	98.7	10	110.0
13.	101	3.4	112.8	10	110.0
14.	96	3.6	110.3	9	102.9
15.	87	3.2	105.7	10	110.0
17.	104	4.1	114.3	10	110.0
18.	99	3.8	111.8	10	110.0
19.	75	2.7	99.7	10	110.0
21.	90	3.3	107.2	9	102.9
22.	97	3.7	110.8	10	110.0
23.	97	3.7	110.8	10	110.0
24.	61	2.3	92.7	6	81.4
25.	97	3.7	110.8	9	102.9
26.	107	4.4	115.8	10	110.0
27.	105	4.2	114.8	10	110.0
28.	73	2.6	98.7	9	102.9
29.	116	4.4	120.3	10	110.0
31.	123	6.1	123.8	10	110.0
32.	79	2.9	101.7	9	102.9
33.	79	2.9	101.7	6	81.4
X=	89.1	3.3	107.2	9.4	105.6
s.d.=	14.7	0.8	7.3	1.1	2.3

Average Readers
(N=7)

3.	18	1.6	71.0	6	81.4
4.	22	1.6	73.0	6	81.4
7.	18	1.6	71.0	1	45.7
8.	24	1.7	74.0	7	88.6
16.	27	1.7	75.5	6	81.4
20.	29	1.7	76.5	4	67.1
30.	40	1.8	82.0	9	102.9
X=	25.4	1.7	74.7	5.6	85.4
s.d.=	7.1	0.1	3.7	2.3	18.0

TABLE 19

First Grade Hebrew Reading divided into Superior and Average Readers: Raw Scores, Standardized Scores ($X=100$; $s.d.=15$), Means and Standard Deviations

Superior Readers
($N=26$)

Case	Vowelized	Standard	Unvowelized	Standard	Nonsense	Standard
1.	38	109.2	10	118.8	8	104.8
2.	40	112.8	10	118.8	10	116.8
5.	33	100.2	4	62.5	4	80.8
6.	39	111.0	9	116.9	10	116.8
9.	18	73.4	5	71.9	4	80.8
10.	38	109.2	9	116.9	7	98.8
11.	39	111.0	7	90.6	10	116.8
12.	28	93.1	6	81.3	6	92.8
13.	37	107.4	7	90.6	9	110.8
14.	36	105.6	9	116.9	8	104.8
15.	35	103.8	10	118.8	7	98.8
17.	38	109.2	10	118.8	10	116.8
18.	34	102.0	8	100.0	8	104.8
19.	36	105.6	8	100.0	8	104.8
21.	39	111.0	10	118.8	8	104.8
22.	37	107.4	8	100.0	7	98.8
23.	39	111.0	6	81.3	9	110.8
24.	33	100.2	6	81.3	6	92.8
25.	38	109.2	8	100.0	7	98.8
26.	40	112.8	8	100.0	10	116.8
27.	39	111.0	7	90.6	10	116.8
28.	31	96.6	8	100.0	9	110.8
29.	39	111.0	8	100.0	9	110.8
31.	40	112.8	10	118.8	10	116.8
32.	37	107.4	9	116.9	10	116.8
33.	27	89.3	8	100.0	3	74.8
X=	35.7		8		8.0	
s.d.=	4.9		1.6		2.0	

Average Readers
($N=7$)

3.	24	83.1	3	53.1	5	86.8
4.	27	89.3	4	62.5	5	86.8
7.	2	44.2	1	34.4	0	56.8
8.	25	85.7	0	25.0	4	80.8
16.	22	80.3	3	53.1	4	80.8
20.	23	82.1	2	43.8	5	86.8
30.	36	105.6	4	62.5	8	104.8
X=	22.7		2.4		4.4	
s.d.=	9.5		1.4		2.5	

that for this subset of subjects, IQ cannot account for the observed differences.

Because of the bimodal distribution, Pearson correlation coefficients were computed between English and Hebrew reading measures for each homogeneous group to determine if the significant relationships established between English and Hebrew reading measures were upheld with a narrower range of scores.

Correlations between English and Hebrew Single Word Reading among First Grade Superior Readers:

Among superior readers ($n=26$), English single word reading was significantly correlated with English nonsense word reading [$r(24)=.46$, $p<.01$], vowelized Hebrew reading [$r(24)=.40$, $p<.05$], and Hebrew nonsense word reading [$r(24)=.40$, $p<.05$]. English nonsense word reading was significantly correlated with vowelized Hebrew reading [$r(24)=.32$, $p<.05$] and Hebrew nonsense word reading [$r(24)=.54$, $p<.01$]. While the correlation between English reading measures and unvowelized Hebrew reading measures did not reach significance [$r(24)=.28$, $p>.08$, n.s.], Hebrew vowelized and unvowelized reading were significantly correlated [$r(24)=.52$, $p<.01$], as were vowelized Hebrew and Hebrew nonsense word [$r(26)=.76$, $p<.001$] and unvowelized Hebrew and Hebrew nonsense words [$r(26)=.50$, $p<.01$].

Correlations between English and Hebrew Single Word Reading among First Grade Average Readers:

Among average readers ($n=7$), English single word reading was significantly correlated with vowelized Hebrew reading [$r(5)=.68$, $p<.05$] and Hebrew nonsense word reading [$r(5)=.74$, $p<.05$]. English nonsense word reading was very significantly correlated with vowelized Hebrew reading [$r(5)=.94$, $p<.001$] and Hebrew nonsense word reading [$r(5)=.88$, $p<.01$]. Vowelized Hebrew reading was very significantly correlated with Hebrew nonsense word reading [$r(5)=.97$, $p<.001$]. English single word reading and English nonsense word reading were more weakly correlated [$r(5)=.63$, $p<.07$].

The significant correlations between English and Hebrew reading measures for each homogeneous subgroup of first grade readers demonstrate that parallel similarities between English and Hebrew occurred at each level of reading ability.

Reading Strategy Preferences as Reflected Through Errors of Superior and Average Readers:

The relationship between reading error types and group membership (superior or average readers) was investigated to gain further insight into reading strategy preferences in English and Hebrew. It was hypothesized that phonetic errors reflect a phonetic approach to reading while real word substitution and spatial errors reflect a whole-word approach to reading.

English:

As shown in Table 20, superior readers made almost four times as many phonetic errors as average readers, while average readers made twice as many real word substitution errors as superior readers. Using Mann-Whitney U Tests, these differences were significant [phonetic errors: $p(26,7) < .01$; real word substitution errors: $p(26,7) < .01$]. There was no difference between groups in the number of spatial errors made [$p(26,7) > .20$, n.s.]. Average readers had a significantly higher percentage of real word substitution errors out of total errors than did the superior readers [Mann-Whitney U Test: $p(26,7) < .001$], while superior readers had a significantly higher percentage of phonetic errors out of total errors than average readers [Mann-Whitney U Test: $p(26,7) < .05$]. The percentage of spatial errors did not differ significantly between groups [$p(26,7) > .10$, n.s.].

Hebrew:

As shown in Table 21, the number of spatial errors made in Hebrew differed significantly between groups [Mann-Whitney U Tests: vowelized Hebrew, $p(26,7) < .05$; unvowelized Hebrew, $p(26,7) < .05$]. While it appears that average readers made more real word substitution errors with unvowelized words than did superior readers, this difference is attributable to one subject (subject #16 in the Average reader group), and the Mann-Whitney U Test is nonsignificant ($p > .10$). The difference between groups on real word substitution errors

TABLE 20
First Grade English Real Word Reading Errors: Numbers and Percentages of Phonetic, Spatial and Real Word Substitution Errors

Superior Readers
(N=26)

Subject	Raw Scores			Percentages		
	Phonetic	Spatial	Substitution	Phonetic	Spatial	Substitution
1.	4	1	2	57	14	29
2.	6	1	5	50	8	42
5.	3	1	2	50	17	33
6.	4	1	3	50	12	38
9.	1	2	3	17	33	50
10.	3	3	4	30	30	40
11.	8	1	3	67	8	25
12.	2	2	4	25	25	50
13.	1	1	0	50	50	0
14.	9	3	3	60	20	20
15.	1	2	1	25	50	25
17.	6	0	0	100	0	0
18.	3	3	1	43	43	14
19.	4	2	9	27	13	60
21.	5	5	2	42	42	16
22.	6	4	1	55	36	9
23.	6	1	1	75	13	13
24.	1	1	9	9	9	82
25.	4	1	1	67	17	17
26.	7	1	0	88	12	0
27.	0	0	0	0	0	0
28.	6	0	6	50	0	50
29.	3	3	1	43	43	14
31.	3	1	0	75	25	0
32.	1	4	4	11	44	44
33.	7	4	7	39	22	39
X=	4.2	1.8	2.8	48.2	23.4	28.4
s.d.=	2.4	1.4	2.6			

Average Readers
(N=7)

3.	2	0	4	33	0	67
4.	1	0	4	20	0	80
7.	0	2	5	0	29	71
8.	2	2	9	15	15	70
16.	0	1	9	0	10	90
20.	0	2	6	0	25	75
30.	3	1	3	43	14	43
X=	1.1	1.1	5.7	15.9	13.3	70.9
s.d.=	1.1	0.8	2.2			

TABLE 21
First Grade Hebrew Vowelized and Unvowelized Reading: Numbers and Percentages of Spatial and Real Word Substitution Errors

