Reading and Writing (2005) 18:527–558
DOI 10.1007/s11145-005-3179-x

Predicting foreign language reading achievement in elementary school students

JANINA KAHN-HORWITZ[1], JOSEPH SHIMRON[2] and RICHARD L. SPARKS[3]
[1]*University of Haifa, Haifa, Israel;* [2]*University of Haifa, Haifa, Israel;* [3]*College of Mt. St. Joseph, Cincinnati, Ohio, USA*

Abstract. This study examined whether factors affecting first language reading acquisition also affect English Foreign Language (EFL) reading acquisition. Hebrew (L1) and EFL reading related measures were administrated to 145 fourth graders from the north of Israel who were beginning their first year of English instruction. Results from a Linear Structural Equational Analysis (LISREL) showed that the Hebrew independent variable consisting of morphological and phonological awareness, orthographic ability, and word reading (accuracy and speed) predicted EFL knowledge of letter sounds and names, word attack and reading comprehension. In addition to the Hebrew independent variable, English word recognition (accuracy and speed) predicted English reading comprehension. These results support the Linguistic Coding Differences Hypothesis (LCDH), which argues for core linguistic abilities that influence first and subsequent language reading acquisition.

Key words: Acquisition, Foreign language, Reading

Abbreviations: English as a Foreign Language – EFL; first language – L1; Linguistic Coding Differences Hypothesis – LCDH; second language – L2

First language (L1) reading acquisition research over the past three decades (Adams, 1990; Carlisle & Nomanbhoy, 1993; Catts, Fey, Zhang, & Tombling, 1999; Ehri & Chun, 1996; Muter & Snowling, 1998; Scanlon & Vellutino, 1997; Shankweiler et al., 1995; Share & Stanovich, 1995; Snow, Burns, & Griffin, 1998) has specified basic linguistic abilities which have been shown to predict reading acquisition across languages (Bentin & Leshem, 1993; Geva, 1995; Geva & Siegel, 2000; Geva & Wade-Woolley, 1998; Gholamain & Geva, 1999; Olofsson & Niedersoe, 1997), but left open the question about the contribution of these abilities to the acquisition of reading in a foreign language (FL). The present research focused on children who had already acquired reading in their first language and were about to begin reading

instruction in a FL. The aim of the study was to identify the language related predictor variables for reading acquisition in English as a foreign language (EFL) and to determine whether these predictors were the same as those that predict L1.

Core linguistic abilities underlying L1 and FL reading

The present study examined the contribution of phonological, orthographic, morphological, and semantic knowledge to successful word recognition as well as overall FL reading comprehension. In examining this issue, the study tests the hypothesis that core linguistic abilities underlie success in both L1 and FL reading acquisition. In fact this study tests the Linguistic Coding Differences Hypothesis (LCDH), which was developed by Sparks and Ganschow (1993a, b; Sparks, 1995), which predicts that basic linguistic abilities that allow for successful L1 reading have similar impact on the acquisition of FL reading. Linguistic abilities imply intuitive use of oral or written language (Menyuk & Chesnick, 1997), as well as basic linguistic skills. The speaker who masters these linguistic skills are at least partially sensitive to the linguistic structure of language (Rayner & Pollatsek, 1989). In the context of this research, spelling, word reading and knowledge of Hebrew morphology such as deriving an appropriate word from a given root in L1 Hebrew would be examples of linguistic ability.

Difficulty in first language processing, very often at the phonological and orthographic levels but also at the syntactic or semantic level, is likely to be expressed in both first and later FL processing. Sparks and Ganschow based the LCDH on L1 reading research conducted by Vellutino and Scanlon (1986), who found that poor L1 readers had difficulty with the structural aspects of the printed word, particularly with the phonological and orthographic aspects, but also with the syntactic aspects. In their research with high school and college students, Sparks and Ganschow found that these ''core'' linguistic abilities also affected FL learning (including reading) (Ganschow, Sparks, Javorsky, Pohlman, & Bishop-Marbury, 1991; Sparks & Ganschow, 1993a).

Two theories compatible with the LCDH are the Central Processing Hypothesis and the Interdependence Hypothesis. The Central Processing Hypothesis (Geva & Siegel, 2000; Gholomain & Geva, 1999), found cognitive and linguistic abilities to underlie L1 and second language (L2) reading skills (Geva, Mack, Merlbaum, Lam, & Wade-Woolley, 1998; Geva & Wade-Woolley, 1998; Gholomain & Geva, 1999). Cummins' Interdependence Hypothesis proposes that L1 and L2 reading are

related to common cognitive-linguistic abilities: Reading ability in L1 would influence reading ability in L2 as well as overall linguistic and academic abilities (Cummins, 1984; Verhoeven, 1991). According to the Interdependence Hypothesis, reading related abilities developed in L2 will affect L1 reading development. The common thread linking the three above-mentioned hypotheses is the relationship between first and FL (or L2) reading development and their claim that L1 and L2 (or FL) reading is largely based on common linguistic abilities.

Differences between Hebrew and English orthographies

The English language is derived from an Indo-European lineage. Hebrew is a Semitic language. But both languages have alphabetic orthographies. The Hebrew orthography is written from right to left and has two written forms (orthographies). One includes vowels that are used in printing poetry, children's literature, biblical texts, and texts for learners of Hebrew. The second which excludes most vowels features in most Hebrew texts. In contrast, English is written from left to right. It is written linearly with all vowels being visually equivalent to other letters in the alphabet. On a continuum of shallow to deep orthographies, English is considered a deep orthography in that it has a considerable degree of irregularity between graphemes and phonemes. Voweled Hebrew should be considered a shallow orthography in that the grapheme–phoneme relationship is quite regular. However, unvoweled Hebrew should be considered a deep orthography because its readers should retrieve phonological information regarding vowels from their memory of Hebrew words due to the fact that vowels are not represented in the print. Another result of the lack of vowel signs in the unvoweled orthography is that many words are homographs, implying that they may be decoded in several ways. In such cases, the reader relies on context to disambiguate words (Shimron, 1993).

The English morphology is concatenative. That is, prefixes and suffixes are affixed to the original base word before or after the base in a linear fashion. Hebrew morphology is a mix of concatenative and nonconcatenative principles (Bentin & Frost, 1995). According to one linguistic analysis, Hebrew verbs and most nouns have roots and word patterns. The root contributes semantic and morphological information, whereas the word pattern categorizes the function of the word (Ravid, 2003), thereby, contributing information about the part of speech to which the word belongs. The root is a morpheme that consists of mostly three consonants and it is intertwined within the word pattern

which has vowels and templative consonants. An example is *safran* 'librarian' (male singular), where the root consists of the three letters *s-p-r* (*f* in *safran* and *p* in *s-p-r* are represented by the same letter) and the vowels together with the suffix *–an* denotes the noun. The roots and word patterns are bound morphemes in that only in combining the two will the specific phonological and semantic information about the word be elicited (Shimron, 2003). Different words have in common a root or word pattern (Berent & Shimron, 1997; Frost & Bentin, 1992). Alternatively, the root and pattern combination may be attributed to the word stem only, which is accompanied by prefixes and suffixes to mark gender, number, person and tense.

Developmentally, root perception precedes word pattern perception (Ravid, 2003). Monolingual 3 year old children from middle socioeconomic backgrounds comprehend innovative verbs that do not exist in the Hebrew lexicon based on their root structure (Berman, 2003). Research has found that early elementary school children have explicit knowledge of Hebrew morphology. Berman (2003) reports on children from ages 5 to 7 producing new verbs based on their knowledge of roots and patterns and Gillis and Ravid (2000) as well as Ravid (2001) report on Hebrew speaking 1st graders differentiating between roots and affixes and 3rd graders explicitly identifying roots. The Hebrew orthography is less compromising than its phonological counterpart so that salient root information is provided in the spelling of the language. During the process of reading and spelling acquisition, children's understanding of Hebrew root structure is facilitated (Ravid, 2003). Between kindergarten and 1st grade, spoken morphology assists in spelling development and is in turn developed by spelling acquisition (Levin, Ravid, & Rapaport, 1997). Elementary school children learn to spell grammatical words correctly before they reach correct spelling for content words (Ravid, 2001). Grammatical words are less morphologically complex and most grammatical words are frequent and fewer in number as opposed to the numerous content words, making spelling mastery of grammatical words a less challenging task. In addition, most function letters are spelled correctly from 2nd grade, whereas homophonic root letters remain a source of error, significantly declining only between 4th and 6th grades (Ravid, 2001). Elementary students are influenced by their language typology and use Hebrew morphological characteristics when acquiring word recognition (Ben-Dror, Bentin, & Frost, 1995) and spelling (Gillis & Ravid, 2000; Levin, Ravid, & Rapaport, 1997).

Fourth grade Hebrew (L1) elementary students are expected to be skilled at reading voweled Hebrew and already read a substantial

amount of unvoweled Hebrew texts (Kahn-Horwitz, 1994, Unpublished). They are accustomed to the unambiguous phonological information provided by the Hebrew vowels. As they acquire English reading, they have to confront a relatively irregular vowel system, as well as morpho–phoneme knowledge. This irregular orthographic system, as well as differences in the Hebrew word morphology, may account for difficulties in the acquisition of English reading amongst young Hebrew readers.

