

**BASIC READING SKILLS IN L1 AND L2: A COMPARISON OF CROATIAN  
AND ENGLISH**

by

**Dunja Monaghan**

**A thesis submitted in conformity with the requirements  
for the degree of Master of Arts  
Graduate Department of Education  
University of Toronto**

**© Copyright by Dunja Monaghan 1997**



National Library  
of Canada

Acquisitions and  
Bibliographic Services

395 Wellington Street  
Ottawa ON K1A 0N4  
Canada

Bibliothèque nationale  
du Canada

Acquisitions et  
services bibliographiques

395, rue Wellington  
Ottawa ON K1A 0N4  
Canada

*Your file Votre référence*

*Our file Notre référence*

The author has granted a non-exclusive licence allowing the National Library of Canada to reproduce, loan, distribute or sell copies of this thesis in microform, paper or electronic formats.

The author retains ownership of the copyright in this thesis. Neither the thesis nor substantial extracts from it may be printed or otherwise reproduced without the author's permission.

L'auteur a accordé une licence non exclusive permettant à la Bibliothèque nationale du Canada de reproduire, prêter, distribuer ou vendre des copies de cette thèse sous la forme de microfiche/film, de reproduction sur papier ou sur format électronique.

L'auteur conserve la propriété du droit d'auteur qui protège cette thèse. Ni la thèse ni des extraits substantiels de celle-ci ne doivent être imprimés ou autrement reproduits sans son autorisation.

0-612-29166-9

**Canada**

## **Abstract**

The study reported here is concerned with the influence of first language (L1) word recognition in a shallow orthography on word recognition in a second language (L2) with a deeper orthography (English). It also compared L1 and L2 decoding skills and investigated the role of individual differences in word recognition component processes on text comprehension in L1 and L2. The study was conducted with a sample of 27 grade eight Croatian children (the L1) who have been studying English (the L2) for 4.5 years. Children were administered parallel L1 and L2 tasks focusing on text comprehension, naming letters, words, pseudowords as well as a lexical decision task. The results indicate that (a) the processes underlying word recognition in L1 and L2 share similarities (These results contradict the findings of the single-language studies conducted with the Serbo-Croatian language.); (b) attained reading skills in L1 correlate with reading skills in L2; (c) in spite of differences in orthographic depth between L1 and L2, there are similarities in reading processes; and (d) speed of naming may represent an underlying variable that is significant for word recognition and text comprehension in both languages.

## **Acknowledgments**

There are many people who in a different way helped me and made this project possible.

I would like to thank Dr. Esther Geva who guided me patiently, kindly and knowledgeably through all of the obstacles standing in my way. I would also like to thank Dr. Dale Willows who showed interest in this project and agreed to be a thesis committee member; Dr. Nobu Akamatsu who helped me with log transformation and who threw into it a large dosage of optimism; Dr. Leslie Wade-Woolley who was there to listen about my doubts in moments of my inability to cope with computer programs; my husband David who guided me (and worked on it himself) through transferring my experiment on the computer screen; Sara Bingham who was involved in coding English pseudowords; Nenad Veletic who supplied me with Croatian Roman and Serbian Cyrillic letters; and all of my family, friends and colleagues who did not stop asking how I was doing during the past few years (in which I rapidly lost most of my social skills), and who would listen patiently about my work. And last but not least, I want to thank my Grandfather who always stood by my side with unconditional love and unshakable trust, and therefore made all of life's obstacles easier to deal with.

## Table of Contents

<b>Abstract</b> .....	<b>ii</b>
<b>Acknowledgments</b> .....	<b>iii</b>
<b>Table of Contents</b> .....	<b>iv</b>
<b>List of Figures</b> .....	<b>vii</b>
<b>List of Tables</b> .....	<b>viii</b>
<b>List of Appendices</b> .....	<b>x</b>
<b>CHAPTER 1: BACKGROUND</b> .....	<b>1</b>
Introduction .....	1
Literature Review .....	4
<b>About Writing and Orthography: How can a Writing System Be Shallow or Deep?</b> .....	<b>4</b>
<b>The Croatian Language and Its Orthography</b> .....	<b>5</b>
<b>The English Language and Its Orthography</b> .....	<b>7</b>
<b>Word Recognition and Reading</b> .....	<b>8</b>
<b>The Dual-Route Theory</b> .....	<b>9</b>
<b>Connectionism and Word Recognition</b> .....	<b>11</b>
<b>Orthographic and Phonological Processing in Word Recognition and What is the Role of Speed of Naming?</b> .....	<b>12</b>
<b>Automaticity and Modularity</b> .....	<b>14</b>
<b>Summary</b> .....	<b>16</b>
<b>Naming and Lexical Decision Tasks in Word Recognition</b> .....	<b>17</b>
<b>Theoretical Perspectives of Word Recognition Processes Across Different Orthographies</b> .....	<b>19</b>

<b>Reading in a Shallow Alphabetical Orthography .....</b>	<b>22</b>
<b>Reading in a Second Language (L2) .....</b>	<b>37</b>
<b>Rationale of the Present Study .....</b>	<b>38</b>
Hypotheses .....	42
<b>CHAPTER 2 : METHODOLOGY .....</b>	<b>44</b>
Participants .....	44
Measures .....	45
Procedure .....	50
<b>CHAPTER 3 : RESULTS .....</b>	<b>52</b>
<b>Processing Words and Pseudowords: Is the Route the Same for Both Languages?.....</b>	<b>53</b>
<b>Do Attained Reading Skills in L1 Correlate with Reading Skills in L2 Regardless of the Differences in Language Proficiency and Orthography?.....</b>	<b>56</b>
<b>Are Reading Processes in L1 Similar to Reading Processes in L2 Regardless of the Differences in Language Proficiency and Orthography? .....</b>	<b>61</b>
<b>Individual Differences in Component Processes of Reading Comprehension: Are They Similar in L1 and L2? .....</b>	<b>68</b>
Summary of Status of Hypotheses .....	74
<b>CHAPTER 4 : GENERAL DISCUSSION .....</b>	<b>75</b>
Discussion.....	75
Implications .....	84
<b>Practical Implications .....</b>	<b>84</b>
<b>Implications for Future Research .....</b>	<b>84</b>

<b>References</b> .....	<b>86</b>
<b>Appendices</b> .....	<b>97</b>

## **List of Figures**

<b>Figure 1: Similarities and Differences Between Roman and Cyrillic Alphabets in Serbo-Croatian .....</b>	<b>25</b>
<b>Figure 2: Croatian and English Word and Pseudoword Speed Naming .....</b>	<b>54</b>
<b>Figure 3: Parallel Accuracy Measures in Croatian and English .....</b>	<b>63</b>
<b>Figure 4: Parallel Speed Measures in Croatian and English.....</b>	<b>64</b>

## **List of Tables**

Table 1 : Correlations for Accuracy for Parallel Variables in Croatian and English .....	57
Table 2 : Correlations for Speed for Parallel Variables in Croatian and English.....	58
Table 3 : Correlations for Speed and Accuracy in Croatian and English .....	59
Table 4 : Means, Standard Deviations and t-Test Values for Accuracy .....	62
Table 5 : Means, Standard Deviations and t-Test Values for Speed .....	63
Table 6 : Intercorrelations for Accuracy Among Reading Measures in Croatian .....	65
Table 7 : Intercorrelations for Accuracy Among Reading Measures in English .....	66
Table 8 : Intercorrelations for Speed Among Reading Measures in Croatian .....	67
Table 9 : Intercorrelations for Speed Among Reading Measures in English .....	67
Table 10: Correlations Among Text Comprehension, Memory and Parallel L1 and L2 Accuracy Measures .....	69
Table 11: Correlations Among Text Comprehension, Memory and Parallel L1 and L2 Speed Measures .....	70
Table 12: Correlations Among Memory and Text Comprehension .....	71

<b>Table 13: Predictors of Croatian and English Text Comprehension: Forward Stepwise Multiple Regression Analysis Summary.....</b>	<b>73</b>
--	-----------

## **List of Appendices**

Appendix I	: Example of Printed Text in the Roman Alphabe....	98
Appendix II	: Example of Printed Text in the Cyrillic Alphabet ...	99
Appendix III	: Text Comprehension Croatian (texcompC) .....	100
Appendix IV	: Text Comprehension English (texcompE) .....	102
Appendix V	: Word Naming Croatian (wordC) .....	104
Appendix VI	: Word Naming English (wordE) .....	105
Appendix VII	: Pseudoword Naming Croatian (pseudoC) .....	106
Appendix VIII	: Pseudoword Naming English (pseudoE) .....	107
Appendix IX	: Lexical Decision Croatian (lexdecC) .....	108
Appendix X	: Lexical Decision English (lexdecE) .....	109
Appendix XI	: Means and Standard Deviations For Lexical Decision According to the Position of a Real Word .....	110
Appendix XII	: Scatterplot for Speed in Parallel Variables in Croatian and English .....	111

## CHAPTER 1 : BACKGROUND

### Introduction

We are living in a world of written words, and even if they are flashing in front of our eyes in bright colours or are being hidden in some new letter font we have never seen before, we can still decode them, or at least recognize them as a writing system. We are surrounded with messages that are not tied anymore to books, language, culture, or a certain caste of people. For a long time we have been living in a world in which being able to read is a prerequisite for survival. And those of us who can read, do not think much about it, we take it for granted.