Superior Readers (N=26)								
Vowelized Hebrew					Unvowelized Hebrew			
<u>Subject</u>	<u>Spat</u>	<u>Subst</u>	<u>%Spat</u>	<u>%Subst</u>	<u>Spat</u>	<u>Subst</u>	<u>%Spat</u>	<u>%Subst</u>
1.	1	1	50	50	0	0	0	0
2.	0	2	0	100	0	0	0	0
5.	3	0	100	0	0	0	0	0
6.	0	0	0	0	0	0	0	0
9.	1	0	100	0	1	2	33	67
10.	0	0	0	0	0	0	0	0
11.	0	1	0	100	0	0	0	0
12.	3	0	100	0	0	1	0	100
13.	2	0	100	0	0	0	0	0
14.	2	0	100	0	0	1	0	100
15.	1	1	50	50	0	0	0	0
17.	0	0	0	0	0	0	0	0
18.	0	0	0	0	0	0	0	0
19.	1	6	14	86	0	1	0	100
21.	0	3	0	100	0	0	0	0
22.	0	0	0	0	0	0	0	0
23.	0	2	0	100	0	0	0	0
24.	0	2	0	100	0	1	0	100
25.	0	3	0	100	0	0	0	0
26.	0	0	0	0	0	0	0	0
27.	0	0	0	0	0	0	0	0
28.	0	3	0	100	0	0	0	0
29.	0	2	0	100	0	0	0	0
31.	0	2	0	100	0	0	0	0
32.	0	9	0	100	0	1	0	100
33.	4	1	80	20	0	1	0	100
X =	0.7	1.5	36.5	63.5	0.04	0.3	4.7	95.3
Average Readers (N=7)								
3.	4	3	57	43	1	1	50	50
4.	7	1	88	12	1	0	100	0
7.	3	1	75	25	1	0	100	0
8.	1	0	100	0	0	0	0	0
16.	9	2	82	18	2	4	33	67
20.	0	4	0	100	0	0	0	0
30.	1	2	33	67	0	1	0	100
X=	3.6	1.9	62.1	39.9	0.7	0.8	56.6	43.4

with vowelized words was also nonsignificant (Mann-Whitney U Test: $p > .10$).

Summary and Interpretation of Error Findings:

English real word substitution errors and Hebrew spatial errors were associated with average readers, which suggests that these readers may resort more to a "whole word" strategy when confronted with an unfamiliar word in English or Hebrew than do superior readers. It may also suggest that the phonetic code is less available and less stable for the average readers. Real word substitution errors may be less prominent in Hebrew than in English among these average readers because they have fewer vocabulary words in their non-native language from which to draw substitutes. Spatial errors may be more common in Hebrew than in English among average readers because of the increased opportunity for spatial errors among Hebrew vowels, which differ largely by the spatial configuration of dot or dot-dash combinations. English phonetic errors were strongly associated with superior readers, which suggests that when confronted with an unfamiliar word in English, these children are more likely than average readers to use a phonetic strategy. While phonetic errors cannot be made in Hebrew, English phonetic errors were also strongly correlated with Hebrew vowelized [$r(31) = .71$; $p < .001$] and unvowelized [$r(31) = .47$; $p < .01$] reading proficiency in grade 1 and Hebrew vowelized reading proficiency in grade 2 [$r(11) = .58$; $p < .05$]. This finding

suggests that English phonetic skill proficiency may also be related to Hebrew reading achievement.

Second Grade Superior and Average Readers:

As shown in Table 22, two second grade children (subjects #7&8) continued to score more than one standard deviation below the mean for English real words, and one (subject #7) of these two scored significantly below the mean in nonsense word reading as well. The child (subject #7) who read both English real and nonsense words poorly also scored significantly below the mean on all Hebrew measures. In contrast, the child (subject #8) who demonstrated adequate phonetic skills in English reading (average nonsense words) scored in the average to high average range on Hebrew reading measures. These patterns of reading in these two children support the idea that English phonetic skill proficiency may be related to Hebrew reading achievement.

There was one exception to this generally observed relationship. One second grader (subject #12) scored in the average range on English real and nonsense word reading and on unvowelized word reading, yet scored more than one standard deviation below the mean in Hebrew vowelized and nonsense word reading. His reading profile suggests that he had developed phonetic skills in English but not in Hebrew.

Vowel Errors in English vs. Hebrew:

Average readers read approximately the same number of

TABLE 22
 Second Grade Standardized Scores for English and Hebrew Reading
 Measures and Phonetic Errors

<u>Case</u>	<u>Eng Real</u>	<u>Eng Nons</u>	<u>Heb Vow</u>	<u>Heb Unvow</u>	<u>Heb Nons</u>	<u>Phon Err</u>
1.	101.8	105.3	105.8	98.5	111.5	92.8
2.	113.9	105.3	108.2	113.5	111.5	118.9
3.	92.9	96.5	105.8	98.5	88.5	122.2
4.	94.6	105.3	100.0	83.5	111.5	83.0
5.	99.6	105.3	105.8	98.5	105.8	86.3
6.	115.0	105.3	108.2	98.5	105.8	105.9
7.	68.2	52.4	62.3	68.5	71.2	83.0
8.	78.1	96.5	103.4	113.5	105.8	89.5
9.	111.1	105.3	103.4	113.5	82.7	99.3
10.	104.9	105.3	108.2	83.5	111.5	115.7
11.	116.7	105.3	108.2	113.5	105.3	99.3
12.	90.2	105.3	72.0	98.5	76.1	83.0
13.	113.9	105.3	108.2	113.5	111.5	112.9

words in English ($X=38.4$) and in vowelized Hebrew (40), and the same number of nonsense words in each language (10).² Therefore the number of opportunities for making vowel errors were similar in the two orthographies. As shown in Table 23, average readers made more vowel errors with vowelized Hebrew real words than with English real words, however this difference was nonsignificant (binomial sign test, $p>.45$, 2-tailed). Average readers also made more vowel errors with Hebrew nonsense words than with English nonsense words, but this difference was also nonsignificant (binomial sign test, $p>.12$, 2-tailed). These findings do not support hypothesis 6, which states that average readers will make more vowel errors in English than in Hebrew.

To address the second part of hypothesis 6, which states that children who make significantly more than average spatial errors in English will make more vowel errors in Hebrew than in English, an analysis of Hebrew and English vowel errors among high spatial error children was made (Table 24). High spatial error children included all subjects who scored one or more standard deviations above the mean for English spatial errors. Eight of the 33 children qualified. None of the eight children made more than an average number of vowel errors in Hebrew. One (subject #29)

²Each subject read as many English words as he could out of 150 possible words until he made 5 consecutive errors. In contrast, all subjects were asked to read all 40 vowelized words in Hebrew, and all 10 each of English and Hebrew nonsense words and Hebrew unvowelized words.

TABLE 23
Average Readers: Vowel Errors in English and Hebrew

Subject	# of English Words Read	VOWEL ERRORS			
		<u>E Real</u>	<u>H Real</u>	<u>E Nons</u>	<u>H Nons</u>
3.	30	3	12	2	5
4.	31	4	6	2	4
7.	31	1	4	2	5
8.	40	8	4	2	6
16.	43	7	9	4	6
20.	42	11	16	6	5
30.	52	5	1	1	2
X=38.4		5.6	7.4	2.7	4.7

TABLE 24
High Spatial Error Subjects: Vowel Errors in English and Hebrew

Subject	# of English Words Read	VOWEL ERRORS			
		<u>E Real</u>	<u>H Real</u>	<u>E Nons</u>	<u>H Nons</u>
10.	87	2	1	0	3
14.	108	6	1	0	1
18.	110	3	5	0	2
21.	108	8	0	0	2
22.	116	6	3	0	3
29.	145	12	1	0	1
32.	87	2	0	1	0
33.	105	3	1	3	7
X=108.3		5.8	3.5	0.5	2.4

made more than an average number of vowel errors in English. In absolute numbers, these children actually made more vowel errors in English than in Hebrew, though this difference is not quite significant (binomial sign test, $p=.07$, 2-tailed). However the opportunities for error were greater in English than in Hebrew because of the greater number of English words read by these subjects. Therefore the true difference between Hebrew and English vowel errors with real words is not even close to significant (binomial sign test, $p>.72$, 2-tailed). With nonsense words, high English spatial error children made more vowel errors in Hebrew than in English, though the difference is not quite significant (binomial sign test, $p=.07$, 2-tailed). Since nonsense words in both orthographies are phonetically regular, vowel errors cannot be attributed to phonetic errors. However vowel errors in Hebrew can be secondary to spatial errors, as several of the Hebrew vowels are spatially confusable with one another. The higher number of vowel errors in Hebrew nonsense word reading than English nonsense word reading among children who make significantly more than an average number of spatial errors in English reading appears to support hypothesis 6. However an examination of the nonsense word vowel errors among those subjects who made average or fewer spatial errors in English reading reveals the same pattern of nonsense word vowel errors (Appendix D). These "low English spatial" subjects made significantly more vowel errors with Hebrew nonsense

words than with English nonsense words (binomial sign test, $p < .01$, 2-tailed). Therefore this pattern is not particular to children who make above average spatial errors in English as was suggested by hypothesis 6.

Reading Predictors:

To address hypotheses 4 and 5, scores achieved in kindergarten on English linguistic tasks were correlated with reading measures in first and second grades. Of all the 14 reading predictors administered in kindergarten, only phoneme analysis correlated significantly with English reading achievement in both grades, [grade 1: $r(13) = -.79$, $p < .01$; grade 2: $r(11) = -.82$, $p < .001$], and Hebrew reading achievement in both grades [grade 1: $r(13) = -.82$, $p < .001$; grade 2: $r(11) = -.80$, $p < .001$], accounting for 63% and 67% of the variance in English reading and 67% and 64% of the variance in Hebrew reading in first and second grades, respectively. When errors were divided into those committed with vowels and those committed with consonants, each error-type correlated significantly with English and Hebrew reading achievement in first and second grades. Vowel errors were more highly predictive of English reading achievement than Hebrew in both grades, while the consonant errors were more highly predictive of Hebrew reading achievement than English in both grades. In second grade picture vocabulary was also significantly correlated with English and unvowelized Hebrew

reading achievement, and syntax errors were significantly negatively correlated with unvowelized Hebrew reading achievement (Table 25). Nonsignificant reading predictor correlations are listed in Appendices E and F.