Measures of reading acquisition subskills

There are several linguistic factors that affect L1 as well as second (L2) or FL reading acquisition (Badian, 1995; Koda, 1992; Leong & Joshi, 1997; Vellutino & Scanlon, 1986). Basic reading skills include **letter recognition, phonological awareness** and **morphological awareness**. Letter recognition and phonological awareness require attention to language form regardless of meaning. They both are considered vital for successful reading acquisition in an alphabetic orthography (Schneider & Naslund, 1997; Share & Stanovich, 1995; Snow, Burns, & Griffin, 1998; Wagner et al., 1997) and they facilitate the decoding and encoding of an infinite number of words. Phonological awareness involves understanding that spoken words are made up of phonemes (Frost & Bentin, 1992) and is considered an essential component associated with successful L1 reading as it facilitates awareness of the relationship between the printed word and the phonemic representation of the word (Adams, 1990; Olofsson & Neidersoe, 1997; Share, 1995). Single phoneme awareness that involves identifying the smallest linguistic building blocks of spoken words, is very often developed in parallel with and as a result of beginning reading acquisition (Bentin & Leshem, 1993; Liberman & Shankweiler, 1985; Perfetti, 1985). The FL literature suggests a cross-language shared interpretation of phonological abilities in FL learning (Dufva & Voeten, 1999; Wade-Woolley, Chiappe, & Siegel, 1998). That is, phonological abilities measured in L1 would predict FL reading acquisition.

Orthographic knowledge, refers to knowledge of the writing system of a particular language, and consists of using the visual-orthographic cues found in written words to assist in word recognition (Ehri, 1992; Nassaji & Geva, 1999) and oral or text comprehension (Wagner & Barker, 1994). Orthographic units associated with the phonemes they represent are stored in memory and facilitate direct access to the lexicon (Ehri, 1992; Share & Stanovich, 1995). A foreign orthography may

place different demands and constraints on readers who have already acquired word recognition skills in their L1 orthography.

Knowledge of letter names may be considered a correlate measure of orthographic knowledge and is a L1 reading readiness measure that has been found to be a powerful predictor of L1 reading acquisition at the end of first grade (Badian, 1995; Scanlon & Vellutino, 1997; Snow et al., 1998). Knowledge of letter names often provides a cue to the sound of the letter (Carroll, 2000) and enables the beginner reader to use initial decoding strategies. Letter name knowledge can be evidence of an initial conception that words are made up of graphemes that represent phonemes (Share, 1995). In addition, accuracy of letter naming is a precursor of letter naming speed, which is strongly associated with reading success (Adams, 1990).

Rapid automatized naming (RAN) is considered an essential component of automatic, fluent reading. According to Bowers and Wolf (1993), slow naming of letters and digits indicates that automatic integration of orthographic units is not taking place and unsuccessful or inefficient word recognition results. Cutting, Carlisle and Denckla (1998) explain the relationship between RAN and orthographic awareness as being facilitated by processing speed. Successful, rapid accessing of familiar stimuli allows for efficient word recognition because readers can process orthographic units before they disappear from working memory (Kail & Hall, 1994). In L1 reading research, Cutting et al. (1998) found that RAN was independent of phonological processing and directly contributed to word reading amongst first to third graders. Geva, Yaghoub-Zadeh, and Schuster (2000) support the aforementioned results in their research on L1 English and ESL children. They found that although RAN shared common variance with phonological awareness, it also added considerable unique variance to fluent word reading. Research on children studying a L2 by Gholamain and Geva (1999) found that speed in letter naming was a strong predictor of both English and Persian word recognition and word attack. Dufva and Voeten (1999) reported that the faster young Finnish first and second graders decoded words in Finnish, the higher their EFL overall grades were in third grade (including beginning spelling and writing skills).

Grapheme–phoneme identification together with the ability to blend sounds into words allows for automatic word recognition as a means to reaching higher-level EFL reading comprehension. Researchers of both native language (Share, 1995; Share & Stanovich, 1995; Stanovich & Stanovich, 1995) and FL adult reading (Brisbois, 1995; Grabe, 1991; Koda, 1992; Nassaji & Geva, 1999; Segalowitz, Poulsen, & Komoda, 1991) have shown the necessity of reaching relative automaticity in

lower level decoding in order for high level reading comprehension to succeed.

Grapheme–phoneme correspondence in some alphabetic systems is constrained in order to preserve other aspects of the language such as morphological relationships (e.g. *heal*, *health* in English). In such writing systems, it seems that in order to ensure successful reading acquisition, sensitivity to orthographic as well as morphemic cues must be developed as additional routes to automatic decoding (Share, 1995).

Morphological knowledge is another basic linguistic ability that facilitates reading. Morphological knowledge requires focus on form in addition to meaning in a language. Sensitivity to morphemes requires attending to the smallest grammatical unit with meaning and perceiving a common structure associating two words even if they are not semantically related (e.g. *standing, working*) (Perfetti, 1985). Morphological knowledge may be necessary for word identification as well as reading comprehension as it connects the reader with word meaning (Carlisle, 2000; Snow et al., 1998). In L1 research, early morphological ability (measured at age three) has been shown to predict word reading in Danish second graders (Oloffson & Niedersoe, 1997). Although less researched than the causal role of phonological awareness in reading difficulties, Ben-Dror, Bentin, & Frost (1995) have suggested that poor morphological awareness may also be a cause of reading disabilities, especially in orthographies such as Hebrew, a language in which understanding words very often depends on understanding the constituent morphemes of which they are composed, i.e. roots, patterns and affixes. Understanding the morphological structure of a second language may be particularly important for assisting in understanding new words (Durgunoglu, 1997). Morphological knowledge leads to vocabulary growth and knowledge of vocabulary is associated with better FL reading comprehension (Laufer, 1995; Sparks, Ganschow, & Patton, 1995).

Both English and Hebrew orthographies integrate phonological as well as morphological relationships. In order to acquire reading and spelling in these orthographies, morphological (Carlisle, 2000) as well as phonological skills need to be acquired (Carlisle & Nomanbhoy, 1993; Levin et al., 1997). Morphological decomposition would facilitate word recognition as lexical items may be stored according to morphological categories in the lexicon (Frost & Bentin, 1992; Tyler & Nagy, 1990; Shankweiler et al., 1995). English L1 speakers' morphological sensitivity contributed uniquely to decoding skills over and above phonological and vocabulary ability and their morphological sensitivity increased with age starting with first grade (Carlisle & Nomanbhoy, 1993) and continued throughout elementary school (Mahony, Singson,

& Mann, 2000). Hancin-Bhatt and Nagy (1994) witnessed cross-language transfer of morphological knowledge of derivational suffixes amongst bilingual Spanish–English fourth, sixth, and eighth graders. Because Spanish and English are orthographically as well as morphologically similar, these similarities facilitated transfer of morphological knowledge specifically regarding cognates. The distance between Hebrew and English orthographies and morphologies is great and hence the present research examined whether morphological awareness in Hebrew facilitated English reading skills.

Rationale

The current research examines whether students who study a FL based on different linguistic properties as their native language would rely on the same skills and techniques as they did in their first language for new word recognition as suggested by Bialystok (2001a). If so, this finding would support the LCDH. The following research questions were examined:

1. Whether and to what extent basic linguistic abilities (all measured in L1 Hebrew) at the beginning of the year predict EFL reading at the end of their first year of EFL instruction (fourth grade).
2. What is the specific predictive value of end of first year EFL reading related variables as measured by knowledge of letter sounds and names, word attack, word reading latency and word recognition as well as reading comprehension?

Method

Participants

One hundred and fifty-two students (65 boys and 87 girls) in their first year of EFL study (fourth grade) took part in the study. Their mean age at the beginning of the research was 9 years, 5 months, and at the end of the research was 10 years, 1 month. All students were native Hebrew speakers who had not lived in English-speaking countries or did not have English speaking parents. All participants were Hebrew L1 speakers and were able to read Hebrew. Children who spoke other languages as a first language were excluded from the study. None of the participants in the research had received formal

instruction in English in the form of an extracurricular activity. All participants had been exposed to English informally through the media (television and computers). Participants were selected from three schools in the north of Israel, all of which used variations of a whole language method for learning the oral aspects of EFL with emphasis on direct grapheme- phoneme instruction for learning EFL reading and writing.

Procedure

One hundred and fifty-two students were tested in L1 skills as well as knowledge of English letter sounds and names at the beginning of fourth grade. One hundred and forty-five students were tested in EFL reading skills at the end of fourth grade. Seven students who were tested at the beginning of the year missed the end of year testing due to absence on days of testing.

In addition, Hebrew language teachers completed student ratings at the beginning of the year and EFL teachers completed assessments of students' reading at the end of the year. These ratings validated the English reading comprehension informal measures. End of year English teacher evaluations significantly correlated with end of year English reading comprehension measures ($r = 0.60$, $P < 0.01$).

Research design

At the beginning of fourth grade before EFL reading instruction began, the following predictor variables were examined: Hebrew (L1) phonological and morphological awareness, Hebrew orthographic ability, Hebrew word recognition, Hebrew word attack (pseudoword decoding), Hebrew reading speed, Hebrew vocabulary knowledge, and English (FL) recognition of letter sounds and names.