Reading in general, regardless of its importance, became a particular focus of psychologists in the mid 1960s. Being more specific, one should say that this field *re-opened* recently because work on reading was done by Cattell in 1886 and some other authors in the late 1800s, as well as by Huey at the beginning of this century (Rayner and Pollatsek, 1989). However, the whole area of research virtually ceased during the behaviorist era -- until 1968. A vast amount of research findings has been produced in recent decades. Researchers do have some answers about reading processes, but since reading is such a complicated skill, there are still many unanswered questions about this complex, yet everyday, almost ubiquitous ability.

Investigators are debating over facts about reading processes in a first language; yet what we know about reading in a second language is more limited. There are many children sitting in classrooms striving to overcome the obstacles of learning to read in a second language. How do they read? What do they process first? Is the answer the same for all languages? How do children and adults learn to read in one language if they already read in another one well or poorly? Do they transfer reading skills from one language to another? How should reading be taught in a second language? These are some of the questions facing a teacher challenged by teaching reading in the second language.

The author's interest in conducting this study arose from her personal experience in learning to read English. Secondly, as a teacher I felt a responsibility to understand the reading process as fully as possible. And last but not least, it is a great challenge to attempt to add another small brick of knowledge to the road that leads toward better understanding of reading in a second language.

This study investigates the effects of orthography on L2 word recognition by focusing on naming and lexical decision tasks. It examines similarities and differences in speed and accuracy in word reading in Croatian<sup>1</sup> and English. The target group consisted of

---

<sup>1</sup> Recent events in the central/south Europe brought a divorce to a political alignment that existed for almost fifty years. Most of the existing research regarding reading processes in a shallow orthography was done on the Serbo-Croatian language involving the two alphabets (except for one study that was conducted on the Croatian population

children in Croatia who have been studying English as a foreign language for five years.

---

here, in Canada). It is to be expected that coming years will bring new studies on the Croatian language (for more information about the Croatian language refer to Brozovic (1975), Banac (1984) and Nizeteo, (1984-85)) based on its one alphabet. This study is one of them. These studies may shed a new light on the topic discussed here. New research completed on the Croatian orthography will establish a new terminology which is relevant to the existing political situation in the new state of Croatia.

## Literature Review

### **About Writing and Orthography: How Can a Writing System Be Shallow or Deep?**

Writing is one of the most important means of communicating by visible signs, and in order to preserve language and information through time and across space humans invented writing systems. If languages are combinations of symbols, writing is a system for representing these symbols. Because writing represents language and its structure, a writing system is technically referred to as a *script* or *orthography* (Olson, 1991).

Orthography may be defined as an answer to the problem of representing spoken language in written form. One of the basic ways in which orthographies differ is in the extent to which the written form corresponds to the spoken form (Seidenberg, 1992). The attempt to make an efficient match between the written form, and the morphology and phonology of the spoken language, typically determines whether the orthography is classified as a syllabary, syllabary-cum-logography, logography or alphabet.

There are major differences in the degree to which the alphabetic writing systems mirror the phonemic structure of their respective spoken languages. The reasons for these differences are

located in the particular history of development of phonological and morphological characteristics of each language.

Within the group of alphabetic orthographies, there are different degrees of adherence to the strict alphabetical principle; the range of correspondence between grapheme and phoneme varies in consistency and completeness (Katz and Frost, 1992). According to the consistency and completeness of the correspondence between graphemes and phonemes, orthographies may be defined as either 'shallow' or 'deep'. In shallow orthographies, the spelling-to-sound correspondence is direct. That means that the writing system uniformly matches (as closely as possible) the phonemic structure of the spoken language. In contrast, in deep orthographies, the relationship between grapheme and phoneme is less consistent, and the reader must more often learn the pronunciations of irregular words (Besner and Chapnik Smith, 1992). The Croatian orthography, like Spanish or Italian, is an excellent example of a shallow orthography, while English orthography may be considered as deep.

### **The Croatian Language and Its Orthography**

It has been said that most languages get the orthography they deserve (Katz and Frost, 1992). If one looks more closely at the linguistic and grammatical characteristics of the Croatian language,

one finds that inflection (the use of endings, affixes and vowel alternations) is the principal method for differentiating grammatical meanings. Nouns, pronouns and adjectives have seven case forms that occur in both the singular and the plural. In addition to three noun genders (masculine, feminine, neuter), Croatian distinguishes animate and inanimate noun forms as well as personal and non-personal noun forms. Verb categories also have a complex character. Verbs are inflected to show present and past tense, completed and uncompleted aspects of verbs, and so on (Olson, 1991). The verbs may be conjugated by varying the vowels of the root and by attaching affixes that indicate tense, number, person and gender. The meaning elements suggested by verb forms are voice, transitivity, causation and inchoativeness ( e. g., PLAKATI [to cry], PLACEM [I am crying], PLAKALI SU [they were crying ], RASPLAKAO SE [he had started crying]; SE and SU following the verb show reflexivity). Croatian is a heavily inflected alphabetic language and although the linguistic and grammatical characteristics of Croatian are complex, these complexities are nicely balanced with the shallowness of Croatian orthography.

The Croatian language has an orthography in which each letter represents only one phoneme. That is, the grapheme-phoneme correspondence is uniform and direct, and the language uses the Roman alphabet to produce 30 graphemes. Three phonemes are represented by graphemes that consist of two characters (*dz*, *lj* and

nj) while the remaining graphemes have one character for each phoneme. The Cyrillic alphabet (Figure 1) used in Yugoslavia also has 30 graphemes, but only one of them consists of two characters.

### **The English Language and Its Orthography**

English orthography is quite different from Croatian. English has 26 graphemes which map onto more than 36 phonemes. In order to decide on the phonemic value of some graphemes, one often needs to consider neighbouring letters. There is a large amount of regular phonologic change between the words in the same derivational family (Katz and Frost, 1992). English spelling represents in part a compromise between the attempt to maintain a consistent letter-phoneme relation and morphological communality among the words even at the cost of inconsistency in the letter-phoneme relation (e.g. HEAL-HEALTH or STEAL-STEALTH). In reading English aloud, the reader must remember the pronunciation or remember the appropriate context-dependent rule for pronunciation (Katz and Frost, 1992).

The differences between Croatian and English writing systems have two linguistic causes. The first is related to the relationship between the phonology and morphology of the spoken language. According to Katz and Frost (1992), only a phonologically

complex language can have a deep alphabetic orthography. The second linguistic cause is related to the option provided by the orthography of a phonologically complex language. Orthography can represent either morphological invariance (a deep orthography) or grapheme-phoneme invariance (a shallow orthography). The Croatian language follows grapheme-phoneme invariance, and as a language that is not complex phonologically, it does not have any other choice. The English language qualifies as a phonologically complex language. Although in principle it could have been written either as a shallow or deep orthography, the English language developed a deep orthography and has consistent spelling of morpheme invariance. In other words, the letters preserve primarily the morphological structure of a word and only represent its sound when it is not predictable by general phonological rules. There are also different pronunciations of the same spelling (e.g., consider the *EA* in *HEAL-HEALTH*) and identical pronunciations for different spellings (e.g., *PEEL-DEAL*) (Katz and Frost, 1992).

### **Word Recognition and Reading**

Reading may be defined as understanding the meaning of symbols, signs or gestures by looking at them and assimilating them mentally; considering something to have a certain meaning; or

9

touching Braille symbols and understanding them (Webster's Encyclopedic Dictionary, 1988). If one approaches this complex skill as a psychologist or linguist, one may look upon reading as an activity that generally translates print into sound (Lesgold and Perfetti, 1981), and through these processes accesses the stored meaning of printed words.

Word recognition is widely understood to be a fundamental process of reading, because word recognition is a cognitive process of retrieving a semantic representation from a printed word (Akamatsu, 1996), and is the most studied and still most controversial issue in the field of reading (Adams, 1979). Below I review briefly major theories of the word recognition process.