Though the longitudinal population had dwindled from 22 in kindergarten to only 11 in second grade, thus precluding a reliable multiple regression, the procedure was carried out in order to ascertain trends. Four regression equations were computed using English reading achievement, grade 1; English reading achievement, grade 2; Hebrew reading achievement, grade 1; and Hebrew reading achievement, grade 2 as the dependent variables (Table 26). In all four equations, the phoneme analysis subtest, administered in kindergarten, was the most predictive of future reading achievement in both English and Hebrew. For second grade English reading achievement, picture vocabulary and grammatical completion subtests administered in kindergarten accounted for additional variance. Using all three subtests, 88% of the variance in second grade English reading achievement could be accounted for. Similarly, second grade Hebrew reading achievement was predicted best with kindergarten administration of phoneme analysis and grammatical completion, which together accounted for 90% of the variance in second grade Hebrew reading achievement.

While such results must be replicated using a larger population before they are considered reliable, the data

TABLE 25
Kindergarten Administered Reading Predictors: Correlations with
English and Hebrew Reading Measures in First and Second Grade

Grade 1 (N=11)			
Reading Achievement			
Reading Predictors	English	Vowelized Hebrew	Unvowelized Hebrew
Phoneme Analysis, Vowel Errors	-.80*	-.66+	-.60+
Phoneme Analysis, Consonant Errors	-.66+	-.87**	-.58(ns)
Grade 2 (N=11)			
Reading Achievement			
Reading Predictors	English	Vowelized Hebrew	Unvowelized Hebrew
Phoneme Analysis, Vowel Errors	-.78*	-.60+	-.51(ns)
Phoneme Analysis, Consonant Errors	-.74*	-.91**	-.73*
Picture Vocab	.64+	.55(ns)	.71*

+ p<.05
* p<.01
** p<.001

...

TABLE 26
Multiple Regression of Reading Predictors
Administered in Kindergarten

<u>DEPENDENT VARIABLE</u>	<u>VARIABLE</u>	<u>MULTIPLE R</u>	<u>R SQUARE</u>
English Reading: First Grade	Phoneme Analysis, Vowel Errors	.80	.64
English Reading: Second Grade	Phoneme Analysis, Vowel Errors	.78	.60
	Picture Vocabulary	.88	.77
	Grammatical Comple- tion errors (morphology)	.94	.88
Hebrew Reading: First Grade	Phoneme Analysis, Consonant Errors	.87	.75
Hebrew Reading: Second Grade	Phoneme Analysis, Consonant Errors	.91	.83
	Grammatical Comple- tion errors (morphology)	.95	.90

suggests that a test of phoneme analysis, administered in kindergarten, will predict to future reading achievement in English and in Hebrew in first and second grades, thus supporting hypotheses 4 and 5. With more subjects, one could determine the potentially significant contributions of other linguistic awareness tasks administered in kindergarten including picture vocabulary and grammatical completion.

CHAPTER VII

DISCUSSION

Introduction

The underlying assumption for the six hypotheses explored in this study was that English and Hebrew are processed in an essentially analogous fashion, despite their orthographic differences. Error types were used as "windows" through which processing strategies could be inferred.

In the present chapter a brief overview of the findings is presented with respect to the six proposed hypotheses. An interpretation of the findings from theoretical, methodological and pragmatic views follows. In addition some implications for models of reading are presented, limitations of the study are discussed and suggestions for further research are offered.

Brief Summary of Findings

Hypothesis 1 stated that there is a significant positive relationship between reading achievement in English and reading achievement in Hebrew. This hypothesis was strongly supported by the significant correlations found between English reading achievement and Hebrew reading achievement in both grades 1 and 2.

Hypothesis 2 stated that children who show a phonetic approach profile in English will show a phonetic approach

profile in Hebrew. Hypothesis 3 stated that children who show a "whole-word" approach profile in English will show a "whole-word" approach profile in Hebrew. In support of the second hypothesis, children who demonstrated proficient phonetic skills in reading English nonsense words also demonstrated phonetic skills in Hebrew. However these phonetically sophisticated children were also competent in using whole word reading strategies when necessary in English, as evidenced by their high performances with English real words, and in Hebrew, as evidenced by their proficiency in unvowelized word reading.

In support of the third hypothesis, children who demonstrated predominantly whole word strategies in English also preferred whole word approaches in Hebrew. In contrast to the "phonetic" group, their preference appeared to be by default, as they had only weakly developed phonetic skills and thus lacked the flexibility required to adapt to the demands of the script. Their whole word skills were primitive, as evidenced by the few words correctly identified and the preponderance of real-word substitution errors committed by these children, who often appeared to look at the first or other salient letters of a word and then guess. In support of hypotheses 2 and 3, the vast majority of subjects demonstrated equivalent competencies and word-attack approaches to unfamiliar words in the two languages.

Hypothesis 4 stated that English linguistic awareness

tasks administered in kindergarten will predict to English reading achievement in first and second grades. Significant correlations were found between performance on a phoneme analysis task administered in kindergarten and English reading achievement in first and second grades, thus supporting the hypothesis. Results of multiple regression procedures suggest that English picture vocabulary and English grammatical completion (morphology) subtests administered in kindergarten may increase the predictability of second grade English reading achievement when administered along with the phoneme analysis subtest.

Hypothesis 5 stated that English linguistic awareness tasks administered in kindergarten will predict to Hebrew reading achievement in first and second grades. Significant correlations were found between performance on a phoneme analysis subtest administered in kindergarten and Hebrew reading achievement in first and second grades. Results of multiple regression procedures suggest that the administration of an English grammatical completion subtest (morphology), together with the phoneme analysis subtest, may significantly increase the predictability of Hebrew reading achievement in first and second grades.

Hypothesis 6 stated that in general, average readers will make more vowel errors in English than in Hebrew. However children who make significantly more than an average number of spatial errors in English will make more vowel errors in

Hebrew than in English. The first part of hypothesis 6 was not supported. Average readers made an equivalent number of vowel errors in reading English and Hebrew real words and they made more Hebrew than English vowel errors in reading nonsense words. The second part of hypothesis 6 was also unsupported. When opportunities for errors were accounted for, subjects who made above average spatial errors in English reading made a similar number of vowel errors in reading English and Hebrew real words. On nonsense word reading these children made more vowel errors in Hebrew than in English, but so did all the subjects. Since this error profile was not particular to high spatial error subjects, it did not support hypothesis 6, which claimed more vowel errors in Hebrew for high spatial error subjects only.

Discussion

In the pilot study conducted with 4th grade subjects, very significant similarities were observed between reading achievement and reading approaches in English and in Hebrew. However the question was raised as to whether these findings were the result of transfer of skills and strategies from one language to the other, or whether they developed independently. Therefore it was decided to conduct a study beginning at the earliest stages of reading. The current longitudinal study examined children at a prereading level and followed them through first and second grades to observe their initial reading behaviors in English and in Hebrew.

The findings of the longitudinal study suggest that children approach reading in English and Hebrew in much the same manner from the very beginning reading stages, despite the significant differences between the two orthographies. From first grade test results and again in second grade, the vast majority of the children demonstrated analogous wholistic and phonetic decoding skills in the two languages, resulting in a very similar degree of overall reading proficiency in English and in Hebrew. Superior readers of English developed simultaneously into superior readers of Hebrew, and average to below average English readers were similarly slow at acquiring reading proficiency in Hebrew. Though whole-word reading strategies are not necessary to read Hebrew in first and second grades because the orthography presented is always vowelized, these superior readers had at their disposal wholistic skills, and were therefore able to read unvowelized Hebrew words, as well. While it is possible that these wholistic skills developed in Hebrew reading because they were being taught simultaneously in English reading, it may be the case that they developed autonomously, as part of the normal reading process regardless of the immediate orthographic demands.

Consistent with the literature, at least some linguistic awareness tasks predicted to future reading achievement in English. Phoneme analysis, which requires an awareness of the individual sounds which together comprise words, was the best

"predictor" among the subtests used. Phoneme awareness tasks have also been found by others to be particularly sensitive reading predictors (Liberman et al, 1974; Helfgott, 1976; Zifcak, 1976). Consistent with Borck (1983), phoneme analysis was an equally sensitive predictor of Hebrew reading.

The finding that awareness of morphology may also serve as an English reading predictor is also consistent with the literature (Fry et al, 1970; Britten, 1970; Wiig et al, 1973). In this study it was demonstrated that knowledge of English morphology may also predict to Hebrew reading achievement.

Picture vocabulary, which measures passive knowledge of English words, also contributed to the prediction of English reading achievement. This is consistent with several reading prediction studies including Fry and Schute (1970), de Hirsh et al (1966), Jansky and de Hirsh (1972) and Ravenette (1961).