The EFL measures by which EFL reading acquisition was assessed (referred to as criterion variables) were: Recognition of English letter sounds and letter names (a repeated measure of the tests given at the beginning of fourth grade), a standardized measure of English word and pseudoword reading, a measure of English word recognition (word reading accuracy) and latency (made up of words that were familiar to the participants and were two different measures of the same test), andtext comprehension. In addition, English teachers completed assessments of the students' EFL reading achievement.

Instruments

L1 linguistic abilities (predictor measures). Hebrew (L1) Phonological Awareness was measured by the Ben-Dror/Shany phoneme deletion task (Shany, Zeiger, & Ravid, 2001). This task consists of 20 one and two syllable words presented orally to the participants after five trials at the beginning of the task. Participants were required to complete all items. They were requested to repeat a word after the tester and subsequently repeat it whilst deleting either the beginning, final, or medial target phonemes resulting in a nonword, e.g., Say *xatul* (Hebrew for "cat"). Now say *xatul* without the /t/. The required answer would be the nonword: *xa'ul*.

Hebrew (L1) Morphological Knowledge was measured by the Ben-Dror/Shany morphological processing production task (Ben-Dror, et al., 1995). A production task was chosen because it is considered to be more sensitive in tapping metalinguistic abilities and contributes greater variance in word reading than a judgment task (Carlisle & Nomanbhoy, 1993). This task consists of five trial items and 15 test items. Participants were presented orally with the root of a word and thereafter a sentence with a word missing. They were requested to provide the missing word in the sentence that was morphologically related to the root of the word. For example, the tester pronounced the root word *rakad* (Hebrew for "dance"). Then, the tester presented the sentence: "*Ha'iš šehofi'a al habama hu ha'*_____" (Hebrew for "The man that performed on the stage is the _____ ."). The student had to fill in *rakdan* (Hebrew for *dancer*). Speed in completing all of the 15 test items and accuracy for this task were measured for each student. Time was measured using a stopwatch.

L1 reading related predictor measures. Hebrew (L1) Orthographic Ability was measured by an informal spelling measure (see Appendix A). The test consisted of two subtests. One subtest consisted of 14 single words and the second subtest was made up of two sentences consisting of five and six words. Both subtests were dictated to students. The single words were dictated within the context of a sentence in order to control for ambiguity. The students were required to listen to the contextual sentence but to write the target words only within the contextual sentence. In addition to the list of 14 single words, students were asked to write the two sentences (consisting of five and six words) in their entirety. All words were homophonic and contained sounds that could be represented by more than one letter, e.g., *tsohorayim 'noon'*. Each word was given in the context of a sentence, e.g. *Ani ose ši'urey*

bayit batsohorayim 'I complete my home-work at noon'. One point was given for each target word spelled correctly and one point was given for each word spelled correctly within the two 5 and 6 word sentences, making a total final score of 25 words.

Hebrew (L1) Word Recognition was measured by a nonstandardized single word decoding measure consisting of 20 frequent fourth grade level words (Balgur, 1977). All words included vowel diacritics. The words were presented in two columns of 10 words each on a single A4 size white cardboard. Each word was read aloud individually by the student.

Hebrew (L1) Word Attack Skills (pseudoword decoding) was individually measured by a list of 20 nonwords (e.g., *šer*, *zaši*, *erof*a) (Greenbaum & Lichter, 1996). These vowelized nonwords consisted of 6 one syllable, 11 two syllable and 3 three syllable nonwords. The words were presented in two columns of 10 words each on a single A4 size white cardboard with enlarged font size. Each word was read aloud by the student.

Hebrew (L1) Reading Speed was measured by a list of 210 unvoweled Hebrew words adapted from the Balgur Word Reading Measure (Balgur, 1977). Students were asked to read the words aloud as fast and as accurately as they could. In cases where a word could be pronounced in more than one way (24 out of the 210 words), any correct pronunciation was accepted (e.g., *ševa 'seven', sava 'eat one's fill',* savey'a *'satisfied'*). A timer was used and students were given one minute to read the words. The number of errors and words read in one minute were recorded for each student.

L1 verbal language predictor measures. Hebrew Vocabulary (Semantic) Skills were measured individually by the antonyms and synonyms subtests of the Man measure (Glantz, 1991). Each subtest consisted of 12 items that are normally presented in written format. However, the aim was to test vocabulary skills independently of reading skills and the items were therefore presented orally to the students. The tester read the key words and five options to the student. In order to circumvent short-term memory difficulties, the tester repeated the items if the student did not remember them. The synonyms task was presented as follows: The tester told the student that she/he would hear (and see) a word followed by five other words. One of the five words would have the same meaning as the target word. The student needed to identify the word that meant the same as the target word (e.g., *levana* 'moon'; *sefer* 'book'*; agala* 'wagon'*; koxav* 'star'*; yareax* 'moon'*; kutonet* 'nightie').

The antonyms task was explained in the same way as the synonyms task but students were told that they had to find the word that was the semantic opposite of the target word amongst the five possibilities (e.g., *yom* 'day'; *ša'*a 'hour'; *boker* 'morning'; *šemeš* 'sun'*; et* 'time'; *layla* 'night').

A Hebrew language evaluation was completed by fourth grade Hebrew language teachers as a supplement to L1 reading measures and L1 verbal ability measures. Teachers rated the students on a scale of 1–5 with 1 being the lowest score and 5 being the highest score. Items that were rated included Hebrew word recognition, Hebrew reading comprehension, Hebrew writing, Hebrew oral expression, Hebrew listening comprehension and overall ability in Hebrew. Evaluations were completed in the first three months of the fourth grade year.

Criterion variables – measures which assessed EFL reading. Knowledge of English letter sounds and letter names was measured by individually presenting students with the 26 lower case letters of the English alphabet in randomized fashion. Students pronounced the sounds that the letters represented and named the letters. For knowledge of letter sounds, one point was given for each sound correctly pronounced so that a maximum of 26 points could be awarded for this task. For knowledge of letter names, one point was given for each letter named correctly so that a maximum of 26 points could be acquired. This task was measured at the beginning and at the end of fourth grade.

English (FL) speed and accuracy of reading was measured by an informal list of 20 words to which the students had been exposed in their first year of EFL study (see Appendix B). The list included most letters of the English alphabet (excluding d, q, v, x and z), common digraphs (e.g., ee, oo, ch, th), and two irregular words (the, you). The participants read the list aloud as accurately and as quickly as they were able. Reading time was measured using a stopwatch. Two separate scores were calculated for this task. One score was an accuracy score out of 20 and the second was a speed score in seconds. The speed score was independent of the accuracy score and did not account for errors in accuracy.

English (FL) word attack (pseudoword decoding) was measured using the Word Attack subtest from the Woodcock Reading Mastery Test – Revised, Form H (Woodcock, 1987), which entails reading English nonwords of increasing difficulty. The test is discontinued after the student makes six consecutive errors. Raw scores were calculated for word reading accuracy because this test is used in an English L1 setting and is normed on the American English speaking population.

English (FL) word recognition was measured using the Word Identification subtest from the Woodcock Reading Mastery Test – Revised, Form H (Woodcock, 1987) which requires participants to read single English words of increasing difficulty. The test is discontinued after the reader makes six consecutive errors. As on the Word Attack subtest, raw scores were calculated.

English (FL) Reading Comprehension was measured by an informal measure consisting of two texts read silently by the student (see Appendix C for an example of one of the texts). Each text covered a different topic to which students were exposed during the fourth grade year and was followed by five written multiple choice questions presented in Hebrew. In order to determine whether the levels of the two passages were equivalent, a reliability analysis was conducted on a representative sample of 30 students. Guttman Split-half analysis results yielded a reliability estimate of 0.87. A Cronbach Alpha, which measured for uniformity between the answers, yielded 0.91 for the first five questions (part 1) and 0.83 for the second five questions (part 2).

An EFL reading evaluation was completed by EFL teachers as a supplement to the above measures. EFL teachers rated students on their overall English FL reading ability on a scale from 1 to 5 (1 was the lowest score and 5 was the highest score). Teachers were told to base their rating on a combination of student's EFL word recognition and reading comprehension.

Results

A path diagram was created which represented the research questions being tested. The path diagram represented the LCDH whereby linguistic, reading related and verbal language abilities measured in L1 (Hebrew) predicted the various subcomponents of EFL reading (measured as word recognition and reading comprehension). A LISREL was performed in order to check for statistical confirmation of the theoretical driven path diagram. This analysis was preferred to multiple regression analyses because the latter did not allow for examining whether the model (driven by the theory and represented by the path diagram) explained the data in one stage and in its entirety (Biddle & Marlin, 1987). Due to the number of participants in this study ($n = 145$), it was necessary to reduce the number of variables entered into the equation. The following six procedures assisted in reducing the independent variables that were subsequently included in the LISREL analysis. First, variables were combined in order to prevent

multicolinearity. Multicolinearity refers to high correlations between predictor variables creating redundancy and thereby limiting the predictability of each variable as separate predictors (Stevens, 1986), knowledge of English letter names and letter sounds ($r = 0.96$; $P < 0.01$) and Hebrew word identification and Hebrew word attack (pseudoword reading) ($r = 0.71$; $P < 0.01$).