### **The Dual-Route Theory**

The dual-route theory holds that a skilled reader uses two independent routes for processing words; one is lexical (addressed) and the other one is the nonlexical (assembled) route (Humphreys and Evett, 1985). The lexical route is thought to operate by a direct mapping of a word's visual characteristics to a stored lexical representation. Phonological and semantic information that is appropriate to the word may then be obtained, either because the phonological and semantic descriptions are stored along with the

orthographic descriptions, or because these descriptions are addressable from a separate orthographic lexicon. If the knowledge resources for orthographic, phonological and semantic descriptions of words are functionally separate, the lexical processing route contains two subroutes for access to phonology. In one subroute, access to phonology is mediated by the access to the semantic knowledge resource. In the other subroute, phonological information is directly accessed from the orthographic lexicon (Humphreys and Evett, 1985).

In other words, the dual-route model claims that one route is based on processing whole word while the other route is based on processing subword units. In order to pronounce irregular words (e. g., *pint*, *have*, *deaf*) correctly the visual route must be used. The use of spelling-sound rules for pronunciation of these words would result in an incorrect pronunciation (Colombo and Tabossi, 1992). Regular words (e. g., *leaf*, *table*, *hill*) are divided to segments (e. g., the word *hill* is divided into three segments *h*, *i*, and *ll*) and converted to the corresponding phonemes /h/, /i/ and /l/ following grapheme-to-phoneme rules (GPC). Because the nonwords do not have a lexical entry, they are also pronounced according to GPC rules.

In most theoretical explanations of the dual-route model the direct route to meaning is assumed to run in parallel with the phonological route, thereby creating a competition between these routes. For regular words, output of these two routes produces a

consistent pronunciation, while for irregular words these two routes cause interference. Such an account of processing regular and irregular words explains why regular words are named faster than irregular words (Colombo and Tabossi, 1992).

### **Connectionism and Word Recognition**

Connectionist models provide a new understanding of knowledge representation that is different from standard dual-route conception of use of spelling-sound correspondence rules. According to connectionist models, knowledge is represented in terms of weights on connections between units (Seidenberg, 1992). In other words, ability to read irregular words correctly is not due to the use of GPC rules but to "weights on connections between units in a lexical network that produce the correct input (orthographic) - output (phonological) mappings" (Seidenberg 1992, p. 96). For example, the pronunciation of the spelling pattern *-ave* depends upon the consonant in front of it. If the word starts with *s-* the pronunciation of *-ave* is [e i v], but if the word starts with *h-* the pronunciation changes in [æ v]. Connectionism states that a spelling pattern is not represented by a single unit (and therefore does not have single pronunciation), but is represented by the same weights which are used in all cases involving *-ave*. In sum, there is a net that maps from

orthography to phonology, producing correct output for all words whether they are regular or irregular (Seidenberg, 1992).

### **Orthographic and Phonological Processing in Word Recognition; What is the Role of Speed of Naming ?**

A majority of studies investigating reading in the last 15 years have come to the conclusion that word recognition, as an automatic process, is the primary factor which supports skillful reading and that phonological processing abilities are the foundation of word recognition proficiency (Geva and Willows, 1994). The significance of orthographic processing in word recognition and the overlap of phonological and orthographic processing is yet to be determined. One of the obstacles to discovering more about the role of orthographic processing in word recognition is partially due to the various definitions of orthographic knowledge presently in use by many researchers in this field (Berninger, 1994); due to these different viewpoints the problem is approached variously by different research teams.

The importance of phonemic sensitivity for reading acquisition and speed of lexical access has been clearly established by reading researchers. Newer research (Bowers, et al., 1994; Wolf, et

al., 1994), inquiry mostly situated in the field of reading disabilities, has brought a different perspective to the role of speed of naming simple symbols or letters in reading processes (Bowers et al., 1994). The evidence of naming speed deficits observed in children and adult dyslexics, and the studies using rapid or discrete letter naming, showed results that suggest that lack of letter naming speed interferes with forming precise orthographic representations of words and accessing them efficiently (Bowers et al., 1994). Speed of naming is presently seen by some researchers as an additional cause of reading disability which is not necessarily based on lack or failure of phonological processes, but on visual or orthographic aspects of the "processes indexed by naming speed" (Bowers et al., 1994, p.175). Wolf et al. (1994) argue that it is necessary to distinguish naming speed from phonological processes, and offer justification for such a view:

"[differentiating] naming-speed from phonological processes [begins] with an understanding of the complex, interrelated perceptual, cognitive, and linguistic processes underlying naming-speed operations. Briefly ... visual naming-speed requires: (1) attention to the stimulus; (2) visual perception and identification; (3) conceptual knowledge of the stimulus; (4) integration of conceptual information with stored lexical (semantic and phonological) information; (5) access and retrieval of phonological label; (6) motoric activation leading to articulation; and (7) precise rapid timing both within individual subprocesses and across them ..." (p.145).

Additional support for such an understanding of naming speed is found in the results of studies (Spring and Davis, 1988; Bowers and Swanson, 1991; Young and Bowers, 1994; referred to in Bowers et al., 1994) when indicate that naming-speed tasks are related to reading independently from other predictors. Note that in these studies digit or letter naming speed correlated with the measures of reading proficiency using both accuracy and speed.

This body of research coming from the field of reading disabilities, brings to focus another controversy pertaining to the relative role of individual differences in orthographic and phonological processing.

### **Automaticity and Modularity**

Reading is a complex skill and the execution of many component processes requires attention. Execution of this complex set of component skills would be impossible within a very short period of time (measured in milliseconds). Therefore one of the questions addressed in earlier research on reading concerned automatic word recognition. LaBerge and Samuels (1974) proposed an information processing model in which the key elements are attention, visual memory, phonological memory and semantic memory. According to their model, difficulties in decoding are caused by lack of automaticity

which causes the overload of the attentional system and places a heavy demand on short term memory and therefore prevents comprehension (Samuels, 1987).

The importance of the automaticity theory is that this theory assumed that there is a difference between word recognition processes and postlexical processing; consequently, most inquiries by other reading researchers focused on prelexical processes such as orthographic segmentation, phonological coding and feature extraction (Stanovich, 1990). In sum, scientific inquiry centered on processes which were believed to be executed in a linear bottom-up fashion without using conscious cognitive resources. The downfall of this model occurred in the 1980's, when the results of developmental work (e. g., developmental studies using the Stroop task) indicated that various properties of automaticity do not take place at the same time, but that speed, obligatory processing and capacity usage are at least partially dissociable (Stanovich, 1990).

The mid and late 1980's moved the focus in reading research toward another feature associated with the automaticity concept: this property was variously labeled as "functional autonomy" or "cognitive impenetrability" (Stanovich, 1990). This perspective gained great attention with the use of Fodor's concept of modularity. Stanovich and Cunningham (1991), addressing the question of whether reading is a form of reasoning, discussed Fodor's concept of modularity and prelexical word recognition processes. As Stanovich and Cunningham

(1991) explained, Fodor's concept of modularity, like the associated concept of automaticity, is a complex construct that connects a number of separate concepts, but the gist of the modular process is that it is executed automatically without the presence of higher-level operations.

In word recognition, this means that previously stored word knowledge does not influence this process, and that a defining feature of modularity is a concept of *information encapsulation*, i.e., "the operation of a module is not controlled by higher level processes or supplemented by information from knowledge structures not contained in the module itself ..." (Stanovich, 1990 p.82).

Informational encapsulation has become the core of current theories of individual differences in word reading ability (Stanovich, 1990), and some research findings have begun to show that reading skill increases as word processes become increasingly encapsulated (Perfetti, 1985).

### **Summary**

Theories and models of word reading still present a challenge to researchers who are investigating reading processes in one's first language (L1) . Although many researchers in the field of reading agree that word recognition is an automatic and

informationally encapsulated cognitive process (Stanovich, 1990), there are still a number of different explanations of how the transformation from print to sound takes place; the respective roles of orthographic and phonological processing and speed of lexical access are not clear yet. Even less is known about the development of word recognition in L2.

### **Naming and Lexical Decision Tasks in Word Recognition**

Jared and Seidenberg (1991) discussed the value of naming and lexical decision tasks when investigating the role of phonology in word recognition. They saw the use of naming and lexical decision tasks in most studies investigating word recognition as one of the reasons for the ambiguity concerning the role of phonology in word recognition. According to Jared and Seidenberg (1991), both tasks are of limited use when addressing questions concerning the mechanisms used to activate word meaning: naming may be accomplished by using knowledge of spelling-sound rules without activating meaning as in the case of naming nonwords.

A similar critique extends to lexical decision tasks (LDT) in which subjects determine whether the letter string is a word or not.