Hypothesis 6 arose out of a supposition that in general, average readers would be aided by the regularity of Hebrew vowels and therefore would make fewer vowel errors in Hebrew than in English, where each vowel has multiple pronunciations. However this was not the case. It appeared that for these first graders, vowel symbols in Hebrew were not yet stabilized, and that therefore they made just as many vowel errors with Hebrew real words as with English real words. With nonsense words, where both English and Hebrew vowels are rule-governed and therefore have only one permissible pronunciation, more errors were made with Hebrew. It appears

that the vowel sound-symbol correspondences for Hebrew were less stable than they were for English, possibly because of the visual similarities among Hebrew vowel symbols. Though hypothesis 6 predicted that more Hebrew than English vowel errors would occur only for subjects who showed other spatial error tendencies (i.e. spatial errors in English reading), it may be the case that in first grade all readers are confused by the visual similarities among vowels. Furthermore, though they were labeled the same for the purposes of this study, it appeared that "spatial errors" in English, which consisted largely of the omission or displacement of parts within a word, may be different from Hebrew "spatial errors," which were largely confusions regarding the dot configurations of vowels. In future studies it may be better to form separate subtypes of spatial errors.

Implications

The analogous performances in English and Hebrew reading achievement and word attack strategies demonstrated by the subjects in this study suggest that a single reading model may account for reading in these two orthographies despite their alphabetic, phonetic and morphologic differences. The analogous whole word reading proficiency exhibited in the two orthographies is a particularly significant finding with regard to reading models because it is not necessary for first and second graders to use whole word strategies to read

Hebrew. The vowelized orthography that is presented to primary school children can be read perfectly with exclusive reliance on a phonetic decoding strategy. Nevertheless these beginning readers demonstrated whole word decoding skills in Hebrew commensurate with their whole word decoding skills in English.

The "dual-route" reading models, whereby reading may proceed via phonetic or whole-word channels, could therefore account for reading in Hebrew as well as English. However unlike English, where one can clearly demonstrate the need for both processing strategies from the earliest reading stages (i.e. many "beginner" words are irregular, e.g. "the," "come"), beginning Hebrew reading does not require an alternate route to phonetic decoding. There is no orthographic demand on a beginning Hebrew reader to engage a whole word reading process. Yet these better readers read the unvowelized words without hesitation. Possibly a wholistic approach to reading occurs spontaneously over the course of development, as is claimed with regard to English reading by Gibson and Levin (1975), Seidenberg (1985) and Stanovich (1986). If it were demonstrated to be true for Hebrew in the absence of simultaneous instruction in English, then one could make a stronger claim that such a developmental stage is independent of particular orthographic demands. It may be the case, as Seidenberg (1985) and Stanovich (1986) have argued, that increased wholistic reading leads to faster and more

efficient word processing.

Glusko's single route reading model, which claims that all words are read lexically, and that new words and non-words are read by analogy with familiar letter clusters, while plausible with regard to English, would appear to be a very inefficient method of reading Hebrew. Whereas the direct application of a few single and consistent phonetic "rules" are sufficient for fluent Hebrew reading, reading by analogy would require a search through already wholistically familiar words to find both the same vowel patterns and then each consonant with which to pair each vowel. With unvowelized words one cannot derive the pronunciation from patterns alone. It is not by analogy with other words but rather through context and syntax that pronunciation is derived in the absence of pure "rote knowledge." Given the similar performances of subjects in this study in reading English and Hebrew, it makes little sense to invoke two different models of reading, one for each orthography. Since a single-route reading-by-analogy model may accommodate English reading but not Hebrew reading, it does not appear to be a sufficient model of reading in either orthography. Rather, it is likely that, at minimum, a dual-route model is necessary to account for the analogous single-word reading performances in the two orthographies.

Models that include knowledge of context, syntax, word frequency etc. may better explain the analogous performances

in textual reading in the two orthographies demonstrated in the pilot study. A more thorough study of passage reading in English and Hebrew would be necessary in order to make claims about the extent to which an interactive model might better accommodate the totality of reading behaviors, including single word and passage reading, in English and Hebrew.

Conclusions

A longitudinal study of English and Hebrew reading abilities in 5-7 year-old Hebrew Day School students revealed very significant correlations between reading achievement in the two languages. Specific reading error types committed in each language suggested analogous processing strategies in English and Hebrew. A test of phoneme analysis, administered in kindergarten, predicted to first and second grade reading achievement in English and in Hebrew.

Limitations of the Study

This study examined reading development in English and in Hebrew among children learning to read in both languages simultaneously, and found very significant similarities between the two. While one can speculate as to the generalizability of these results to other language combinations, any such conclusions based on these results are entirely unfounded. Furthermore, even with English and

Hebrew, the similarities that were observed occurred in a population of children learning to read the two languages simultaneously. One cannot assume that if reading instruction in the two orthographies were sequential rather than simultaneous that the results would be the same. It may be the case that the similar strategies observed were due to the children's developmental stage, which may predispose them to a particular approach or approaches for decoding symbolic material. Finally, until these results are replicated with a larger sample, the conclusions must be regarded cautiously.

Suggestions for Further Research

This investigation has stimulated questions and issues in need of further examination. Additional research should be conducted to cross-validate the current results and to examine related issues before the results of the present investigation can be generalized to other biliteracy situations or situations where reading is learned in one language before another. First, the present study should be replicated using a larger sample, to allow for cross validation of the present findings. Second, a comparison of English and Hebrew reading achievement when reading instruction takes place sequentially, rather than simultaneously, should be conducted to see whether or not age of acquisition or order of acquisition affects the results. Third, comparisons of simultaneous reading development using

other language combinations than English and Hebrew and including orthographies with greater and lesser degrees of similarity to one another should be conducted. Finally, studies of passage reading in two differing orthographies could provide insight as to the similarities and differences in the use of context and syntactical cues in decoding written language.

APPENDICES

Appendix A
Pilot Study Record Sheets

Subject Number:

1. Phoneme to Grapheme (English)

total correct /28
 regular /6
 irregular /6
 nonsense /16

vowel errors _____ consonant errors _____
 vowel errors _____ consonant errors _____
 vowel errors _____ consonant errors _____

2. Phoneme to Grapheme (Hebrew)

total correct /18
 vowels optional /6
 vowels required /6
 nonsense /6

used () not used () mixed ()
 vowel errors _____ consonant errors _____
 vowel errors _____ consonant errors _____

3. Grapheme to Phoneme (English)

- | | | | | |
|------------------|-----------------|------------------|------------------------|----------------------|
| 1 ___ is | 31 ___ mitten | 61 ___ listen | *91 ___ smolder | *121 ___ yacht |
| 2 ___ come | 32 ___ duck | 62 ___ paper | *92 ___ professional | *122 ___ alertly |
| 3 ___ the | 33 ___ name | 63 ___ until | *93 ___ delayed | *123 ___ sapphire |
| 4 ___ look | 34 ___ sit | 64 ___ peace | *94 ___ inventor | *124 ___ pathology |
| 5 ___ up | 35 ___ bear | 65 ___ remember | *95 ___ amazement | *125 ___ inaptitude |
| 6 ___ big | 36 ___ farm | 66 ___ strange | *96 ___ drawl | *126 ___ physician |
| 7 ___ down | 37 ___ night | 67 ___ angry | *97 ___ broadcast | *127 ___ memorandum |
| 8 ___ that | 38 ___ could | 68 ___ while | *98 ___ departure | *128 ___ sulphuric |
| 9 ___ she | 39 ___ food | 69 ___ watch | *99 ___ gruffly | *129 ___ aberration |
| 10 ___ on | 40 ___ high | 70 ___ leap | 100 ___ giggle | *130 ___ embassy |
| 11 ___ my | 41 ___ walk | 71 ___ quick | *101 ___ vehicle | *131 ___ alkali |
| 12 ___ jump | 42 ___ told | 72 ___ crash | *102 ___ cauliflower | *132 ___ cistern |
| 13 ___ something | 43 ___ street | 73 ___ body | *103 ___ lagoon | *133 ___ instigator |
| 14 ___ at | 44 ___ much | 74 ___ piece | *104 ___ rudely | *134 ___ ghoulish |
| 15 ___ look | 45 ___ still | 75 ___ public | *105 ___ valid | *135 ___ unsociable |
| 16 ___ him | 46 ___ pony | 76 ___ brought | *106 ___ relapse | *136 ___ abdominal |
| 17 ___ of | 47 ___ love | 77 ___ busy | *107 ___ jeopardize | *137 ___ causation |
| 18 ___ work | 48 ___ morning | 78 ___ surface | *108 ___ excusable | *138 ___ judicious |
| 19 ___ what | 49 ___ ship | 79 ___ groan | *109 ___ urgent | *139 ___ carnivore |
| 20 ___ rabbit | 50 ___ surprise | 80 ___ gravy | *110 ___ sociable | *140 ___ manganese |
| 21 ___ out | 51 ___ wife | *81 ___ comfort | *111 ___ zenith | *141 ___ vigil |
| 22 ___ was | 52 ___ most | *82 ___ engine | *112 ___ balmy | *142 ___ anarchy |
| 23 ___ man | 53 ___ better | *83 ___ soapy | *113 ___ penetration | *143 ___ vernacular |
| 24 ___ be | 54 ___ city | *84 ___ human | *114 ___ dignify | *144 ___ artesian |
| 25 ___ as | 55 ___ always | *85 ___ design | *115 ___ occasionally | *145 ___ expostulate |
| 26 ___ fly | 56 ___ found | *86 ___ crime | *116 ___ frigid | *146 ___ plagiarist |
| 27 ___ away | 57 ___ learn | *87 ___ warning | *117 ___ clerical | *147 ___ grandiose |
| 28 ___ cake | 58 ___ once | *88 ___ zigzag | *118 ___ radioactivity | *148 ___ arid |
| 29 ___ water | 59 ___ front | *89 ___ twilight | *119 ___ skeletal | *149 ___ picaresque |
| 30 ___ sheep | 60 ___ meaning | *90 ___ produce | *120 ___ recurrence | *150 ___ beatitude |
| 1 ___ ift | 11 ___ ziz | 21 ___ tob | 31 ___ telequik | 41 ___ polybend |
| 2 ___ bim | 12 ___ off | 22 ___ chen | 32 ___ shenning | 42 ___ dinian |
| 3 ___ ut | 13 ___ nudd | 23 ___ hets | 33 ___ quib | 43 ___ eldop |
| 4 ___ rayed | 14 ___ weet | 24 ___ plon | 34 ___ laip | 44 ___ wubform |
| 5 ___ kak | 15 ___ plen | 25 ___ lundy | 35 ___ dwit | 45 ___ wotfeb |
| 6 ___ maft | 16 ___ twib | 26 ___ hode | 36 ___ pertome | 46 ___ cigbet |
| 7 ___ nen | 17 ___ beb | 27 ___ expram | 37 ___ sloy | 47 ___ conratior |
| 8 ___ ab | 18 ___ rejune | 28 ___ stabe | 38 ___ subcrote | 48 ___ biftel |
| 9 ___ tash | 19 ___ knap | 29 ___ imbaf | 39 ___ pipped | 49 ___ bafmotben |
| 10 ___ wip's | 20 ___ ain | 30 ___ eam | 40 ___ etbom | 50 ___ nolhod |