Second, simple correlations were calculated between beginning Hebrew predictor variables (see Table 1). Speed of the morphological awareness task became a candidate for exclusion due to insignificant correlations between it and other measures.

Third, a principal component factor analysis was performed that produced one factor including all independent variables except for speed of performance on the morphological awareness task (see Table 2). Together the one factor accounted for 43% of the variance. The speed of morphological awareness variable was thereby excluded from the LISREL Analysis.

Fourth, hierarchical forced multiple regression analyses were conducted for each of the dependent (criterion) variables (EFL reading tasks). Separate models were created in order to find the relative contribution of each L1 predictor variable for each EFL reading skill. Separate regressions were conducted for: (a) the linguistic awareness L1 measures: phonological awareness, morphological awareness – speed and accuracy; (b) L1 (Hebrew) reading related measures: orthographic ability, word recognition, word attack, reading speed, teacher evaluation of Hebrew reading ability; and (c) the L1 verbal ability measures

Table 1. Intercorrelations between Hebrew predictor measures.

	1	2	3	4	5	6	7	8
1. phon	–							
2. orthog	0.39*	–						
3. morph	0.38*	0.38*	–					
4. hwrds	0.49*	0.46*	0.31*	–				
5. readsp	−0.38*	−0.49*	−0.40*	−0.44*	–			
6. semsyn	0.32*	0.42*	0.49*	0.29*	−0.34*	–		
7. semant	0.42*	−0.23*	0.41*	−0.34*	−0.23*	0.45*	–	
8. morpht	0.17**	0.14	0.15	0.13	−0.18**	0.16	0.13	–

Note. phon, Hebrew phonological awareness; orthog, Hebrew orthographic (spelling); morph, Hebrew morphological awareness; hwords, Hebrew word identification and word attack; readsp, Hebrew reading speed (errors); semsyn, Hebrew semantics synonyms; semant, Hebrew semantics antonyms; morpht, speed of morphological awareness. *$P < 0.01$ and **$P < 0.05$.

Table 2. Principal component factor analysis – Hebrew predictor measures.

	Component 1
Phonological awareness	0.72
Orthographic ability (spelling)	0.72
Morphological awareness (accuracy)	0.72
Word identification & word attack (z)	0.66
Reading speed (errors)	−0.67
Hebrew semantics synonyms	0.72
Hebrew semantics antonyms	0.64
Speed of morphological awareness	**0.30**

Note. Number in bold indicates that this measure did not load onto the one factor.

(vocabulary skills – synonyms and antonyms). Knowledge of English letter sounds and names from the beginning of the fourth grade year were entered into each of the aforementioned regressions in the first step as a way of controlling for the influence of initial knowledge of English sounds and names that students brought with them to fourth grade. After separate models were created for each criterion variable, significant predictors were taken from each of the three theoretically based models and entered into an integrated regression for each English end-of-year criterion variable. Multiple regressions were performed for each criterion variable (see Table 3).

The results showed that the two L1 verbal ability measures (vocabulary skills – synonyms and antonyms) in spite of being significant predictors of end-of-year English reading skills had the lowest beta values (Hebrew synonyms (vocabulary) task ($\beta = 0.15$, $P < 0.01$) and Hebrew antonyms (vocabulary) task ($\beta = 0.14$, $P > 0.05$)). They were therefore excluded from the LISREL analysis. Further support for their exclusion came from previous L2/FL research studies that did not find semantic tasks in L1 to predict reading in L2/FL (Ganschow et al., 1991; Geva et al., 2000; Sparks & Ganschow, 1993a).

Fifth, the Hebrew teacher evaluations of students, which consisted of four separate evaluations of Hebrew on each student (technical reading, reading and listening comprehension, and verbal expression) were combined based on a Cronbach Alpha reliability analysis with a coefficient of 0.92 (Smith, 1975, p. 59). In spite of the fact that the Hebrew teacher evaluation was a significant predictor of knowledge of English letter sounds and names, English word reading accuracy as well as latency it was excluded from the LISREL analysis as this was a variable which did not directly measure reading related abilities of the

Table 3. Integrated multiple regression – beginning of year (T1) variables predicting endof year (T2) EFL reading measures (controlling for english letter sounds and names).

	T2 Criterion Variables	End of year E. letter sounds & names (*z*)		E. word id. & word attack (*z*)		E. word recognition		E. word reading latency		E. text comprehension	
	T1 Predictor Variables	R^2	β	R^2	β	R^2	β	R^2	β	R^2	β
1	T1 English letter sounds and names	0.25	0.51^c	0.28	0.54^c	0.28	0.53^c	0.03	-0.19^a	0.17	0.41^c
	$F(1,150)$	51.73^c		60.69^c		58.7^c		5.34^a		30.5^c	
2	English letter sounds and names		0.17^a		0.24^b		0.21^b		-0.27^b		0.18^a
	Hebrew phonological awareness				0.17^a						0.23^b
	Hebrew morphological awareness										0.20^a
	Hebrew morphological awareness – time										-0.19^a
	Hebrew word id. & word Attack (z)		0.26^b		0.17^a		0.21^b				
	Hebrew reading speed (errors)				-0.20^b		-0.19^b				
	Hebrew teacher evaluation		0.24^b				0.17^a		0.18^a		
	Hebrew vocabulary – synonyms		0.15^b								
	Hebrew vocabulary – antonyms				0.14^a						
	R^2 Δ change		0.26		0.22		0.24		0.05		0.13
	Cumulative R^2		0.51		0.50		0.52		0.08		0.30
	F		20.71^c		26.36^c		24.11^c		5.3		16.8^c
	df		8, 143		8, 143		8, 143		8, 143		8, 143

$^aP < 0.05$; $^bP < 0.01$; $^cP < 0.001$

participants in the present study. It did, however, indicate that the empirical measures administered to participants were validated by or at least consistent with teacher evaluations.

Sixth, results of the English Word Identification subtest from the Woodcock Reading Mastery Test – Revised correlated very highly with the results of the Word Attack subtest ($r = 0.86$; $P < 0.01$). This subtest was designed for L1 English speakers and most of the words being read were possibly unknown to beginner fourth grade EFL readers. This was not the case for the informal word recognition task, which consisted of words that were expected to be part of the fourth graders' EFL lexicon. For these novice EFL language learners and readers, many of the real words presented in the Woodcock Word Recognition subtest may have been pseudowords. This explanation provided the rationale for choosing the informal word recognition task as opposed to the Word Identification subtest from the Woodcock Reading Mastery Test as a measure of EFL word recognition in the Linear Structural Equational Analysis.

Means and standard deviation scores were calculated for all variables entered into the LISREL analysis (see Table 4) and intercorrelations were calculated between these variables (see Table 5).

Phonological and morphological awareness, orthographic (spelling) ability, the combined score of word identification and word attack and the speed of reading variables (all measured in Hebrew) were entered into the LISREL Analysis as components of the Hebrew predictor independent variable. Dependent variables included knowledge of letter sounds and names, word reading latency, word attack, word recognition and reading comprehension (all measured in English).

The results suggest answers to the questions: Which beginning of the year L1 predictor variables best predicted end of year EFL reading criterion variables? In addition, the results suggest an answer to the question examining the relationship between the various EFL measures resulting in English word recognition and reading comprehension. The main objective of the study was to identify predictor variables for the initial reading acquisition process, focusing on word recognition as an essential prerequisite for reading comprehension.

Results of the LISREL Analysis are presented in Figure 1. The lambda values illustrating significant latent variables which comprised the Hebrew independent predictor, the gamma values showing significant regression coefficients between the Hebrew independent variable (made up of the phonological, morphological, orthographic, word recognition, word attack and speed reading abilities) and the respective English dependent variables, and the beta values showing significant

Table 4. Means, standard deviations and possible range of independent and dependent variables.

Variables	Mean Scores	Standard deviations	Range
Phonological awareness	10.8	3.88	1–20
Orthographic ability (spelling)	18.84	4.24	1–25
Morphological awareness (accuracy)	9.61	2.63	1–15
Hebrew word identification & word attack (z)	−0.03	0.96	
Hebrew reading speed (errors)	5.04	3.65	1–210
English letter sounds & names (z)	0.00	1.00	
English reading latency (seconds)	68.36	42.76	
English word attack	7.23	6.43	
English word recognition	8.61	6.19	1–20
English reading comprehension	3.99	3.7	1–10

Note. Possible range for all variables except for the composite scores and speed measure are included.

regression coefficients between the respective English dependent variables appear in Figure 1. The independent Hebrew measure did not predict the English reading latency measure and so the arrow connecting the two was removed. Although the sample size is relatively small,

Table 5. Intercorrelations between Hebrew predictor and English outcome measures included in LISREL analysis.