For a long time it was considered that response latency reflected the process of extracting information from a lexicon, and that lexical access is the only process being affected in lexical decision when manipulating the variables. However, Balota and Chumbley (1984) showed that "[the] lexical decision process in the LDT may result in an exaggerated role of word frequency." (Balota and Chumbley 1984, p.340) . However, Seidenberg (1985) has argued that word frequency is the primary factor that determines whether or not assembled phonology is used to access the lexicon. He contends that, in any orthography, frequently seen words will become familiar visual-orthographic patterns and therefore rapid visual access will occur before the (presumably) slower phonological code can be assembled from the print. Therefore, Balota and Chumbley's (1984) findings raise serious questions about the role of phonology in a lexical decision task and raise doubts about the extent to which phonological information influences lexical decision (if at all) in a task where high frequency words are used as stimuli. The argument is as follows: if naming words is obtained only through the assembled route without accessing meaning, it would not be possible to observe the effects of associative priming (lower RTs in naming words, when these words are preceded by an associative context than when they are preceded by an unrelated context), or faster naming of real words than pseudowords or faster naming of high frequency words than low frequency words. Nonetheless, these are the findings of a large group who studied

word recognition processes (e. g., Glushko, 1979 & 1981; Frost, Katz and Bentin, 1987; Jared and Seidenberg, 1991; Katz and Feldman, 1981; Seidenberg, 1985).

All in all, naming and lexical decision tasks continue to be used in word recognition research although their use is enriched with a new understanding of the possible entanglement of high and low frequency words within word recognition. The role of outline, shape and word- specific patterns is also being investigated through the use of naming and lexical decision tasks.

### **Theoretical Perspectives of Word Recognition Processes Across Different Orthographies**

As mentioned earlier, a major focus of research in cognitive psychology for the last 15 years has been the question of how words are identified in the process of reading (Rayner and Pollatsek, 1989). Many theories of word processing addressed differences in correspondence between graphemes and phonemes across orthographies. According to the orthographic depth hypothesis (ODH) the differences in orthographic depth lead to word processing differences for naming and lexical decision.

The ODH can be formulated as follows: Shallow orthographies support more easily a word recognition process that involves the language phonology while, in contrast, deep orthographies encourage the reader to process printed words by referring to the morphology, using the printed word's visual-orthographic structure (Katz and Frost, 1992). Katz and Frost (1992) have elaborated that shallow orthographies are optimal for assembling phonology from the component letters of a word, and therefore the phonology is more easily available to the reader prelexically than in the deep orthography. They also point out that the more easily a reader can obtain prelexical phonology, the more likely it will be used for pronunciation and lexical access. This suggests that the reader of a shallow orthography would more easily recover a printed word's phonology prelexically by assembling it from letter-phoneme correspondences than would the reader of a deep orthography.

Two versions of the orthographic depth hypothesis exist: The *strong* ODH states that phonological representations derived from assembled phonology alone are sufficient for naming and lexical decision in shallow orthographies. This implies that, in a shallow orthography rapid naming is a result of a prelexical analytic process and does not involve pronunciation obtained from memory (i. e., accessing the lexicon). The *weak* ODH states that the phonology needed for the pronunciation of printed words comes not only from prelexical letter-phonology correspondences, but also from memory.

The latter is the result of a visual-orthographic addressing of the lexicon. The degree to which a prelexical process is active in naming is a function of orthographic depth. Therefore, prelexical analytic processes will be more functional in shallow orthographies (Katz and Frost, 1992) than in deep orthographies.

Besner and Chapnik Smith (1992), however, proposed an alternative viewpoint: the universal hypothesis. In contrast to ODH, the universal hypothesis suggests that there are more commonalities across different orthographies than has been acknowledged. In their model they propose three ways of converting print into speech: One way to name a word is via semantics. When a word is presented, it activates its lexical entry in the orthographic input lexicon, which leads to the activation in the semantic system and then the activation of the phonological output system. A second way to name a word is for the orthographic input lexicon directly to activate the phonological output lexicon. A third way is to use the assembled routine, that is a reader utilizes spelling-to-sound correspondence knowledge to translate subword orthographic segments directly into subword phonological segments and then assembles these phonological segments into speech. The term "addressed" route in this model is used to describe the first two ways of converting print into speech. Research based on this three-route model suggests that the addressed and the assembled routines are available in virtually all orthographies, not solely in the deep orthographies (Besner and

Chapnik Smith, 1992). This model appears similar in some respects to the dual-route. Besner and Chapnik Smith's (1992) model and the dual-route theory both rest on the assumptions that the lexical and nonlexical routes operate independently of each other, and that two subroutes are present within the lexical route. In fact, if the dual-route theory is viewed as proposing two lexical subroutes, the universal hypothesis may be considered a version of the dual route theory.

### **Reading in a Shallow Alphabetical Orthography**

Research on the reading process in shallow alphabetic orthographies can be divided into research carried out on the Serbo-Croatian orthography and research done on shallow alphabetical orthographies of other languages, e.g., Persian, Italian, Spanish, Greek, vowelized Hebrew. Most of the research on the Serbo-Croatian language was done by the same group of authors (e.g., Katz and Feldman, 1981, 1983; Feldman and Turvey, 1983; Lukatela and Turvey, 1980, 1985; Feldman and Turvey, 1983; Turvey, Feldman and Lukatela, 1984; Lukatela, Popadic, Ognjenovic and Turvey, 1980). In general, their results support the strong version of the orthographic depth hypothesis. These studies were single-language studies which are not suitable for testing the weak ODH (Katz and Frost, 1992) .

The majority of the studies conducted on the Serbo-Croatian orthography were based on the two alphabets that exist for this language - Roman and Cyrillic. A few multilingual studies on Serbo-Croatian and English orthography (Katz and Feldman, 1981 and 1983; as well as Frost, Katz and Bentin in 1987) investigated the influence of orthographic depth on visual recognition by comparing naming performance in Hebrew, English and Serbo-Croatian. The results of these studies support the orthographic depth hypothesis, as well.

While the results from the studies conducted on Serbo-Croatian orthography do not apparently allow much space for a substantially different interpretation than that supporting the ODH, the evidence coming from the studies based on other shallow orthographies suggests different interpretations which will be discussed below.

#### *Research on the Serbo-Croatian orthography*

As was mentioned earlier, most of the investigations (except those of Lukatela and Turvey, 1980; Frost, Katz and Bentin, 1987; and Katz and Feldman, 1983.) were based on naming and lexical decision tasks investigating word recognition processes in the two alphabets. The difference between these two alphabets is significant enough that they cannot be looked upon as representing two versions of the same alphabet. As one can see in Figure 2, some of the letters are the same

in both alphabets (A, E, O, J, K, M and T); some are utterly different; some are ambiguous (B, C, H and P), in that their pronunciation depends on whether these letters are interpreted as Roman or Cyrillic. In their investigation of the processing relation between these two alphabets, Lukatela and Turvey (1980) drew the conclusion that the order in which the alphabets are acquired leaves a profound impression on the later decoding processes of adult readers of Serbo-Croatian. Their results indicate that, on a lexical decision task, the alphabet learned first leaves its mark, although the subjects have been reading in the two alphabets for a period of 12 and 16 years.

### Common Letters

Roman	A	E	O	J	K	M	T
Cyrillic	А	Е	О	Ј	К	М	Т

### Separate Letters

Roman	B	Č	Ć	D	Đ	Dž	Đ	F	G	H	I	L	Lj	N	Nj	P	Š	U	Z	Ž
Cyrillic	Б	Ч	Ћ	Д	Ђ	Џ	Ђ	Ф	Г	Х	И	Л	Љ	Н	Њ	П	Ш	У	З	Ж

### Ambiguous Letters

Roman	V	[və]	S	[tsə]	N	[nə]	R	[rə]
Cyrillic	В	[və]	С	[tsə]	Н	[nə]	Р	[rə]

Figure 1: Similarities and Differences between Roman and Cyrillic alphabets in Serbo-Croatian.

Although both of these alphabets could be present (in the former eastern Yugoslavia) in a person's everyday life (e. g., packaging of groceries, store signs, street names, newspapers, TV commercials and so on), not all people have been equally exposed to both.

In almost all studies including Serbo-Croatian participants, authors have not provided information as to whether sampling processes considered which of the alphabets was acquired first. (Note that natives from the eastern part of the former Yugoslavia study

the Cyrillic alphabet first, while in the western areas, the Roman alphabet was acquired first.) It is not clear, in many published studies, which alphabet participants prefer and choose to use in their everyday life in reading and writing . The exception is Lukatela and Turvey's study (1980) where the authors were using grade one students in the first part of the study, and later focused their inquiry on the psychological relation between these two alphabets.