Subject Number: _____

total correct _____	vowel errors _____	consonant errors _____
regular _____	vowel errors _____	consonant errors _____
irregular _____	vowel errors _____	consonant errors _____
nonsense _____	vowel errors _____	consonant errors _____
grade level equivalency: real _____	nonsense _____	

4. Grapheme to Phoneme (Hebrew)

- | | | | | |
|----------|----------|----------|-----------|-----------|
| 1 _____ | 31 _____ | 61 _____ | 91 _____ | 121 _____ |
| 2 _____ | 32 _____ | 62 _____ | 92 _____ | |
| 3 _____ | 33 _____ | 63 _____ | 93 _____ | |
| 4 _____ | 34 _____ | 64 _____ | 94 _____ | |
| 5 _____ | 35 _____ | 65 _____ | 95 _____ | |
| 6 _____ | 36 _____ | 66 _____ | 96 _____ | |
| 7 _____ | 37 _____ | 67 _____ | 97 _____ | |
| 8 _____ | 38 _____ | 68 _____ | 98 _____ | |
| 9 _____ | 39 _____ | 69 _____ | 99 _____ | |
| 10 _____ | 40 _____ | 70 _____ | 100 _____ | |
| 11 _____ | 41 _____ | 71 _____ | 101 _____ | |
| 12 _____ | 42 _____ | 72 _____ | 102 _____ | |
| 13 _____ | 43 _____ | 73 _____ | 103 _____ | |
| 14 _____ | 44 _____ | 74 _____ | 104 _____ | |
| 15 _____ | 45 _____ | 75 _____ | 105 _____ | |
| 16 _____ | 46 _____ | 76 _____ | 106 _____ | |
| 17 _____ | 47 _____ | 77 _____ | 107 _____ | |
| 18 _____ | 48 _____ | 78 _____ | 108 _____ | |
| 19 _____ | 49 _____ | 79 _____ | 109 _____ | |
| 20 _____ | 50 _____ | 80 _____ | 110 _____ | |
| 21 _____ | 51 _____ | 81 _____ | 111 _____ | |
| 22 _____ | 52 _____ | 82 _____ | 112 _____ | |
| 23 _____ | 53 _____ | 83 _____ | 113 _____ | |
| 24 _____ | 54 _____ | 84 _____ | 114 _____ | |
| 25 _____ | 55 _____ | 85 _____ | 115 _____ | |
| 26 _____ | 56 _____ | 86 _____ | 116 _____ | |
| 27 _____ | 57 _____ | 87 _____ | 117 _____ | |
| 28 _____ | 58 _____ | 88 _____ | 118 _____ | |
| 29 _____ | 59 _____ | 89 _____ | 119 _____ | |
| 30 _____ | 60 _____ | 90 _____ | 120 _____ | |

total correct /167
 print with vowels /
 print without vowels /
 script with vowels /
 script without vowels /
 nonsense /

41 _____
 42 _____
 43 _____
 44 _____
 45 _____
 46 _____

Subject Number _____

5. Auditory Discrimination (English)

- | | | |
|----------------------|-----------------------|-----------------------|
| 1. cad-cab _____ | 7. lit-lick _____ | 13. wedge-wedge _____ |
| 2. led-lad _____ | 8. bug-bud _____ | 14. suck-sock _____ |
| 3. thief-sheaf _____ | 9. lass-lath _____ | 15. vie-thy _____ |
| 4. lake-lake _____ | 10. fret-threat _____ | 16. map-nap _____ |
| 5. bead-deed _____ | 11. bum-bun _____ | 17. cuff-cuss _____ |
| 6. pet-pit _____ | 12. lave-lathe _____ | |

total correct /17
 same /2
 different /15

6. Auditory Discrimination (Hebrew)

- | | |
|----------|-----------|
| 1. _____ | 6. _____ |
| 2. _____ | 7. _____ |
| 3. _____ | 8. _____ |
| 4. _____ | 9. _____ |
| 5. _____ | 10. _____ |

total correct /10
 same /2
 different /8

7. Sound Analysis

- | | | | | |
|-------------|------------|-------------|-------------|--------------|
| 1. ch _____ | 5. g _____ | 9. p _____ | 13. ā _____ | 17. u _____ |
| 2. sh _____ | 6. t _____ | 10. f _____ | 14. ʾ _____ | 18. o _____ |
| 3. p _____ | 7. f _____ | 11. h _____ | 15. a _____ | 19. oo _____ |
| 4. w _____ | 8. b _____ | 12. b _____ | 16. i _____ | 20. i _____ |

total correct /20
 vowel errors /8

consonant errors /12

8. Reversed Phonemes

- | | | | |
|--------------|---------------|--------------|--------------|
| 1. ag _____ | 3. ba _____ | 5. mip _____ | 7. af _____ |
| 2. tac _____ | 4. keet _____ | 6. oop _____ | 8. tez _____ |

total correct /8
 vowel errors /3

consonant errors /5

9.

A The Balloon

Nearly two hundred
years ago
in France,
the first man
went up in a balloon.
The balloon was made of
paper
covered with strips of cloth
to make it strong.
A huge basket
was attached underneath
to carry people,
and a long rope
anchored it
to the ground.
On this first trip,
the man was in the air
alone for several minutes.
Later he took a friend
up in the balloon with him.
That time, they rose
more than five hundred feet
and stayed up
for half an hour.
They came down
several miles
from where they started.

A Time _____ sec Speech
Memories
Cued Memories

Open Recall:

- When does this story take place?
Where does this story take place?
What was the balloon made of?
What was underneath the balloon?
Who went in the balloon on the first trip?
How long was he in the air?
Who went in the balloon on the second trip?
How high did they go?
How long did they stay up?
Where did they come down?

Subject Number: _____

Oral Reading: English

ERRORS	NOUNS	VERBS	PUNCTUATION	OTHER
Substitutions				
Mispronunciations				
Words Permitted by Examiner				
Disregard of Punctuation				
Insertions				
Repetitions				
Omissions				
Total Errors				

	4			5			6
GRADE	L	M	H	L	M	H	L
TIME	56	45	42	39	38	35	31
MEMORIES	12			12			13

Subject Number:

10. ☐ An Adventure

Silent Reading: English

Last week
 a boy and girl from our school
 had a real adventure.
 They were going past the bank
 on their way home
 for lunch
 when two men ran out
 with a bag of money.
 The men had a car waiting for them
 and drove away
 very fast.
 When the police came, ...
 the children told them
 what color the car was
 and how big it was.
 They could even tell the police
 that one man was short and
 the other one was tall.
 Because the children were
 in the right place
 that day, ...
 the men were soon caught and
 the money was returned.

☐ Time _____ sec Spontaneous Memories _____

Cued Memories _____

GRADE	3			4			5		
	L	M	H	L	M	H	L	M	H
TIME	60	53	49	45	41	37	36	34	30
MEMORIES	12			12			12		

Cued recall:

When did this story take place?

Where did it take place?

Who were the heroes in the story?

What did they see?

What important details did they remember?

To whom did they report the information?

What happened to the men? The money?

וְלֹא רֹדֵף - צָאן וְשֵׁחַ עֲקִיבָא
 עֲקִיבָא דִּיבּ אִישׁ יִשְׂרָאֵל וְלֹא
 אִתְּרָא לֹא לְמַד מִזֶּה
 וְלֹא יִדַּע וְלִטְרָא
 וְלִטְרָא דְּהָר בֵּן אֲרַבָּעַם שָׁנָה
 וְבֵן דְּהָר בֵּן אִישׁ כְּשֶׁר
 וְשֵׁחַ דְּחַל
 דְּחַל כֹּחֵם יִבֵּן מֵאִד
 אֲרַבָּעַם
 דְּחַל אֲרַבָּעַם אֵל עֲקִיבָא
 אֵל עֲקִיבָא אֵל אֵל דְּחַל
 כְּשֶׁם אִתְּרָא אִתְּרָא אִשׁ דְּחַל
 יִדַּע אִשׁ דִּי אֵל בֵּן אִישׁ עֲשֵׂר
 אִתְּרָא דְּחַל עֲשֵׂר
 אִתְּרָא אִשׁ אֲרַבָּעַם אֲרַבָּעַם
 דְּחַל אֲרַבָּעַם אֲרַבָּעַם
 דְּחַל דְּחַל אֲרַבָּעַם אֲרַבָּעַם
 אֲרַבָּעַם דְּחַל אֲרַבָּעַם אֲרַבָּעַם

Time _____ Spontaneous Memories _____
Cued Memories _____

who are the characters in this story?
what do you know about each of them?
what was Akiva like?
what was Akiva unable to do?
how old was Akiva?
what was Rachel like?
what did Akiva ask Rachel?
what did Rachel reply?