	1	2	3	4	5	6	7	8	9	10
1. phon	–									
2. orthog	0.39*	–								
3. morph	0.38*	0.38*	–							
4. hwrds	0.49*	0.46*	0.31*	–						
5. readsp	0.38*	−0.49*	−0.40*	−0.44*	–					
6. esn	0.45*	0.46*	0.48*	0.56*	−0.50*	–				
7. ewordt	−0.14**	−0.05	0.04	0.03	0.02	0.19	–			
8. ewat	0.55*	0.42*	0.41*	0.53*	−0.50*	0.71*	−0.20*	–		
9. ewrec	0.53*	0.47*	0.44*	0.56*	−0.51*	0.80*	−0.16**	0.87*	–	
10. ercomp	0.42*	0.44*	0.47*	0.38*	−0.35*	0.57*	−0.28*	0.63*	0.71*	–

Note. phon, Hebrew phonological awareness; orthog, Hebrew orthographic (spelling); morph, Hebrew morphological awareness; hwords, Hebrew word identification and word attack; readsp, Hebrew reading speed (errors); esn, English letter sounds and names; ewordt, English reading latency; ewat, English word attack; ewrec, English word recognition; ercomp, English reading comprehension. *$P < 0.01$ and **$P < 0.05$.

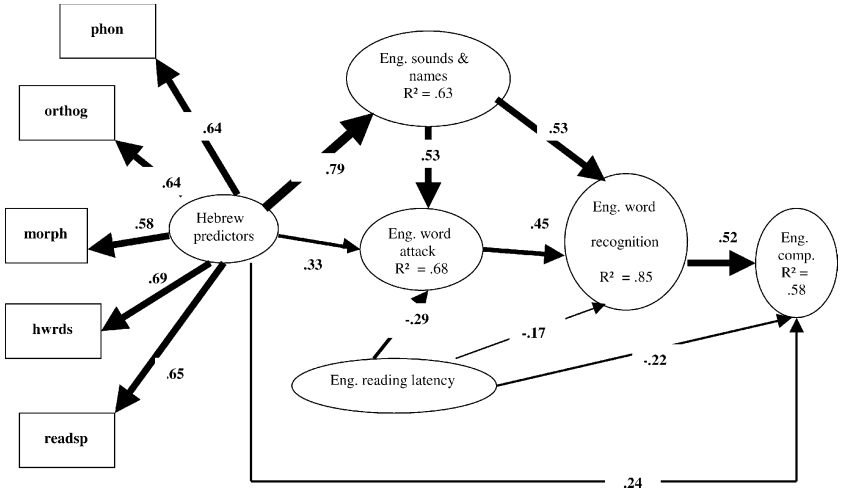

Figure 1. Linear structural equational model: Linguistic reading related L1 Hebrew predictors of EFL reading abilities.
Note. phon = Hebrew phonologica awareness; orthog = Hebrew orthographic (spelling); morph = Hebrew morphological awareness; hwords = Hebrew word identification & word attack; readsp = Hebrew reading speed (errors).

the model produced had a good statistical fit, χ^2 (29, $N = 145$) = 35.88, $P = 0.177$. Other goodness of fit measures produced optimal results; RMSEA = 0.041; a low standardized root means squared residual, SRMR = 0.040; and a high comparative fit index, CFI = 0.994 and adjusted goodness of fit index, AGFI = 0.910. These results show confirmation of the path diagram which aimed to test the Linguistic Coding Differences Hypothesis as well as the connections between knowledge of EFL letter sounds and names, word attack, word reading latency (EFL reading related subcomponents) and the ultimate dependent variables, EFL word recognition and reading comprehension.

Discussion

The primary purposes of this study were to identify the best reading related predictor variables for EFL reading achievement in elementary school age Hebrew speakers and to determine whether L1 Hebrew reading related variables successfully predicted EFL reading. Results provide support for the core linguistic hypotheses and are specifically consistent with the LCDH, which argues for a language basis consisting of various linguistic abilities. Difficulties in one or more of these abilities should have an impact on FL reading success. Despite the differences between

the Hebrew and English orthographies and morphological structure, common underlying abilities affecting L1 reading impacted on FL reading as well. In other words, the major finding of this study is that phonological, orthographic, morphological, and speed variables measured in Hebrew were accountable for EFL reading acquisition.

At the beginning of fourth grade, Hebrew phonological awareness, which was one of the observed variables that combined to form the Hebrew independent variable, significantly predicted knowledge of English letter sounds and names, English word attack and English text comprehension. Findings that phonological awareness in one language has successfully predicted "lower level" reading measures in a second language has been corroborated separately by Durgunoglu (1997) and Comeau, Cormier, Grandmaison, and Lacroix (1999), who found cross-language impact of phonological awareness on "lower level" reading measures. Also, in their L2/FL research, Geva and Wade-Woolley (1998) found evidence of an effect of phonological awareness in English as L1 on Hebrew as FL.

Findings that phonological awareness in one language has successfully predicted "higher level" reading measures in a second language have been corroborated by Carlisle, Beeman, Hull-Davis, and Sphraim (1999), who found phonological awareness measured in Spanish predicted English reading comprehension in elementary school Spanish speakers. Phonological processing allows for storing letter sounds in working memory whilst word recognition takes place in initial stages of reading acquisition and sequences of words are stored as phonological representations in working memory whilst comprehension takes place. The role of phonological processing in reading has been found to be universal even across languages that do not have an auditory component, as is the case with American Sign Language (Hanson, Goodell, & Perfetti, 1991) and orthographies that are logographic, as in the case of Chinese (Leong & Joshi, 1997; Perfetti, Zhang, & Berent, 1992).

The phoneme deletion task used in this research is considered a sensitive phonological awareness task (Wade-Woolley et al., 1998). The high correlations between the phonological awareness measure and the respective Hebrew as well as English reading measures indicate that there is a strong connection between phonological awareness skills and L1 reading skills in a stage of reading as late as fourth grade (Ben-Dror et al., 1995; Muter & Snowling, 1998; Wagner et al., 1997). The results provide evidence for an underlying awareness of phonology (measured in L1) which impacts across languages despite their different characteristics. The significant prediction of EFL reading measures by phonological awareness could be further explained by Hebrew L1 students

confronting a new alphabetic orthography and therefore needing to utilize their phonological abilities in successfully retaining new phonological representations in memory (initially English letter sounds and names and continuing with unfamiliar words).

Accuracy of the morphological awareness task (measured in Hebrew) successfully predicted knowledge of English letter sounds and names, English word attack and English text comprehension. Both morphological awareness and phoneme awareness appear to facilitate the reading of an unlimited amount of unfamiliar words for the novice reader. The high correlations found between morphological awareness and phonological awareness tasks in the present research as well as previous L1 research (e.g., Carlisle & Nomanbhoy, 1993; Feldman & Andjelkovic, 1992; Shankweiler et al., 1995) may indicate that in order to access different forms of the same roots or utilize different affixes, one has to utilize a phonological store of the morphological form in memory. It is noteworthy that in the present study morphological awareness measured in Hebrew predicted English word attack but not English word reading accuracy. The beginning EFL readers in this research were relatively novice decoders. They may not yet have been at the point in their EFL reading development where they used morphological strategies for EFL word recognition. However, their developed morphological awareness in Hebrew may have indicated stronger linguistic capabilities, which subsequently facilitated easier acquisition of EFL letter sound and name knowledge, pure decoding and reading comprehension.

The finding that both phonological and morphological awareness (measured in Hebrew) predicted EFL word attack as well as EFL reading comprehension lends additional support to the Linguistic Coding Differences Hypothesis, which speculates that the core abilities in L1 coding, i.e., that underlying linguistic abilities (phonological and morphological awareness) facilitate successful EFL reading.

The spelling (orthographic) measure was the third observed variable comprising the Hebrew independent variable that predicted EFL reading ability. In L1 research and theory, orthographic processing is seen to be intertwined with phonological processing (Wagner & Barker, 1994) as well as morphological processing (Levin et al., 1997). Orthographic processing is viewed as vital for successful reading skills at a more advanced level (Share & Stanovich, 1995). The results regarding orthographic abilities (measured in L1 Hebrew) predicting EFL reading comprehension in the present research were supported for adult advanced readers in cross-language and L2 research where Nassaji and Geva (1999) found that Farsi L1 orthographic processing skills contributed significantly to ESL reading comprehension.

An alternative explanation for the central role of orthographic ability has been presented in the literature where it is viewed as a skill separate from phonological ability but connected with rapid naming. Slow naming ability indicates difficulty in automatic identification of orthographic units (Bowers & Wolf, 1993). Results from the present research indicate that L1 orthographic abilities impacted on knowledge of English letter sounds and names, word attack and comprehension. Clear orthographic representations in Hebrew may coexist with a linguistic sensitivity, which facilitates the easy and fast acquisition of EFL knowledge of letter sounds and names, decoding skills and ultimately beginner level reading comprehension.

The composite score of word identification and word attack and the speed of reading measure (all measured in Hebrew) were the additional reading related measures that were part of the independent Hebrew predictor variable, which subsequently predicted knowledge of letter sounds and names, word attack and comprehension (all measured in English). Share and Stanovich (1995) suggest that retention in memory of L1 letter sounds and names by beginning readers is akin to the process of identifying pseudowords. Memory of L1 letter sounds and names requires the reader to retain new phonological representations in memory, a process that has to occur when reading pseudowords (word attack). In the present research Hebrew word attack and word identification were combined into a composite score due to their high intercorrelation. The predictive value of this combined measure supports a strong claim for between-language sharing of decoding skills.