One would expect that relative fluency in reading in both alphabets would be a significant factor for interpreting the data in the above studies. It appears highly desirable to establish level of word recognition automaticity in both alphabets for each subject early in the course of the study. This would allow more accurate interpretation of the data, especially in light of the dual route theory. For example, subjects who are less fluent in one of the alphabets may approach a high frequency word in their "weak" alphabet using the same strategies as they would when reading a pseudoword or a low frequency word in their "better" alphabet. Since the researchers did not measure the subjects' fluency they were unable to control for this variable and their interpretation may have been inaccurate. For example, although both of these alphabets are shallow, the fact is that it would be impossible to process frequent words composed of letters in both alphabets as real words unless the subjects are equally fluent in reading both alphabets (e. g., word SKY (NEBO in the Roman alphabet and HEBO in Cyrillic):

NEBO where first two letters belong to the Roman alphabet, and last two are Cyrillic letters) . Even in the case of equal fluency one may wonder whether it is possible to perceive a well known word, written using two alphabets, as a holistic pattern due to the presence of ambiguous letters (e. g., the word GAME (IGRA in the Roman alphabet and ИГПА in Cyrillic): IGPA, where the first two letters belong to the Roman alphabet, and last two are Cyrillic letters).

There are other confounds in this research which are less evident to non Yugoslavian researchers. For example, in Katz and Feldman's study (1981) American grade five and college students and Yugoslavian adult readers were tested. The experiment focused on how syllable information is used in printed word recognition. The results suggested that Yugoslavian readers use syllable information for word recognition more than readers who were reading English. The authors' explanation for these results was that syllable coding is a more viable process for Yugoslavian readers because of its accessibility and efficiency in obtaining phonological information.

Yet an alternative explanation is that, due to the inflected nature of Serbo-Croatian, it is to be expected that Yugoslavian readers would rely more on a syllabic code which carries important morpho-syntactic information (see Chitiri, Willows, Sun and Taylor, 1992). This proposal contrasts with the authors' explanation that the readers rely on a syllable code due to its accessibility and efficiency in obtaining phonological information. An additional variable in assessing

20

these results could be linked to a common practice of printed text in Serbo-Croatian, whereby words are divided with a slash at the syllable boundary at the end of a line (see Appendix I and II for examples of printed text in the Cyrillic and Roman alphabets). In other words, due to morpho-syntactic information embedded in syllables and the salience of syllables divided by slashes, Yugoslavian subjects may perceive a syllable as a more salient unit in the word recognition process. In contrast, for English speaking adult subjects, the syllable may be less salient as it contains relatively less linguistic information, and syllable boundaries are not made salient in text.

A further limitation in above mentioned study involves the authors' attempt to remove or reduce the possibility of word-specific coding. In order to achieve this goal, they created a set of stimuli using both the Roman and Cyrillic alphabet. In this set, part of the word was given in one alphabet and following a slash the rest of the word was written in another alphabet. The authors justified this change in stimuli with an explanation that "roughly analogous technique in English would be to switch from uppercase to lowercase letters" (p. 101). Thus Yugoslavian subjects were exposed to two alphabets, but American subjects were exposed to lower and upper case letters. Viewing two different alphabets as even a rough analogy to *letter cases* of the same alphabet is highly questionable. Hence it seems that studies conducted on processing Serbo-Croatian are flawed. The authors also ignored, as noted above, potential confounding due to the

29

existence of alphabet bias (e.g., influence of the first learned alphabet, possible difficulties caused by ambiguous and common letters and/or influence of various levels of fluency in reading two alphabets). These methodological concerns raise doubts about the validity of conclusions concerning the effect of orthographic depth on word recognition.

Support for these findings, however, came from a study by Feldman, Lukatela and Turvey (1985). In that study 34, grade 3 and grade 5 students were tested on speed of naming words and pseudowords (95 % learned the Cyrillic alphabet first). One half of a letter string was written in one alphabet and the other half was written in another alphabet, and ambiguous letters were included. Results showed that letter strings with ambiguous letters were named more slowly and less accurately than their non ambiguous controls. Also, the more skilled beginning reader had more difficulties with ambiguity than the less skilled reader. Feldman et al. (1985) interpreted their data as indicating that skilled readers access the lexicon in such a way that an analysis of phonological components must be included. Their conclusion, was as follows:

"the Serbo-Croatian orthography is phonologically very regular (permitting a valid prediction of how a word sounds solely on the basis of the letters comprising the word) and as such encourages neither the development of the options for accessing lexicon, nor a sensitivity to the linguistic situations in which one option fares better than another. In this important respect it is very different from the phonologically deep English

orthography which encourages (and, perhaps, demands) flexibility." (p. 88)

An observation made by the authors was that the subjects did not treat a word as a holistic figural pattern. It would be interesting to find out how a group of bilingual children (e. g., English as L1 and Hebrew as L2) would name English words and pseudowords written half in the Hebrew alphabet and half in the English alphabet; it appears doubtful that such stimuli would encourage the reader to process them by referring to their morphology via the word's visual-orthographic structure. It appears that perceiving a letter string written half in the Roman alphabet half in Cyrillic using ambiguous letters as holistic figural patterns is very improbable, if for no other reason than lack of familiarity with words written in such a manner. It seems apparent that, in order to decode and name those stimuli, the subjects needed to rely on phonological coding.

Frost, Katz and Bentin (1987) investigated the influence of orthographic depth on visual recognition by examining naming performance in Hebrew, English and Serbo-Croatian. The authors conducted three experiments in which they were investigating the psychological reality of the concept of ODH, using high and low-frequency words and nonwords, semantic priming effects in naming and combination of nonwords and real words in the stimulus list. They found no frequency and lexicality effects in Serbo-Croatian, and interpreted these results as "strong support for the orthographical

depth hypothesis ... [which] suggest, in general, that in shallow orthographies phonology is generated directly from print, whereas in deep orthographies phonology is derived from the internal lexicon" (Frost et al., 1987, p. 104).

Seidenberg (1992) has challenged such an interpretation of the results and argued that the frequency and lexicality effect do not provide evidence for the use of direct, orthographic recognition process, but indicate properties of the orthographic-phonological computation. Seidenberg reanalysed the data and suggested that the lexical decision data indicate frequency and lexicality effects in all three orthographies; therefore orthography, in fact, shows very little effect on a lexical decision task. Such an interpretation challenges the orthographic depth hypothesis, given the assumptions that lexical decisions require access to meaning and that these three orthographies differ in the extent to which phonology influences access of meaning. In particular, Seidenberg argued that there should be some difference between the orthographies on a lexical decision task. But none were observed. In another study conducted by Seidenberg and Vidanovic (1985), a lexicality effect was found in naming words in Serbo-Croatian. One critique of their findings was based on their choice of primes in their stimuli; namely, as primes they used associative relations, while previously mentioned studies (e. g., Frost et al., 1987) used semantic relations consisting of categories.

A recent investigation conducted by Carello, Lukatela, Peter and Turvey (1995), which examined the effects of association, frequency and stimulus quality in naming words and pseudowords in Serbo-Croatian and English, also reported a lexicality effect in naming words in Serbo-Croatian. Although the results suggested the influence of frequency effect and associative priming in naming words, the authors stated that a satisfactory account need not require a different understanding of processes underlying word recognition in Serbo-Croatian from one based on a well established assembled route.

To summarize, a brief survey of research on the Serbo-Croatian orthography points to seeming evidence supporting the ODH as the only satisfying framework accounting for word recognition in that orthography. Closer scrutiny, however, suggests that the role of phonological coding and possible role of orthographic neighborhoods in Serbo-Croatian orthography is still unclear and needs further investigation.

*Research on other languages with shallow alphabetical orthographies*

Baluch and Besner (1991) conducted a study on the Persian language; they sought to determine what effect phonological transparency has upon word recognition. In the Persian alphabet, there are two ways of representing vowels. As a function of the way vowels are represented in print it is possible to contrast opaque and transparent words within a script, rather than across the scripts (as

was done in some Serbo-Croatian studies reviewed above). The results from their experiments support the theoretical argument that transparent words are processed by using nonlexical spelling-to-sound correspondence rules, while opaque words are read using the addressed routine.

An investigation completed on Italian and English orthography (Tabossi and Laghi, 1992) examined the semantic priming effect in both orthographies. As target pairs, the authors used only frequent words. The findings suggest that, as in languages with a deep orthography, reading in languages with shallow orthographies is usually performed lexically. Semantic priming effects disappear in shallow orthographies if the items lacking lexical representations (nonwords) are introduced into a list of frequent, regularly stressed words. Under these conditions, the investigators concluded that actual words appear to be pronounced nonlexically, on the basis of assembled routine.

These findings replicate the results of Katz and Feldman (1983) and Frost et al (1987) who also did not find a semantic priming effect in Serbo-Croatian. No comparable effects were observed in English, in which word reading is believed to be accomplished with reliance on lexical knowledge. Nonlexical reading, Tabossi and Laghi argue, therefore has a quite limited use, even in a language with a very transparent orthography, like Italian. These results confirm that

the orthographic depth hypothesis, in fact, is "sinking" as Besner and Chapnik Smith (1992) suggest in the title of their article.