ERRORS	NOUNS	VERBS	FACTORS	OTHER
Substitutions				
Mispronunciation				
Words Programmed by Examiner				
Disregard of Punctuation				
Insertions				
Hesitations				
Repetitions				
Omissions				
Total Errors				

Subject Number

מחבר דביר

14. Silent Reading:
Hebrew without
vowels

	האחיות הקטנות שלי
	שמה דביר
	היא כבר גדולה - היא בג' ג'ש
	היא קומצת בביתה ב'.
	לוקר היא קמה בעשר שש
	היא מתחבבת
	מחבבת
	ואיכסל אכזבת - לוקר
	היא גם שוקה בוס חלה
	בית - הספר שלי בחור מחבב שלי
	היא קומצת לבית - הספר וכל הילכה
	אחרי אחרת - לוקר
	היא לוקרת את הספרים שלה
	ואם מתחבבת עליה
	ומה קשה מאד כש
	בשבת לוקרת לבית - הספר
	אחרי מאלה
	במה כש' אל צדד
	בשבת לוקרת לבית הספר
	אחרי צדד: אני צדד שלישי אחרון:
	חמש - עשרה בשבת לוקרת
	וחמש עשרה בשבת הבית - שואל מאד
	וחמש - עשרה ... וחמש - עשרה אני צדד בשבת אחר
	אחרי צדד
	לוקרת שלישי אחרון
	אחרי צדד לוקרת את הספר
	אחרת שלישי
	לוקרת מן הבית
	לוקרת לבית - הספר

New Reading:

What is this story about?

How old is Rivka?

What grade is she in?

What time does she get up in the morning?

What does she do before breakfast?

What does she do with breakfast?

How does Rivka get to school? Why?

What does Rivka do after breakfast?

What does Rivka do after school for the night?

What does Rivka do every day for?

Subject Number:

15. Animal Naming

1.	11.	21.
2.	12.	22.
3.	13.	23.
4.	14.	24.
5.	15.	25.
6.	16.	26.
7.	17.	27.
8.	18.	28.
9.	19.	29.
10.	20.	30.

16. Clothing Naming

1.	11.	21.
2.	12.	22.
3.	13.	23.
4.	14.	24.
5.	15.	25.
6.	16.	26.
7.	17.	27.
8.	18.	28.
9.	19.	29.
10.	20.	30.

17. C.	F.	L.
1.	1.	1.
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.
6.	6.	6.
7.	7.	7.
8.	8.	8.
9.	9.	9.
10.	10.	10.
11.	11.	11.
12.	12.	12.
13.	13.	13.
14.	14.	14.
15.	15.	15.

18. D	G	H
1.	1.	1.
2.	2.	2.
3.	3.	3.
4.	4.	4.
5.	5.	5.
6.	6.	6.
7.	7.	7.
8.	8.	8.
9.	9.	9.
10.	10.	10.

Subject Number

19. Homonyms

1. ate _____
2. wood _____
3. sail _____
4. witch _____
5. brake _____
6. plain _____
7. root _____
8. threw _____
9. reed _____
10. tale _____

20. *9.11.10*

2.1.10

- | | | | |
|-----|-----|-----|-----|
| 1. | 11. | 1. | 11. |
| 2. | 12. | 2. | 12. |
| 3. | 13. | 3. | 13. |
| 4. | 14. | 4. | 14. |
| 5. | 15. | 5. | 15. |
| 6. | 16. | 6. | 16. |
| 7. | 17. | 7. | 17. |
| 8. | 18. | 8. | 18. |
| 9. | 19. | 9. | 19. |
| 10. | 20. | 10. | 20. |

21. Propositional Speech

1. A man was bitten by a dog. _____
A dog was bitten by a man. _____
2. Ron _____ Jimmy _____
3. mother's sister _____
4. sister's mother _____
5. aunt's daughter _____
6. daughter's aunt _____

Appendix B

Kindergarten Record Sheets

1. Animal Naming

- | | | |
|----|-----|-----|
| 1. | 6. | 11. |
| 2. | 7. | 12. |
| 3. | 8. | 13. |
| 4. | 9. | 14. |
| 5. | 10. | 15. |

2. Clothing Naming

- | | | |
|----|-----|-----|
| 1. | 6. | 11. |
| 2. | 7. | 12. |
| 3. | 8. | 13. |
| 4. | 9. | 14. |
| 5. | 10. | 15. |

3. Picture Vocabulary (Discontinue after 5 consecutive failures)

- | | | | | | |
|--------------|---|-------|--------------|---|-------|
| 1. mirror | A | _____ | 16. emigrant | C | _____ |
| 2. bulb | A | _____ | 17. vine | A | _____ |
| 3. tray | D | _____ | 18. monument | B | _____ |
| 4. farmer | A | _____ | 19. herd | C | _____ |
| 5. anchor | B | _____ | 20. novel | B | _____ |
| 6. explosive | B | _____ | 21. feeble | D | _____ |
| 7. lizard | A | _____ | 22. dome | D | _____ |
| 8. winged | B | _____ | 23. floral | B | _____ |
| 9. stump | B | _____ | 24. maternal | A | _____ |
| 10. medical | B | _____ | 25. infantry | D | _____ |
| 11. young | C | _____ | | | |
| 12. voyage | B | _____ | | | |
| 13. weep | C | _____ | | | |
| 14. salmon | A | _____ | | | |
| 15. oil | A | _____ | | | |

4. Oral Vocabulary

1. bird _____
2. rest _____
3. face _____
4. door _____
5. cow _____
6. finger _____
7. ocean _____
8. sugar _____
- forest _____
10. baby _____

4. Oral Vocabulary (continued)

11. poor _____
12. sad _____
13. season _____
14. castle _____
15. old _____
16. true _____
17. behind _____
18. village _____
19. tall _____
20. north _____

total correct /20

5. Verbal Memory (English)

1. dog							
2. skirt							
3. hat							
4. cake							
5. cat							
6. pants							
7. butter							
8. milk							
9. bird							

totals:

organizational strategy: recency () primacy () semantic ()

other () none ()

6. Grammatical Completion

- | | | | |
|----|-----|-----|-----|
| 1. | 6. | 11. | 16. |
| 2. | 7. | 12. | 17. |
| 3. | 8. | 13. | 18. |
| 4. | 9. | 14. | 19. |
| 5. | 10. | 15. | |

7. Nonsense Word Morphology

- | | | |
|----|----|-----|
| 1. | 5. | 9. |
| 2. | 6. | 10. |
| 3. | 7. | 11. |
| 4. | 8. | 12. |

8. Auditory Discrimination (English)

- | | | |
|----------------------|-----------------------|-----------------------|
| 1. cad-cab _____ | 7. lit-lick _____ | 13. wedge-wedge _____ |
| 2. led-lad _____ | 8. bug-bud _____ | 14. suck-sock _____ |
| 3. thief-sheaf _____ | 9. lass-lath _____ | 15. vie-thy _____ |
| 4. lake-lake _____ | 10. fret-throat _____ | 16. map-nap _____ |
| 5. bead-dead _____ | 11. bum-bun _____ | 17. cuff-cuss _____ |
| 6. pet-pit _____ | 12. lave-lathe _____ | |

total correct /17
 same /2
 different /15

9. Auditory Discrimination (Hebrew)

- | | |
|--------------------------|---------------------------|
| 1. אָבִיב - אָבִיב _____ | 5. אָבִיב - אָבִיב _____ |
| 2. אָבִיב - אָבִיב _____ | 6. אָבִיב - אָבִיב _____ |
| 3. אָבִיב - אָבִיב _____ | 7. אָבִיב - אָבִיב _____ |
| 4. אָבִיב - אָבִיב _____ | 8. אָבִיב - אָבִיב _____ |
| 5. אָבִיב - אָבִיב _____ | 9. אָבִיב - אָבִיב _____ |
| | 10. אָבִיב - אָבִיב _____ |

total correct /10
 same /2
 different /8

10. Sound Analysis

- | | | | | |
|-------------|------------|-------------|-------------|--------------|
| 1. ch _____ | 5. g _____ | 9. p _____ | 13. ā _____ | 17. u _____ |
| 2. sh _____ | 6. t _____ | 10. f _____ | 14. ā _____ | 18. o _____ |
| 3. p _____ | 7. t _____ | 11. h _____ | 15. a _____ | 19. oo _____ |
| 4. w _____ | 8. b _____ | 12. b _____ | 16. i _____ | 20. i _____ |
- total correct /20 vowel errors /8 consonant errors /12

11. Syllables

- | | |
|----|-----|
| 1. | 5. |
| 2. | 7. |
| 3. | 8. |
| 4. | 9. |
| 5. | 10. |

12. Propositional Speech

1. A man was bitten by a dog _____
 A dog was bitten by a man _____
2. Ron _____ Jimmy _____
3. mother's sister _____
4. sister's mother _____
5. aunt's daughter _____
6. daughter's aunt _____

Appendix C

First and Second Grade Record Sheets

1. Animal Naming

- | | | |
|----|-----|-----|
| 1. | 6. | 11. |
| 2. | 7. | 12. |
| 3. | 8. | 13. |
| 4. | 9. | 14. |
| 5. | 10. | 15. |