The reading speed task in Hebrew was the fifth observed variable comprising the Hebrew predictor independent variable. This finding shows cross-language support for L1 speed of reading and other EFL reading tasks. These results support Dufva and Voeten's (1999) findings that Finnish L1 elementary school students who were fast decoders also received high scores on EFL literacy measures. The present research extends these results in that Hebrew reading speed impacted on EFL reading measures. Finnish and Hebrew are different orthographies yet the speed at which both languages were read impacted on EFL reading. This finding provides support for an overall speed of reading ability, which could be orthography independent.

In the present research the five Hebrew observed variables that comprised the Hebrew independent variable represented some of the important abilities needed for L1 word recognition and reading comprehension and showed cross language transfer of the most fundamental morphophonological, orthographic and speed related skills needed for L1 and FL reading acquisition. These morphological, phonological and ortho-

graphic skills (i.e., phoneme awareness, spelling ability, morphological production, word recognition and word attack) which are facilitated by the speed of processing factor contribute different information in parallel, creating a certain amount of redundancy and facilitating successful word recognition that underlies successful reading comprehension.

The second research question examined the relationship between the various reading processes (measured in English) resulting in successful EFL reading comprehension. Results of the LISREL model support a strong hierarchic connection between ''lower level'' and ''higher level'' EFL reading tasks. In order to easily comprehend text, one needs fast and accurate decoding skills. Successful initial word decoding depends on knowledge of grapheme-phoneme correspondence (following this, morphologic knowledge will contribute to accurate decoding ability).

Knowledge of English letter sounds and names predicted English word attack (a pure decoding measure) and English word recognition. Word attack predicted word recognition and word recognition predicted reading comprehension. English reading latency predicted word attack, word recognition and reading comprehension (all measured in English). Knowledge of English letter sounds and names can be viewed as rudimentary knowledge of the English orthography (Wagner & Barker, 1994) or as the ability to store ''nonword'' phonological information in memory (Share & Stanovich, 1995). Our findings are consistent with other studies that have found recognition of letter sounds and letter names to successfully predict word reading and reading comprehension in the case of L1 students learning to read in their L1 (English) (Ehri & Chun, 1996; Scanlon & Vellutino, 1997; Snow et al., 1998) and for English L1 and Punjabi L1 kindergarten and first graders word reading in English (Wade-Woolley et al., 1998). The ability to read nonwords as well as real words indicated excellent phoneme–grapheme translation as is indicated by the knowledge of English letter sounds and names measure. The English reading latency measure strongly connected with the word attack, word recognition and the reading comprehension tasks illustrating the importance of speed in being able to fluently decode words. The results showed that in EFL, both accurate and fast word recognition was an essential prerequisite for successful reading comprehension. These findings support L1 research results, which have found naming speed to be significantly associated with reading in elementary grades (Kail & Hall, 1994) and subsequent age groups including adults (van den Bos, Zijlstra & lutje Spelberg, 2002).

To sum up, main results of this research support the Linguistic Coding Differences Hypothesis and compatible approaches, which propose a common basic language ability that is expressed both in L1 and subse-

quently in any additional language acquired. However, L1 transfer of linguistic skills is only part of the picture and the importance of EFL word recognition (speed and accuracy) as predictors of EFL reading comprehension provides a more comprehensive outline of the various components that result in successful EFL reading comprehension.

Conclusions

Despite the differences between the Hebrew and English orthographies, the present research provides evidence for basic underlying reading related processes that influence L1 as well as FL reading acquisition. These basic underlying reading related processes (phonological, orthographic, and morphologic) were strong predictors of EFL word attack and text comprehension and indirect predictors of EFL word recognition. The phonological and morphological awareness tasks, the combined word identification and word attack measure, the spelling task and the reading speed task (all measured in Hebrew), which strongly predicted EFL reading ability, are examples of a common "core" ability that manifests itself in L1 and EFL. This finding corroborates the premise of the LCDH.

One of the main findings of the present research was the predictive ability of the two linguistic awareness measures – the phonological and morphological awareness tasks (measured in Hebrew) – which were strongly correlated with one another. To the authors' knowledge, this finding adds a new component to FL reading research in that it shows that morphological awareness (in addition to phonological awareness) is part of the basic underlying abilities that influence FL reading acquisition. Morphological knowledge has been shown to transfer between similar orthographies (Hancin-Bhatt & Nagy, 1994). However, in the case of dissimilar orthographies (Hebrew and English) the predictive ability of morphological awareness measured in Hebrew at the start of EFL reading acquisition may be an indication of accumulated abstract linguistic understanding that may facilitate acquisition of the new, albeit very different alphabetic system. It would be of interest in future studies to examine EFL developing morphological awareness and the relationship between Hebrew morphological awareness, EFL morphological awareness and EFL word recognition. Results of the present research support the morphological component being added to the common "core" ability of the Linguistic Coding Differences Hypothesis, which according to Ganschow and Sparks, consists of phonological, orthographic, syntactic, and semantic components.

The LISREL analysis supported a hierarchy of abilities with English reading comprehension being accounted for by English word recognition, English word reading speed and the Hebrew predictor variable. The English word recognition task was accounted for by English word attack, English word reading speed and knowledge of English letter sounds and names. English word attack was accounted for by English word reading speed, knowledge of English letter sounds and names and the Hebrew predictor variable. Finally, knowledge of English letter sounds and names was accounted for by the Hebrew predictor variable consisting of phonologic, orthographic, morphologic, speed of reading, and word reading abilities. These underlying language processes influencing L1 and FL reading as well as interlanguage hierarchy lend support to a model of reading acquisition that makes use of the various sources of incoming parallel information in order to ensure rapid grapheme–phoneme translation. This information comes from phonologic, orthographic, and morphologic sources.

Limitations of the present study include reduction of predictor variables entered into the model in order to perform a LISREL Analysis. It would have been optimal to have included the semantic variables tested, as these appeared as significant variables in both the factor as well as the multiple regression analyses. However, the relatively small number of participants made reduction of variables a necessity in order to conduct the analysis. Future studies of this nature should include a larger number of participants, thereby allowing for a greater number of independent variables.

L1 Hebrew variables predicted ''higher-level'' FL reading skills to a lesser extent as opposed to their success in predicting ''lower-level'' FL reading skills. FL reading research with adults (e.g., Nassaji & Geva, 1999) report similar findings. Most of the predictor variables in the present research are those that have been found to be related to word recognition in L1 and FL. Although these ''lower-level'' predictor variables are important for text comprehension, they do not take into account important ''higher-level'' meaning related predictors of text comprehension such as meaning strategies, application of prior schemata, awareness of text structure, and knowledge of the FL culture. These variables would presumably add to the explained variance of text comprehension.

The present research contributed to the theory of FL reading acquisition by examining the role of specific linguistic and reading related abilities measured in L1 and EFL in acquiring FL reading. Both L1 and EFL reading related measures contributed to successful prediction of EFL reading comprehension.

Appendix A

Hebrew Orthographic (Spelling) Task

English translations of Hebrew target words and contextual sentences	Hebrew **target words** for dictation with contextual sentences
Branch – The bird builds a nest on a branch of the tree.	ענף – הציפור בונה קן על ענף העץ.
Drop – A large drop of rain is falling from the sky.	טיפה – טיפה גדולה של גשם יורדת מהשמים.
Neck – The giraffe has a long neck.	צוואר – לג'ירפה יש צוואר ארוך.
Noon – I do homework at noon.	צהרים – אני עושה שיעורי בית בצהרים.
Grandmother – My grandmother brings me candy.	סבתא – הסבתא שלי מביאה לי ממתקים.
To fix – We need to fix a date for the party.	לקבוע – אנחנו צריכים לקבוע תאריך למסיבה.
To join – We invited her to join the circle.	להצטרף – הזמנו אותה להצטרף לחוג.
Boring – I find it boring to sit quietly for a long period.	משעמם – משעמם לי לשבת בשקט לתקופה ארוכה.
Woke up – He woke up at six in the morning.	התעורר – הוא התעורר בשש בבוקר.
Angers – Sometimes my brother angers me.	מרגיז – לפעמים האח שלי מרגיז אותי.
Agitates - The boy agitates the class.	מסעיר – הילד מסעיר את הכיתה.
Reminder – The picture is a reminder of my childhood house.	מזכירה – התמונה מזכירה את בית ילדותי.
Forward roll – The girl does a forward roll and then she jumps.	גלגול – הילדה עושה גלגול ואז היא קופצת.
Institution – Send the forms to the institution.	מוסד – שלח את הטפסים למוסד.

English translation of Hebrew target sentences for dictation	Hebrew **target sentences** for dictation
The farmer went out to the field to plow with the plow.	1) האיכר יצא לשדה לחרוש במחרשה.
The teacher requested that the pupils copy a paragraph (section) into their exercise books.	2) המורה ביקשה מהתלמידים להעתיק למחברותיהם קטע.