Another study concerned with the Spanish language addressed the lexical effect in reading pseudowords (Sebastián-Gallés, 1991). The results are inconsistent with theories that propose different reading mechanisms for languages with different orthographies; that in languages with deep orthographies like English, French and unvoiced Hebrew, skilled readers recognize words through the orthographic-graphemic code, while in the case of shallow orthographies, the readers rely on the phonemic prelexical code. The author hypothesized that because different languages encode phonemic information differently in their orthographies, the speed and ease of grapheme-to-phoneme translation varies from language to language. Thus it would be possible, in languages with shallow orthography, to recognize printed words through the prelexical phonological code more frequently than through the lexical code, although only in the case of words that are difficult to locate in the orthographic lexicon. The author found no reason to think that the orthographic way has to work differently according to different orthographies. She also mentioned one more source of variation between languages that may affect reading processing -- average length and number of syllables per word.

Another study that may shed a different light on word recognition processes in shallow orthographies was that of Borowsky

and Besner (1991); the interaction between context and degradation in semantic priming in English was examined. There were two experimental conditions: Both contained a related context, but priming in one was assessed against an unrelated context condition consisting of an unrelated word; the other was assessed against an unrelated context-condition consisting of asterisks. One of the reasons for such a design, lay in the authors' intent to "assess Lukatela and Turvey's (1987) assumption that a baseline context consisting of asterisks is functionally equivalent to a context consisting of unrelated words." (Borowsky and Besner, 1991, p. 273).

Lukatela and Turvey (1987) had argued that their findings in a lexical decision task for the Serbo-Croatian subjects provide evidence that lexical access is phonologically mediated, although Borowsky and Besner's data (1991) clearly show that a condition in which asterisk primes are used as a baseline does not yield the same pattern of priming (between context and degradation) which happens when unrelated-word primes are used. Lukatela and Turvey (1987) compared a related context with an unrelated-prime condition consisting of asterisks instead of an unrelated-prime condition consisting of unrelated words.

Borowsky and Besner's results indicate that Lukatela and Turvey's findings are due to the baseline they used and not processes that underlie word recognition in Serbo-Croatian. Chitiri and Willows (1994) studied the effects of orthographic and linguistic

characteristics on two phonological aspects of word recognition (syllable and stress); they used monolingual readers of English and Greek and a letter cancellation paradigm. Among their findings, the more relevant results for this study suggest that the reading process in different orthographies is sensitive to orthographic and linguistic characteristics of the language (at least at the levels investigated). Their results indicate that the presence of phonological code was more pronounced in Greek than in English; the presence of visual code in Greek was indicated by letter frequency effects and by possible visual processing of stress effects. Although Chitiri and Willows' study (1994) supports the ODH, their results depart somewhat from the stronger version of the ODH, opening some space for the presence of the other means than the use of phonological code in reading processes in shallow orthography.

Frost (1994) conducted research on how skilled readers approached word recognition in shallow (pointed Hebrew script) and deep (unpointed Hebrew script). His results indicated that although the adult readers are exposed to unpointed Hebrew on a daily basis and are trained to use the addressed route in word recognition, when exposed to pointed Hebrew, their reading strategy changed and they relied on assembled route. The results of this study also provide support for the weaker version of ODH.

As presented above, along with ODH, the universal hypothesis and others, current theories require further empirical corroboration

before one can, with more certainty, define common features of word processing in shallow and deep orthographies.

### **Reading in a Second Language (L2)**

Previously mentioned studies were mainly focused on word recognition within different orthographies. A group of authors (Akamatsu, 1996; Chitiri, Sun, Willows and Taylor, 1992; Geva and Clifton, 1994; Geva and Siegel, 1994; Geva, Wade-Woolley and Shany, 1993; Geva, Wade-Woolley and Shany, 1997; Geva and Wade-Woolley, in press; and Gholamain and Geva, 1997) moved forward from investigating one of the subskills (word recognition) in reading process across the languages and focused on examining word recognition and the development of reading skills in a second language. As these investigations are still in a process of defining a theory of L2 reading, there is a tendency to rely on the theoretical frameworks for reading in L1, assuming that processes underlying reading development in L2 are similar. As mentioned above, a number of studies compared level of decoding skills among readers in L1 and L2 (Chitiri et al., 1992; Geva and Clifton, 1993; Geva and Siegel, 1994 and Gholamain and Geva, 1997). These studies suggest that decoding skills in L1 and L2 , although operating among very different orthographies, are nevertheless positively correlated, and that

individual differences in the development of those skills in L1 and L2 can be predicted to some extent on the basis of cognitive and linguistic abilities such as phonological skills, memory, orthographic knowledge and speed of processing (Geva and Wade-Woolley, in press).

Although the importance of carrying out research in L2 has been recognized, the amount of such research is still limited and more carefully designed investigations are necessary to deepen our understanding of reading processes in L2.

### **Rationale of the Present Study**

Beside the more traditional approaches reviewed earlier, which tend to support a weak version of ODH as unique way of processing words in a shallow orthography, there is an alternative view. This option requires more time and more studies before it will be able to offer more relevant answers to researchers' questions pertaining to word processes across different orthographies.

Frost (1994) summarized the alternative approach as a view that emphasizes the importance of orthography limiting the use of phonology in reading processes. According to this approach, it is not the orthographic depth that dictates whether phonology is assembled or addressed but word frequency. Thus in any orthography, frequent

words are familiar visual patterns, hence these letter strings can be easily recognized through a visually based lexical access which is fast, and occurs before a phonological representation has time to be generated prelexically from the print. Therefore, because the orthographic structure is not transferred into a phonological configuration through the use of grapheme-to-phoneme conversion rules, depth of orthography does not appear to play a significant role in the processing of frequent words. The role of orthographic depth is relevant, however, when less familiar words and/or pseudowords are processed. Because such stimuli are less familiar, their visual lexical access is slow and phonology has enough time to be generated prelexically (Seidenberg, 1985; Baluch and Besner, 1991; Tabossi and Laghi, 1992).

Most early studies investigating word recognition were carried out in the English language. There was an underlying assumption that reading processes are universal, and therefore studies in English were considered to be a sufficient source to provide an answer about processes involved in recognizing printed words. In the last decade, however, studies completed on non-English languages have become common, and these studies indicate that reading processes cannot be explained without considering the orthographic and linguistic characteristics of the particular language (Frost, 1994). As a result of these studies, the effect of orthographic depth on

reading has been a focus of current controversies (e.g., Lukatela and Turvey, 1980; Katz and Feldman, 1981; Tabossi and Laghi, 1992).

Research conducted on the Serbo-Croatian orthography "point[s] unequivocally to a nonoptional phonological access route ..." (Carello, Turvey and Lukatela, 1992, p. 211) while research completed with other languages with shallow orthographies points toward presence of other routes beside the phonological. Most studies on Serbo-Croatian orthography were single language studies (except Katz and Feldman, 1981, 1983; Frost, Katz and Bentin, 1987). In contrast, most of the studies conducted on other shallow orthographies were cross-lingual (except Sebastián-Galés, 1991; Baluch and Besner, 1991).

On the other hand, research pertaining to reading in a second language is still in the process of searching for a comprehensive theory. Furthermore, not too long time ago, there was little research addressing comparisons of reading in non-Indo-European languages and languages with non-Roman alphabet, which could assist in building a theory of reading in a second language (Barnett, 1989).

In sum, there is a need to carry out a cross-lingual study on the Croatian orthography with its one alphabet, a study which investigates word recognition processes in Croatian and is designed to investigate, at the same time, the similarities and differences of

word recognition processes across the Croatian and English orthographies.

In order to avoid any possible alphabetical bias when naming words written in the Roman alphabet which may contain ambiguous and common Cyrillic letters, the present study was conducted on Croatian children whose exposure to the Cyrillic alphabet was minimal (if any). Those children were in grade two when the war started and therefore learning the Cyrillic alphabet was not part of their curriculum any more. The careful selection of the subjects ensured that their first learned alphabet was the Roman alphabet and that the children were Croatians who started their formal education in Croatia. The intent of this study was threefold: (a) to test the relevance of the orthographic depth hypothesis to reading in Croatian and English; (b) to compare L1 (Croatian) and L2 (English) decoding skills among young readers; and (c) to investigate the role of individual differences in reading comprehension.