2. Clothing Naming

- | | | |
|----|-----|-----|
| 1. | 6. | 11. |
| 2. | 7. | 12. |
| 3. | 8. | 13. |
| 4. | 9. | 14. |
| 5. | 10. | 15. |

3. Picture Vocabulary (Discontinue after 5 consecutive failures)

- | | | | | | |
|--------------|---|-------|--------------|---|-------|
| 1. mirror | A | _____ | 16. emigrant | C | _____ |
| 2. bulb | A | _____ | 17. vine | A | _____ |
| 3. tray | D | _____ | 18. monument | B | _____ |
| 4. farmer | A | _____ | 19. herd | C | _____ |
| 5. anchor | B | _____ | 20. novel | B | _____ |
| 6. explosive | B | _____ | 21. feeble | D | _____ |
| 7. lizard | A | _____ | 22. dome | D | _____ |
| 8. winged | B | _____ | 23. floral | B | _____ |
| 9. stump | B | _____ | 24. maternal | A | _____ |
| 10. medical | B | _____ | 25. infantry | D | _____ |
| 11. young | C | _____ | | | |
| 12. voyage | B | _____ | | | |
| 13. weep | C | _____ | | | |
| 14. salmon | A | _____ | | | |
| 15. oil | A | _____ | | | |

4. Oral Vocabulary

1. bird _____
2. rest _____
3. face _____
4. door _____
5. cow _____
6. finger _____
7. ocean _____
8. sugar _____
9. forest _____
10. baby _____

4. Oral Vocabulary (continued)

11. poor _____
12. sad _____
13. season _____
14. castle _____
15. old _____
16. true _____
17. behind _____
18. village _____
19. tall _____
20. north _____

total correct /20

5. Verbal Memory (English)

1. dog							
2. shirt							
3. hat							
4. cake							
5. cat							
6. pants							
7. butter							
8. milk							
9. bird							

totals:

organizational strategy: recency () primacy () semantic ()
 other () none ()

6. Grammatical Completion

- | | | | |
|----|-----|-----|-----|
| 1. | 6. | 11. | 16. |
| 2. | 7. | 12. | 17. |
| 3. | 8. | 13. | 18. |
| 4. | 9. | 14. | 19. |
| 5. | 10. | 15. | |

7. Nonsense Word Morphology

- | | | |
|----|----|-----|
| 1. | 5. | 9. |
| 2. | 6. | 10. |
| 3. | 7. | 11. |
| 4. | 8. | 12. |

8. Auditory Discrimination (English)

- | | | |
|----------------------|-----------------------|-----------------------|
| 1. cad-cab _____ | 7. lit-lick _____ | 13. wedge-wedge _____ |
| 2. led-lad _____ | 8. bug-bud _____ | 14. suck-sock _____ |
| 3. thief-sheaf _____ | 9. lass-loath _____ | 15. vie-thy _____ |
| 4. lake-lake _____ | 10. fret-threat _____ | 16. map-nap _____ |
| 5. bead-dead _____ | 11. bum-bun _____ | 17. cuff-cuss _____ |
| 6. pet-pit _____ | 12. lave-lathe _____ | |

total correct /17
 same /2
 different /15

9. Auditory Discrimination (Hebrew)

- | | |
|------------------------|-----------------------------|
| 1. קָבֵץ - קָבֵץ _____ | 6. פִּיּוּ - פִּיּוּ _____ |
| 2. קָבֵץ - קָבֵץ _____ | 7. פִּיּוּ - פִּיּוּ _____ |
| 3. קָבֵץ - קָבֵץ _____ | 8. פִּיּוּ - פִּיּוּ _____ |
| 4. קָבֵץ - קָבֵץ _____ | 9. פִּיּוּ - פִּיּוּ _____ |
| 5. קָבֵץ - קָבֵץ _____ | 10. פִּיּוּ - פִּיּוּ _____ |

total correct /10
 same /2
 different /8

10. Sound Analysis

- | | | | | |
|-------------|------------|-------------|-------------|--------------|
| 1. ch _____ | 5. s _____ | 9. p _____ | 13. a _____ | 17. u _____ |
| 2. sh _____ | 6. t _____ | 10. f _____ | 14. b _____ | 18. o _____ |
| 3. p _____ | 7. c _____ | 11. h _____ | 15. d _____ | 19. oo _____ |
| 4. w _____ | 8. b _____ | 12. b _____ | 16. i _____ | 20. i _____ |
- total correct /20 vowel errors /8 consonant errors /12

11. Syllables

- | | |
|----|-----|
| 1. | 6. |
| 2. | 7. |
| 3. | 8. |
| 4. | 9. |
| 5. | 10. |

12. Propositional Speech

1. A man was bitten by a dog _____
 A dog was bitten by a man _____
2. Ron _____ Jimmy _____
3. mother's sister _____
4. sister's mother _____
5. aunt's daughter _____
6. daughter's aunt _____

Sounds in Isolation

Letters

t (/t/)	b (/b/)	s (/s/ or /z/)	v (/v/)
f (/f/)	j (/j/)	w (/w/)	d (/d/)
p (/p/)	n (/n/)	l (/l/)	k (/k/)
c (/ç/)	h (/h/)	g (/g/ or /j/)	z (/z/)

Blends and Digraphs

st (/st/)	ch (/ch/)	th (/th/)	sl (/sl/)
fr (/fr/)	sm (/sm/)	pl (/pl/)	tw (/tw/)
sh (/sh/)	dr (/dr/)	tr (/tr/)	cl (/kl/)
fl (/fl/)	sk (/sk/)	sw (/sw/)	gr (/gr/)

Phonograms

av (/ʌ/)	ill (/ɪl/)	in (/ɪn/)
ot (/ot/)	ow (/ou/)	ain (/ʔɪn/ or /ɔn/)
aw (/ɔ/)	ock (/ɔk/)	an (/ɔn/)
are (/ar/ or /ɑr/)	unk (/ʌŋk/)	et (/et/)
int (/ɪnt/)	um (/ʌm/)	each (/ɛʃ/)
ess (/es/)	oat (/ɔt/)	eeze (/ɛz/)
uzzle (/ʌz/)	urn (/ɜrn/)	

Affixes (Initial)

con- (/kən/ or /kɔn/)	un- (/ʌn/)	re- (/rɛ/ or /ri/)
in- (/ɪn/)	en- (/ɛn/ or /ɪn/)	de- (/dɛ/ or /di/)
dis- (/dɪs/)	pro- (/prɔ/ or /pra/)	

Affixes (Final)

-er (/ər/)	-ation (/ʔɪʃən/)	-ful (/fʌl/ or /fʊl/)
-ment (/mənt/)	-ic (/ɪk/)	-tion (/ʃən/)
-sion (/ʃən/ or /ʃon/)	-ous (/əs/)	

GRADE	Mid 1	Mid 2	Mid 3	Mid 4	Mid 5	Mid 6
LETTERS	15	16	—	—	—	—
BLENDS AND DIGRAPHS	12	14	16	—	—	—
PHONOGRAMS	—	16	18	—	—	—
AFFIXES (INITIAL)	—	—	—	7	8	—
AFFIXES (FINAL)	—	—	—	6	7	3

SOUNDS IN ISOLATION

	Score	Grade
Letters	—	—
Blends and Digraphs	—	—
Phonograms	—	—
Affixes (Initial)	—	—
Affixes (Final)	—	—

11. Grapheme to Phoneme (English)

1 is	31 mitten	61 listen	91 smolder	121 yacht
2 come	32 duck	62 paper	92 professional	122 alertly
3 the	33 name	63 until	93 delayed	123 sapphirine
4 look	34 sit	64 peace	94 inventor	124 patriotic
5 up	35 bear	65 remember	95 amazement	125 ineptly
6 big	36 farm	66 strange	96 drawl	126 physician
7 down	37 night	67 angry	97 broadcast	127 memorize
8 that	38 could	68 while	98 departure	128 sulphurous
9 she	39 food	69 watch	99 gruffly	129 aberrant
10 on	40 high	70 leap	100 giggle	130 embassy
11 my	41 walk	71 quick	101 vehicle	131 alkali
12 jump	42 told	72 crash	102 cauliflower	132 cluster
13 something	43 street	73 body	103 lagoon	133 instigate
14 at	44 much	74 piece	104 rudely	134 ghoulie
15 book	45 still	75 public	105 valid	135 unsocial
16 him	46 pony	76 brought	106 relapse	136 abdomen
17 of	47 love	77 busy	107 jeopardize	137 causation
18 work	48 morning	78 surface	108 excusable	138 justice
19 what	49 ship	79 groan	109 urgent	139 carnivore
20 rabbit	50 surprise	80 gravy	110 sociable	140 manganese
21 out	51 wife	81 comfort	111 zenith	141 wig
22 was	52 most	82 engine	112 balmy	142 anarchy
23 man	53 better	83 soapy	113 penetration	143 vernacular
24 be	54 city	84 human	114 dignify	144 artesian
25 as	55 always	85 design	115 occasionally	145 expostulate
26 fly	56 found	86 crime	116 frigid	146 plagiarize
27 away	57 learn	87 warning	117 clerical	147 grandiose
28 cake	58 once	88 zigzag	118 radioactivity	148 aria
29 water	59 front	89 twilight	119 skeletal	149 daycare
30 sheep	60 meaning	90 produce	120 recurrence	150 beatitude
1 left	11 ziz	21 tob	31 telequik	41 polybenzyl
2 bim	12 off	22 chen	32 shenning	42 dianian
3 ut	13 nudd	23 hets	33 quib	43 eldop
4 rayed	14 west	24 glon	34 laip	44 wunferant
5 kok	15 plen	25 lundy	35 fupwit	45 woties
6 maff	16 twib	26 hode	36 pertome	46 cigret
7 nen	17 beb	27 exgram	37 sloy	47 conrat
8 ab	18 rejune	28 stabe	38 superote	48 bifet
9 tash	19 knap	29 imbof	39 pipped	49 bafrotte
10 wig's	20 ain	30 cam	40 etoon	50 notran

A-5 In each row, circle the letter or letters that make the sound you will hear.