Appendix B

EFL Informal List of Words for Word Recognition

cat	fit	number	the
yes	balloon	show	happy
green	farm	sport	water
ball	stop	you	Jim
sheep	chicken	mother	song

Appendix C

Example of EFL text comprehension task

My name is Dan. I am a boy. I have brown eyes and black hair. I am ten years old. I have a little sister and two big brothers. My mother is a doctor and my father drives a bus. We live in a city.?(The following questions are English translations of the multiple choice questions provided in Hebrew).

1.	How old is the boy in the story?
a.	10 years old.
b.	6 years old.
c.	9 years old.
d.	12 years old.
2.	Describe the boy in the story.
a.	He has blue eyes and blond hair.
b.	He has brown eyes and brown hair.
c.	He has green eyes and black hair.
d.	He has brown eyes and black hair.
3.	How many children are there in Dan's family?.
a.	three.
b.	two.
c.	four.
d.	one.
4.	What is Dan's mother's job?
a.	a bus driver.
b.	a secretary.
c.	a teacher.
d.	a doctor.

Appendix C Continued.

5.	Who is the youngest in Dan's family?.
a.	his sister.
b.	Dan.
c.	His brother.
d.	None of the answers are correct.

References

Adams, M. (1990). *Beginning to read*. Cambridge, MA: MIT Press.

Badian, N. A. (1995). Predicting reading ability over the long term: The changing roles of letter naming, phonological awareness and orthographic processing. *Annals of Dyslexia, 45*, 79–96.

Balgur, R. (1977). *Mivxan Kriya Diagnosti Letalmidey Kitot bet – yud*. [Diagnostic reading test for pupils in second to tenth grade]. Tel Aviv Israel: Shockan.

Ben-Dror, I., Bentin, S., & Frost, R. (1995). Semantic, phonologic and morphologic skills in reading disabled and normal children: Evidence from perception and production of spoken Hebrew. *Reading Research Quarterly*, *30*, 876–893.

Ben-Dror, I., Frost, R., & Bentin, S. (1995). Orthographic representation and phonemic segmentation in skilled readers: A cross-language comparison. *Psychological Science, 6*, 176–181.

Bentin, S., & Frost, R. (1995). Morphological factors in visual word identification in Hebrew. In L.B. Feldman (Ed.), *Morphological aspects of language processing* (pp. 271–292). Hillsdale, NJ: Erlbaum Associates.

Bentin, S., & Leshem, H. (1993). On the interaction between phonological awareness and reading acquisition: It's a two-way street. *Annals of Dyslexia, 43*, 125–148.

Berent, I., & Shimron, J. (1997). The representation of Hebrew words: Evidence from the Obligatory Contour Principle. *Cognition,* 1–32.

Berman, R. A. (2003). Children's lexical innovations. In J. Shimron (Ed.), *Language processing and acquisition in languages of Semitic, root-based, morphology* (pp. 243–292). Amsterdam Holland: John Benjamins.

Bialystok, E. (2001a). Literacy: The extension of languages through other means. In R.L. Cooper, E. Shohamy & J. Walters (Eds.), *New Perspectives on Educational Linguistics* (pp. 19–33). Amsterdam Holland: John Benjamins.

Biddle, B. J., & Marlin, M. M. (1987). Causality, confirmation, credulity, and structural equation modeling. *Child Development, 58*, 4–17.

Bowers, P. G., & Wolf, M. (1993). Theoretical links among naming speed, precise timing mechanisms and orthographic skill in dyslexia. *Reading and Writing: An Interdisciplinary Journal, 5*, 69–85.

Brisbois, J. E. (1995). Connections between first and second language reading. *Journal of Reading Behavior, 27*, 565–584.

Carlisle, J. F. (2000). Awareness of the structure and meaning of morphologically complex words: Impact on reading. *Reading and Writing: An Interdisciplinary Journal, 12*, 169–190.

Carlisle, J. F., Beeman, M., Hull Davis, L., & Sphraim, G. (1999). Relationship of metalinguistic capabilities and reading achievement for children who are becoming bilingual. *Applied Psycholinguistics, 20*, 459–478.

Carlisle, J. F., & Nomanbhoy, D. M. (1993). Phonological and morphological awareness in first graders. *Applied Psycholinguistics, 14*, 177–195.

Carroll, J. B. (2000). The analysis of reading instruction: Perspectives from psychology and linguistics. *Scientific Studies of Reading, 4*, 3–17.

Catts, H. W., Fey, M. E., Zhang, X., & Tombling, J. B. (1999). Language basis of reading and reading disabilities: Evidence from a longitudinal investigation. *Scientific Studies of Reading, 3*, 331–361.

Comeau, L., Cormier, P., Grandmaison, E., & Lacroix, D. (1999). A longitudinal study of phonological processing skills in children learning to read in a second language. *Journal of Educational Psychology, 91*, 29–43.

Cummins, J. (1984). *Bilingualism and special education: Issues in assessment and pedagogy*. Austin Texas: Pro-Ed.

Cutting, L. E., Carlisle, J. F., & Denckla, M. B. (1998). *A model of the relationships among rapid automatized naming (RAN) and other predictors of word reading*. Paper presented to the fifth annual meeting of the Society for the Scientific Study of Reading, San Diego, CA.

Dufva, M., & Voeten, M. J. M. (1999). Native language literacy and phonological memory as prerequisites for learning English as a foreign language. *Applied Psycholinguistics, 20*, 329–348.

Durgunoglu, A. Y. (1997). Bilingual reading: Its components, development, and other issues. In A.M.B. De Groot & J.F. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistics* (pp. 255–276). Hillsdale, NJ: Erlbaum.

Ehri, L. C. (1992). Reconceptualizing the development of sight word reading and its relationship to recoding. In P.B. Gough, L.C. Ehri & R. Treiman (Eds.), *Reading acquisition* (pp. 107–143). Hillsdale, NJ: Erlbaum.

Ehri, L. C., & Chun, C. (1996). How alphabetic/phonemic knowledge facilitates text processing in emergent readers. In J. Shimron (Ed.), *Literacy and education: Essays in memory of Dina Feitelson* (pp. 69–93). Cresskill, NJ: Hampton.

Feldman, L. B., & Andjelkovic, D. (1992). Morphological analysis in word recognition. In R. Frost & L. Katz (Eds.), *Orthography, phonology, morphology, and meaning* (pp. 343–360). Amsterdam Holland: Elsevier.

Frost, R., & Bentin, S. (1992). Reading consonants and guessing vowels: Visual word recognition in Hebrew orthography. In R. Frost & L. Katz (Eds.), *Orthography, phonology, morphology, and meaning* (pp. 27–44). Amsterdam: Elsevier.

Ganschow, L., Sparks, R. L., Javorsky, J. Pohlman, J., & Bishop-Marbury, A. (1991). Identifying native language difficulties among FL learners in college: A FL learning disability? *Journal of Learning Disabilities, 24*, 530–541.

Geva, E. (1995). Orthography and cognitive processing in learning to read English and Hebrew. In I. Taylor & D.R. Olson (Eds.), *Scripts and literacy* (pp. 277–291). Netherlands: Kluwer.

Geva, E., Mack, A., Merlbaum, C., Lam, M., & Wade-Wolley, L. (1998). *Learning to read in a second language (L2): Does L2 oral proficiency matter?* Paper presented to the fifth annual meeting of the Society for the Scientific Study of Reading, San Diego, CA.

Geva, E., & Siegel, L. S. (2000). Orthographic and cognitive factors in the concurrent development of basic reading skills in two languages. *Reading and Writing: An Interdisciplinary Journal, 12*, 1–30.

Geva, E., & Wade-Woolley, L. (1998). Component processes in becoming English-Hebrew Biliterate. In A.Y. Durgunoglu & L. Verhoeven (Eds.), *Literacy development in a multilingual context: Cross-cultural perspectives* (pp. 85–110). Hillsdale, NJ: Erlbaum.

Geva, E. Yaghoub-Zadeh, Z., & Schuster, B. (2000). Understanding individual differences in word recognition skills in ESL children. *Annals of Dyslexia, 50*, 123–154.

Gholamain, M., & Geva, E. (1999). Orthographic and cognitive factors in the concurrent development of basic reading skills in English and Persian. *Language Learning, 49*, 183–217.

Gillis, S., & Ravid, D. (2000). Effects of phonology and morphology in children's orthographic systems: A crosslinguistic study of Hebrew and Dutch. In E. Clark (Ed.), *The proceedings of the 31st annual child language research forum*. (pp. 203–210). Stanford: Center for the Study of Language and Information.

Glantz, I. (1991). *Xemed, Ma'arexet L'bdika M'kifa*, [Xemed – A Comprehensive Testing Battery]. Tel Aviv: Barak Information Systems.

Grabe, W. (1991). Current developments in second language reading research. *TESOL Quarterly*, *25*, 375–406.

Greenbaum, N., & Lichter, Y. (1996) Milot tefel [Hebrew word attack subtest]. In N. Greenbaum & Y. Lichter (Eds.), *Ivxun Kri'a Ktiva [Reading and writing diagnoses]* (p. 8). Oranim: Oranim College.

Hancin–Bhatt, B., & Nagy, W. (1994). Lexical transfer and second language morphological development. *Applied Psycholinguistics, 15*, 289–310.