## Hypotheses

According to the ODH, naming words in Croatian (a shallow orthography) is qualitatively different from naming regular words in English (deep orthography). However, due to the lack of lexical representations in the lexicon, naming pseudowords in both languages is, accordingly, processed through the assembled route. Hypothesis H1 is as follows:

The subjects will name real words faster than pseudowords in both languages. The difference between naming times for real words and pseudowords in the native and the English language will be substantial enough to indicate whether or not the assembled phonology is used to name real words.

Many people read efficiently in their first language. The question is do they transfer those skills to reading in another language (Barnett, 1989)? Likewise, hypothesis H2 in this study is the following:

The attained reading skills in first language correlate with the parallel reading skills in the second language regardless of the differences in language proficiency and orthography.

Similarities and differences between L1 and L2 reading processes are still in a focus of the debate among second language

reading researchers. Many researchers have concluded that first and second language reading processes resemble each other based on research completed with advanced second language readers. Other researchers argue that reading processes differ between languages, and that subjects' general language proficiency level is a determining factor (Barnett, 1989). H3 therefore, can be stated thus:

Reading processes in L1 are similar to reading processes in L2 regardless of the differences in language proficiency and orthographies.

Much of the research on the development of reading skills is based on reading in English as L1, and correspondingly, some assumptions about reading development are extended to theories of L2 reading. The role of individual differences in reading acquisition is another controversial issue in a second language reading. Therefore, hypothesis H4 is as follows:

In spite of differences in language proficiency, individual differences in component processes play a similar role in reading comprehension in both languages.

## CHAPTER 2 : METHODOLOGY

### Participants

Twenty seven, grade eight students (10 F and 17 M) attending three elementary schools in Zagreb, Croatia (one located downtown and the other two on the outskirts of the city) participated in this study. A consent form was sent to the parents of all grade 8 students in these schools (approximately nine grade 8 classes). The participants were chosen by the author from the children whose parents signed a consent form. The criteria used for selection were as follows: (a) the duration of attending the Zagreb schools; (Due to the war many children emigrated from other areas of former Yugoslavia to Zagreb; this might add a potential confounding effect as a result of children being exposed to different dialects of the language and/or having had early exposure to the Cyrillic alphabet.); (b) 4.5 years of continuous learning of English as a foreign language (EFL instruction started in grade 4); (c) the existence of only one foreign language (English) instruction; and (d) the language/dialect spoken at home being Croatian.

In the majority of Zagreb schools, mandatory foreign language instruction is introduced in grade four. Some schools offer this instruction in grade one, but only as an extracurricular activity. The children exposed to early foreign language instruction were

excluded from this study. Most of the children in Zagreb schools learn two or even three foreign languages, and it was difficult to find subjects who met all the requirements. In fact, more than 40 families agreed that their child could participate in this study; however, only 27 children met the above mentioned criteria.

### Measures

To examine reading processes in Croatian and English, four tasks (letter naming, word naming, pseudoword naming and lexical decision) for each language were constructed, and accuracy and speed of naming were measured. All tasks were designed in the same fashion. Stimuli would appear in a random order for each participant on a screen of a Macintosh laptop computer. Prior to each stimulus, a blank screen would appear which lasted for 300 ms; then a fixation mark would appear in the middle of the screen for 400 ms; this was followed by another blank screen for 400 ms, and then the stimulus would appear. The stimulus would stay on the screen until it was named. The participants were instructed to read each item as quickly and accurately as possible.

Each task was preceded by a practice trial consisting of five examples, prior to which the oral instructions were given in Croatian. The participants were told, prior to each naming task, that a stimulus

would appear on the screen and that their task was to read the letter/word /pseudoword as quickly and accurately as possible. They were also told how many items were in each task. Similar instructions were given before the practice trials for the lexical decision task.

Accuracy for each task in both languages is reported in terms of the percentage of items read correctly out of the total number of items in that task. Accuracy in determining appropriate conjunctions in the text- comprehension task for both languages is reported, likewise, in terms of percentages of correct items.

Reaction Time (naming speed) for each task is based on the mean reaction time of items named accurately.

### Cognitive Variable

Short Term Memory Croatian (digspanC). In order to assess short term memory, a subtest of WISC - III Digit Span Forward and Backward in Croatian was used. The participants were asked to repeat strings of numbers that increased in length with each level (from 2 digits to 8 digits). In Digits Forward participants were repeating numbers in the same order as they heard them, while in Digits Backward task the participants were repeating string of numbers backward from what they heard. Each correctly repeated string was assigned a score of 1. Scores range from 0 - 14.

### Repeated Variables

Letter Naming in Croatian (letterC). A list of 5 printed letters (**S, A, R, N** and **U**) was used to measure accuracy and speed in naming letters. This list included 50 items. Each letter appeared 10 times in a random order (discrete trial, letter naming speed) . The set of letters for this task consisted of two vowels and three consonants. An attempt was made to choose the letters whose names are the least similar across the two languages.

Letter Naming in English (letterE). A parallel task was developed in L2 which also included two vowels and three consonants (**E, O, D, T** and **P**).

Word Naming in Croatian (wordC). A list of 30 Croatian nouns was developed to measure accuracy and speed in naming words (Appendix V). All Croatian real words were judged (by the author of the study) to be frequent two syllable words, consisting each of five letters and one morpheme. It was necessary to develop a list of frequent words in such an arbitrary way because there is no standard objective word frequency source of Croatian words as we have for English. Three or four words were taken from the Frost, Katz and Bentin's (1987) study.

Word Naming in English (wordE). A parallel task was developed in L2 (Appendix VI). English words were translations of the Croatian words whenever it was possible to do so, but mostly the words were taken from English text books used in grades 5, 6 and 7 in the

Croatian elementary schools. All English words were regular high frequency two syllable five letter words.

Text Comprehension Croatian (texcompC) was assessed via a cloze test. The Croatian version consisted of five paragraphs taken from two books which are suitable for young readers. The Croatian text consisted of 302 words, and comprehension was evaluated on the basis of the participant's ability to choose the appropriate conjunctions. There were two conjunctions offered where each conjunction in the text appeared. Readers were required to underline the conjunction that best fit the meaning of the sentence. Across the text there were 20 items to fill out (Appendix III).

Text Comprehension English (texcompE) was assessed by a cloze test similar to the Croatian version. The English version consisted of five paragraphs which were taken from the participants' English text books from grades 6 and 7. The English text was longer than the Croatian and had 368 words; comprehension was likewise evaluated on the basis of the participants' ability to choose the appropriate conjunctions. Across the text there were 20 items to fill out (Appendix IV).

Pseudoword Naming Croatian (pseudoC). A list of 30 Croatian pseudowords was developed to measure accuracy and speed in decoding pseudowords. Each pseudoword was developed by changing one letter in a real word (consonant or vowel in each position of the word) used in the Croatian word naming task (Appendix VII); for

example, from the Croatian word KORIST, a pseudoword KOROST was generated.

Pseudoword Naming English (pseudoE). A parallel task was developed in L2. English pseudowords were developed by changing one letter in the real words (consonant or vowel in each position of the word) used in the English word naming task (Appendix VIII); for example, from the English word DOCTOR, a pseudoword DECTOR was generated.

Lexical Decision Croatian (lexdecC). A list of 18 items (pairs of words-pseudowords) was developed to measure accuracy and speed of lexical access (Appendix IX). Each item consisted of a real word and a pseudoword. Item-pairs would appear on the screen at the same time, side by side. Half the time the real word was on the left, half the time on the right. The position of the real word on the screen was randomized. All words and pseudowords were two-syllable, five letter, one morpheme words. None of the items were used in any of the previous tasks. In this task the participants needed to decide which side of the screen contained the real word and responded by pressing the button (left index finger was positioned on the key designated to choose a word on left side of the screen and right index finger positioned on the key designated for right side prior to the onset of the task).

Lexical Decision English (lexdecE). A parallel task using identical procedures and principles was developed to measure accuracy and speed of lexical access in English (Appendix X).

## Procedure

The administration of the tasks took place during the second semester of the school year (1994/95). The testing was divided into two parts: group and individual testing. The text comprehension tasks were completed through group testing. Speed in completing text comprehension task, in each language, was not controlled due to the difference in length of the Croatian and English texts. The participants received instructions in Croatian and were allowed 10 minutes to complete both tasks. All participants first completed the Croatian comprehension and then the English comprehension task. This pattern was followed throughout the whole study. Individual testing was carried out for all other tasks.

The computation of the reaction time was automatically voice-activated and recorded on the laptop computer. The examiner manually documented errors in the naming tasks. Testing was carried out by the author of this study. All sessions were audio taped, and the accuracy of the examiner's errors in scoring the English naming tasks was checked by a communication clinician. Individual testing was administered in two blocks with a 5 minute break between them. A testing session was conducted as follows:

**Block I - Croatian**

Naming Tasks

List of 30 pseudowords

List of 50 letters.