1	ר	ז	ז	ע
2	ת	ר	פ	ר
3	ר	פ	ר	ח
4	פ	ר	ב	ב
5	מ	ב	ב	ם
6	ב	פ	ק	ר
7	ב	ק	ב	ב
8	ז	ר	ע	ב
9	ב	ב	ר	ן
10	ן	ש	ם	ז

11	ב	ר	ב	ב
12	ק	ג	ב	ב
13	ם	ש	ם	ז
14	ב	פ	ק	פ
15	ר	ח	ב	ח
16	ש	ז	ם	ן
17	פ	ח	ר	ר
18	ץ	ז	ר	ג
19	ח	ן	ם	ש
20	ך	ח	ת	ב

A-8 In each row, circle the vowel that matches the name you will hear.

1	•	•	•	•	•	•	•	•	•
2	•	•	•	•	•	•	•	•	•
3	•	•	•	•	•	•	•	•	•
4	•	•	•	•	•	•	•	•	•
5	•	•	•	•	•	•	•	•	•
6	•	•	•	•	•	•	•	•	•
7	•	•	•	•	•	•	•	•	•
8	•	•	•	•	•	•	•	•	•
9	•	•	•	•	•	•	•	•	•

A-7 In each row, circle the vowel that matches the sound you will hear.

1	•	•	•	•	•	•	•	•	•	•
2	•	•	•	•	•	•	•	•	•	•
3	•	•	•	•	•	•	•	•	•	•
4	•	•	•	•	•	•	•	•	•	•
5	•	•	•	•	•	•	•	•	•	•
6	•	•	•	•	•	•	•	•	•	•
7	•	•	•	•	•	•	•	•	•	•
8	•	•	•	•	•	•	•	•	•	•
9	•	•	•	•	•	•	•	•	•	•
10	•	•	•	•	•	•	•	•	•	•
11	•	•	•	•	•	•	•	•	•	•
12	•	•	•	•	•	•	•	•	•	•

Subject Number: _____

total correct _____

regular _____

irregular _____

nonsense _____

grade level equivalency: _____

vowel errors _____

vowel errors _____

vowel errors _____

real _____

consonant errors _____

consonant errors _____

consonant errors _____

nonsense _____

4. Grapheme to Phoneme (Hebrew)

1 _____	31 _____	61 _____	91 _____	121 _____
2 _____	32 _____	62 _____	92 _____	
3 _____	33 _____	63 _____	93 _____	
4 _____	34 _____	64 _____	94 _____	
5 _____	35 _____	65 _____	95 _____	
6 _____	36 _____	66 _____	96 _____	
7 _____	37 _____	67 _____	97 _____	
8 _____	38 _____	68 _____	98 _____	
9 _____	39 _____	69 _____	99 _____	
10 _____	40 _____	70 _____	100 _____	
11 _____	41 _____	71 _____	101 _____	
12 _____	42 _____	72 _____	102 _____	
13 _____	43 _____	73 _____	103 _____	
14 _____	44 _____	74 _____	104 _____	
15 _____	45 _____	75 _____	105 _____	
16 _____	46 _____	76 _____	106 _____	
17 _____	47 _____	77 _____	107 _____	
18 _____	48 _____	78 _____	108 _____	
19 _____	49 _____	79 _____	109 _____	
20 _____	50 _____	80 _____	110 _____	
21 _____	51 _____	81 _____	111 _____	
22 _____	52 _____	82 _____	112 _____	
23 _____	53 _____	83 _____	113 _____	
24 _____	54 _____	84 _____	114 _____	
25 _____	55 _____	85 _____	115 _____	
26 _____	56 _____	86 _____	116 _____	
27 _____	57 _____	87 _____	117 _____	
28 _____	58 _____	88 _____	118 _____	
29 _____	59 _____	89 _____	119 _____	
30 _____	60 _____	90 _____	120 _____	
1 _____	11 _____	21 _____	31 _____	41 _____
2 _____	12 _____	22 _____	32 _____	42 _____
3 _____	13 _____	23 _____	33 _____	43 _____
4 _____	14 _____	24 _____	34 _____	44 _____
5 _____	15 _____	25 _____	35 _____	45 _____
6 _____	16 _____	26 _____	36 _____	46 _____
7 _____	17 _____	27 _____	37 _____	
8 _____	18 _____	28 _____	38 _____	
9 _____	19 _____	29 _____	39 _____	
10 _____	20 _____	30 _____	40 _____	

total correct /167

print with vowels /

print without vowels /

script with vowels /

script without vowels /

nonsense /

USE OBJECTS

SAMPLE: comb key watch scis. umbr.

key	scis.	umbr.	watch	comb	scis.	key	umbr.	comb	watch
umbr.	watch	scis.	comb	watch	key	scis.	comb	umbr.	key
scis.	key	umbr.	scis.	umbr.	watch	comb	key	watch	scis.
watch	umbr.	comb	key	watch	umbr.	scis.	umbr.	key	comb
umbr.	scis.	watch	comb	scis.	comb	key	scis.	comb	umbr.

	5.0-	5.6-	6.0-	6.6-	7	8	9	10	11	12	13
NORMS: (age)	5.5	5.11	6.5	6.11	(M+F)	(M+F)	(M+F)	(M+F)	(M)	(M)	(M)
<u>MALES</u>											
Mean Score	104	86	75	72	70	62	48	50	47	42	42
+1sd	139	118	92	95	94	75	59	61	59	48	49
<u>FEMALES</u>											
Mean Score	94	76	73	63							
+1sd	120	97	94	76							

SMALL LETTERS - HIGH FREQ.

SAMPLE: p o d a s

o	a	s	d	p	a	o	s	p	d
s	d	a	p	d	o	a	p	s	o
a	o	s	a	s	d	p	o	d	a
d	s	p	o	d	s	a	s	o	p
s	a	d	p	a	p	o	a	p	s

	5.0-	5.6	6.0	6.6-	7	8	9	10	11	12	13
NORMS: (M&F, age)	5.5	5.11	6.5	6.11	(M+F)	(M+F)	(M+F)	(M+F)	(M)	(M)	(M)
<u>MALE</u>											
Mean Score	67	59	45	42	33	31	25	24	22	18	18
+1sd	95	82	66	60	40	32	30	26	27	23	21
<u>Females</u>											
Mean Score	61	47	43	37							
+1sd	83	64	61	47							

APPENDIX D

Average and Low Spatial Error Subjects:
Vowel Errors in English and Hebrew

VOWEL ERRORS

SUBJECT	<u>English Real</u>	<u>Hebrew Real</u>	<u>English Nonsense</u>	<u>Hebrew Nonsense</u>
1.	1	0	0	0
2.	5	0	0	0
3.	3	12	2	5
4.	4	6	2	4
5.	2	5	0	6
6.	3	0	0	0
7.	1	4	2	5
8.	7	3	4	6
9.	1	3	0	6
11.	5	1	0	0
12.	4	8	0	4
13.	4	0	0	0
15.	5	4	0	3
16.	7	9	4	6
17.	1	2	0	0
19.	8	3	0	2
20.	11	16	6	5
23.	7	0	0	1
24.	15	5	3	4
25.	7	2	1	3
26.	14	0	0	0
27.	0	0	0	0
28.	15	7	0	1
30.	5	1	1	2
31.	4	0	0	0
	X=5.6	3.7	0.9	2.5

APPENDIX E

Kindergarten Administered Reading Predictors:
Insignificant Correlations with English and Hebrew
Reading Measures in First Grade

(N=11)

Reading Achievement

Reading Predictors	<u>English</u>	<u>Vowelized Hebrew</u>	<u>Unvowelized Hebrew</u>
English Semantic Fluency	-.41	-.36	-.28
Picture Vocabulary	.43	.51	.43
Oral Vocabulary	-.10	.20	.06
Grammatical Completion errors	-.52	-.41	-.18
Nonsense word Grammatical completion errors	-.43	-.39	-.31
English Auditory Discrimination errors	.09	-.06	.09
Hebrew Auditory Discrimination errors	-.23	.18	-.09
English Syllable errors	-.04	-.02	-.05
Hebrew Syllable errors	-.11	.08	.11
English Syntax and Relational term errors	-.25	-.50	-.31

APPENDIX F

Kindergarten Administered Reading Predictors:
Insignificant Correlations with English and Hebrew
Reading Measures in Second Grade

(N=11)

Reading Achievement

Reading Predictors	<u>English</u>	<u>Vowelized Hebrew</u>	<u>Unvowelized Hebrew</u>
English Semantic Fluency	-.22	-.19	-.11
Oral Vocabulary	.02	-.06	.00
Grammatical Completion errors	-.29	-.29	-.45
Nonsense word Grammatical completion errors	-.46	-.14	-.18
English Auditory Discrimination errors	.01	-.03	-.14
Hebrew Auditory Discrimination errors	-.01	.23	-.19
English Syllable errors	-.10	-.02	-.37
Hebrew Syllable errors	.03	.14	-.45

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