Hanson, V. L., Goodell, E. W., & Perfetti, C. A. (1991). Tongue–Twister effects in the silent reading of hearing and deaf college students. *Journal of Memory and Language*, *30*, 319–330.

Kahn-Horwitz, J. (1994). Developmental effects of reading without vowels. Unpublished Master's Thesis, University of Haifa, Haifa, Israel.

Koda, K. (1992). The effects of lower-level processing skills on FL reading performance: Implications for instruction. *Modern Language Journal, 76*, 502–512.

Laufer, B. (1995). The lexical threshold of second language reading comprehension: Where it is and how it relates to L1 reading ability. In K. Sajavaara & C. Fairweather (Eds.), *Approaches to second language acquisition* (pp. 55–62), Jyvaskyla: Jyvaskyla Cross Language Studies 17.

Levin, I., Ravid, D., & Rapaport, S. (1997). *Developing morphological awareness and learning to write: A two – way street*. Paper presented to the international symposium on Integrating Research and Practice in Literacy, London.

Leong, C. K., & Joshi, R. M. (1997). Relating phonologic and orthographic processing to learning to read and spell. In C.K. Leong & R.M. Joshi (Eds.), *Cross-language studies of learning to read and spell* (pp. 1–29). Netherlands: Kluwer.

Liberman, I. Y., & Shankweiler, D. (1985). Phonology and the problems of learning to read and write. *Remedial and Special Education, 6*, 8–17.

Mahony, D., Singson, M., & Mann, V. (2000). Reading ability and sensitivity to morphological relations. *Reading and Writing: An Interdisciplinary Journal, 12*, 191–218.

Menyuk, P., & Chesnick, M. (1997). Metalinguistic skills, oral language knowledge, and reading. *Topics in Language Disorders*, *17*, 75–87.

Muter, V., & Snowling, M. (1998). Concurrent and longitudinal predictors of reading: The role of metalinguistic and short term memory skills. *Reading Research Quarterly, 33*, 320–337.

Nassaji, H., & Geva, E. (1999). The contribution of phonological and orthographic processing skills to adult ESL reading: Evidence from native speakers of Farsi. *Applied Psycholinguistics*, *20*, 241–267.

Olofsson, A., & Niedersoe, J. (1997). Early language development and kindergarten phonological awareness as predictors of reading problems: From 3 to 8 years of age. In C.K. Leong & R.M. Joshi (Eds.), *Cross-language studies of learning to read and spell* (pp.289–306). Netherlands: Kluwer.

Perfetti, C. A. (1985). *Reading ability*. New York: Oxford University Press.

Perfetti, C. A., Zhang, S., & Berent, I. (1992). Reading in English and Chinese: Evidence for a "Universal" phonological principle. In R. Frost & L. Katz (Eds.), *Orthography, phonology, morphology, and meaning* (pp. 227–248). Amsterdam: Elsevier.

Ravid, D. (2001). Learning to spell in Hebrew: Phonological and morphological factors. *Reading and Writing: An Interdisciplinary Journal*, *14*, 459–485.

Ravid, D. (2003). A developmental perspective on root perception in Hebrew and Palestinian Arabic. In J. Shimron (Ed.), *Language processing and acquisition in languages of Semitic, root-based, morphology* (pp. 293–319). Amsterdam: John Benjamins.

Rayner, K., & Pollatsek, A. (1989). *The psychology of reading*, NJ: Prentice Hall.

Scanlon, D. M., & Vellutino, F. R. (1997). A comparison of the instructional backgrounds and cognitive profiles of poor, average, and good readers who were initially identified as at risk for reading failure. *Scientific Studies of Reading*, *1*, 191–215.

Schneider, W., & Naslund, J. C. (1997). The early prediction of reading and spelling: Evidence from the Munich longitudinal study on the genesis of individual competencies. In C. K. Leong & R. M. Joshi (Eds.), *Cross-Language Studies of Learning to Read and Spell* (pp. 139–159). Netherlands: Kluwer.

Segalowitz, N., Poulsen, C., & Komoda, M. (1991). Lower level components of reading skill in higher level bilinguals: Implications for reading instruction. In J. H. Hulstijn & J. F. Matter (Eds.). *Reading in two languages*, *AILA Review*, *8* (pp. 15–30). Amsterdam: Free University Press.

Shany, M., Zeiger, T., & Ravid, D. (2001). Pitu'ax v'tikuf šel kley ivxun l'tahalixim bsisim b'kriya uv'xtiv: Mem'tsa'im al tif'kud kor'im t'kinim v'hatsa'ot l'šiluv kley ha'ivxun b'ha'araxot kor'im mit'kašim [The development and validation of tests for basic processes in reading and spelling: Performance of normally-achieving readers at various grade levels and implications for the assessment of individuals with reading disabilities]. *Script: Literacy Research, Theory and Practice*, *2*, 167–203.

Shankweiler, D., Crain, S., Katz, L., Fowler, A. E., Liberman, A. M., & Brady, S. A. et al. (1995). Cognitive profiles of reading-disabled children: Comparison of language skills in phonology, morphology and syntax. *Psychological Science*, *6*, 149–156.

Share, D. L. (1995). Phonological recoding and self-teaching: Sine qua non of reading acquisition. *Cognition*, *55*, 151–218.

Share, D. L., & Stanovich, K. E. (1995). Cognitive processes in early reading development: Accommodating individual differences into a model of acquisition. *Issues in Education*, *1*, 1–57.

Shimron, J. (1993). The role of vowels in reading: A review of studies of English and Hebrew. *Psychological Bulletin*, *114*, 52–67.

Shimron, J. (2003). Word decomposition in Hebrew as a Semitic language. In E. M. H. Assink & D. Sandra (Eds.). *Reading Complex Words: Cross-Language Studies* (pp. 93–111). New York, Kluwer.

Smith, H. W. (1975). *Strategies of social research: The methodological imagination*. Upper Saddle River, NJ: Prentice Hall.

Snow, C. E., Burns, M. S., & Griffin, P. (Eds.). (1998). *Preventing reading difficulties in young children*. Washington, DC: National Academic Press.

Sparks, R. L. (1995). Examining the linguistic coding differences hypothesis to explain individual differences in foreign language learning. *Annals of Dyslexia*, *45*, 187–214.

Sparks, R. L., & Ganschow, L. (1993a). Searching for the cognitive locus of foreign language learning difficulties: Linking native and foreign language learning. *Modern Language Journal*, *77*, 289–302.

Sparks, R. L., & Ganschow, L. (1993b). The impact of native language learning problems on foreign language learning: Case study illustrations of the linguistic coding deficit hypothesis. *Modern Language Journal*, *77*, 58–74.

Sparks, R. L., Ganschow, L., & Patton, J. (1995). Prediction of performance in first-year foreign language courses: Connections between native and foreign language learning. *Journal of Educational Psychology, 87*, 638–655.

Stanovich, K. E., & Stanovich, P. J. (1995). How research might inform the debate about early reading acquisition. *Journal of Research in Reading*, *18*, 87–105.

Stevens, J. (1986). *Applied multivariate statistics for the social sciences*. Hillsdale, NJ: Erlbaum.

Tyler, A., & Nagy, W. (1990). Use of derivational morphology during reading. *Cognition, 36*, 17–34.

van den Bos, K. P., Zijlstra, B. J. H., & lutjie Spelberg, H. C. (2002). Life-span data on continuous-naming speeds of numbers, letters, colors, and pictured objects, and word-reading speed. *Scientific Studies of Reading, 6,* 25–49.

Vellutino, F. R., & Scanlon, D. M. (1986). Linguistic coding and metalinguistic awareness: Their relationship to verbal memory and code acquisition in poor and normal readers. In D.B. Yaden & S. Templeton (Eds.), *Metalinguistic awareness and beginning literacy* (pp. 115–141). Portsmouth, NH: Heinemann.

Verhoeven, L. (1991). Acquisition of biliteracy. In J.H. Hulstijn & J.F. Matter (Eds.). *Reading in two languages, AILA Review, 8* (pp. 61–74). Amsterdam: Free University Press.

Wade-Woolley, L., Chiappe, P., & Siegel, L. S. (1998). *Learning to read in a second language: Does phonological awareness matter?* Paper presented to the fifth annual meeting of the Society for the Scientific Study of Reading, San Diego, CA.

Wagner, R. K., & Barker, T. A. (1994). The development of orthographic processing ability. In V.W. Berninger (Ed.), *The varieties of orthographic knowledge: Theoretical and developmental issues* (pp. 243–276). Netherlands: Kluwer.

Wagner, R. K., Torgesen, J. K., Rashotte, C. A., Hecht, S. A., Barker, T. A., & Burgess, S. R. et al. (1997). Changing relations between phonological processing abilities and word-level reading as children develop from beginning to skilled readers: A 5-year longitudinal study. *Developmental Psychology, 33*, 468–479.

Woodcock, R. (1987). *Woodcock reading mastery test-revised*. Circle Pines, MN: American Guidance.

Address for correspondence: Janina Kahn-Horwitz, Manof 46, D. N. Misgav, 20184, Israel

Phone: +972-4-9998357; Fax: +972-4-9998583; E-mail: horwitz@netvision. net.il