Lexical Decision Task

List of 18 pairs of words/pseudowords

Naming Task

List of 30 real words.

(5 minute break)

Digit Span Test

**Block II - English**

Naming Tasks

List of 30 pseudowords

List of 50 letters.

Lexical Decision Task

List of 18 pairs of words/pseudowords

Naming Task

List of 30 real words.

### CHAPTER 3 : RESULTS

Correct responses were defined as letters and/or letter strings that were pronounced accurately and whose RTs were above 300 milliseconds (ms). Most responses under 300 ms were usually caused by some technical difficulties due either to the high sensitivity of the microphone to environmental vibrations (e. g., from an airplane or a truck) or other noise such as stutter or cough.

Accuracy for English pseudowords was judged according to the acceptability of pronunciation. If pronunciation of the pseudoword appeared to be based on an analogy to a real word or if it was reasonable according to the pronunciation rules, it was accepted as an accurate item. In order to insure that accuracy for English pseudowords was appropriately coded, 30% of participants' responses for English pseudowords was analyzed by a communication clinician whose findings differed for only 6.7% of the items from the author's coding for accuracy. In those cases the clinician's judgments were considered as the benchmark.

Due to the large standard deviations on almost all variables, a log transformation was conducted and, a trial analysis was performed with the transformed data. Since the analyses based on the transformed data were not significantly different from those based on the raw data, results reported here are based on analysis carried out with the raw data.

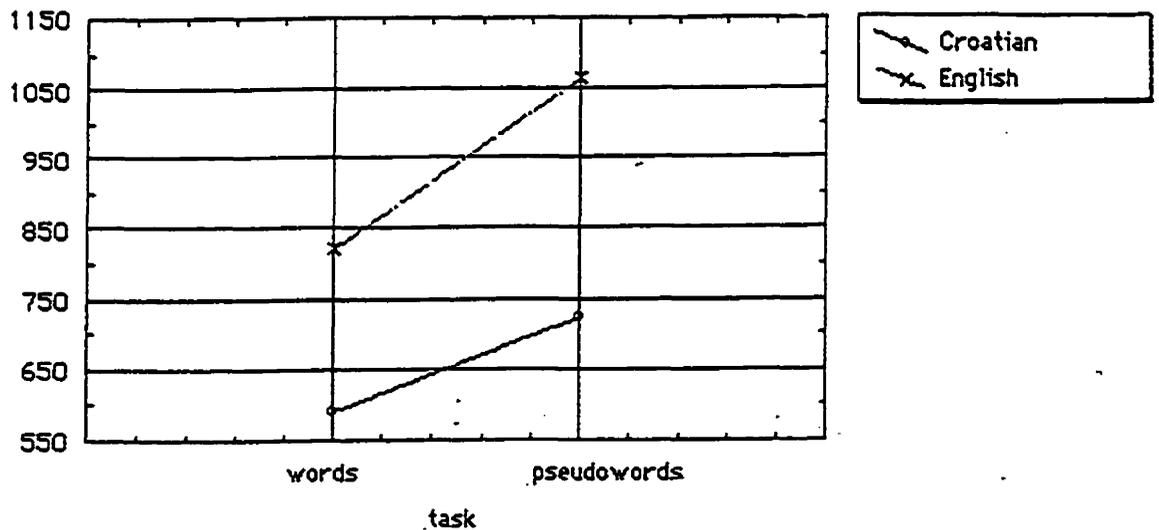
In the lexical decision task, two letter strings appear on the screen at the same time and the correct answer appears either on the left or on the right. A t-test was carried out to examine possible right-left bias in the position of the real word in each pair (means, standard deviations and t-test results for lexical decision task according to the position of the real word in each pair are given in Appendix XII). The results indicate that the difference between the means is not statistically significant. In other words, for both languages the position of the real word in each item did not influence speed of lexical decisions obtained on these tasks. Position was therefore ignored in subsequent analyses.

### **Processing Words and Pseudowords: Is the Route the Same for Both Languages?**

Because the difference between speed in naming words and pseudowords for both languages is positively correlated (Figure 3), the statistical significance of differences in RTs associated with parallel tasks in Croatian (L1) and English (L2) was assessed with a 2 X 2 analysis of variance with task (word, pseudoword naming) and language (Croatian, English) as two repeated measures.

There was a main effect for language  $F(1,26) = 19.42, p < .0002$ . This result reflects the fact that tasks performed in Croatian were accomplished significantly more quickly than their English counterparts. There was also a significant main effect of task  $F(1,26) = 40.27, p < .000001$ , reflecting the fact that, in both languages, participants named the words more quickly than they named the pseudowords. There was no significant interaction between language and task ( $F(1,26) = 3.89, p < .059$ ).

Figure 2: Croatian and English Word and Pseudoword Speed Naming (mean RT)



While coding accuracy for pseudowords in both languages, it was noticed that sometimes participants named pseudowords as real words although at other times, the naming resulted in another non-word which was mispronounced. Error analysis was conducted to compare the incidence of pseudowords read as words vs. pseudowords which were mispronounced for each language. It was found that 35% of the errors in naming pseudowords in Croatian were pseudowords which were pronounced as Croatian real words (e. g., the pseudoword ZDEDAC was pronounced as the real word ZDENAC), and 54% of the errors in naming pseudowords in English resulted in pronouncing them as English real words (e. g., the pseudoword BASKIT was pronounced as the real word BASKET). The Wilcoxon Matched Pairs Test was performed to test for significance between frequencies of naming the pseudowords as real words and frequencies of other errors on pseudoword naming tasks within the each language. The results showed statistical significance ( $T = 59$ ,  $p < .05$ ) for Croatian, but not for the English language.

In sum, in both languages participants named real words significantly faster than pseudowords suggesting that naming the real words in L1 and L2 utilized an addressed route, while in naming pseudowords in both languages, it appears that the subjects relied on an assembled route since they did not have an orthographic/visual representation of the pseudowords in either language. The error analysis (i.e., pronouncing a pseudoword as a real word) suggests

occasional use of addressed route in naming pseudowords. Hence, the evidence suggests that the route for processing words in Croatian and regular words in English is the same, regardless of the differences in orthographic depth of these two languages.

### **Do Attained Reading Skills in L1 Correlate with Reading Skills in L2 Regardless of the Language Proficiency and Orthography?**

As stated earlier, attained reading skills were operationalized in terms of accuracy and speed in naming and lexical decision tasks. In order to determine if attained reading skills in the native language (Croatian) were correlated with reading skills in English, the L2, the results for accuracy and speed measures in Croatian were correlated with the parallel English measures. These results are summarized in Tables 1 and 2. As one can see, accuracy in naming letters, naming words and pseudowords in English was positively related to accuracy in naming pseudowords in Croatian. Furthermore, accuracy in lexical decision in English was positively and significantly related to accuracy in lexical decision in Croatian. The lack of correlations involving accuracy in word naming is likely due to the subjects' high accuracy rates on these tasks (see Table 4). Correlations between measures on which subjects did not reach ceiling in English are positive and significant however.

Table 1

Correlations for Accuracy for Parallel Variables in Croatian and English \*

	letterE	wordE	pseudoE	lexdecE
Letter Naming Croatian (letterC )	.30	-.05	.10	-.17
Word Naming Croatian (wordC)	.09	.31	-.15	.15
Pseudoword Naming Croatian (pseudoC)	.41	.51	.43	.37
Lexical Decision Croatian (lexdecC)	.21	.34	.33	.68

-----  
 \* all correlations above .38 are significant at  $p < .05$ ;  
 all correlations above .52 are significant at  $p < .01$ ;  
 all correlations above .62 are significant at  $p < .001$ ;  
 all correlations above .68 are significant at  $p < .0001$ .

Table 2 presents results for correlations on speed measures in Croatian and English. As can be seen, these correlations are positive and high. The pattern of correlations reveals that the subjects who had faster RTs in naming words, pseudowords and lexical decision in Croatian were also faster in naming words, pseudowords and in the lexical decision task in English. However, speed in naming letters in Croatian was not significantly related to any other variable, except for speed in naming letters in English. The standard deviations associated with letter naming speed in Croatian (see Table 5) are extremely small, suggesting again a ceiling effect which may account for the lack of significant correlations involving this measure.

In sum, the results indicate that the subjects who achieved faster RTs on the tasks in their native language also achieved faster RTs on parallel tasks in the L2. In general, speed measures are highly related to each other (Scatterplot for speed for parallel variables in L1 and L2 is presented in Appendix XII.) indicating a presence of a common underlying factor in Croatian and English language proficiency.

Table 2  
Correlations for Speed for Parallel Variables in Croatian and English\*

	letterE	wordE	pseudoE	lexdecE
Letter Naming Croatian (letterC)	.48	.19	.21	.08
Word Naming Croatian (wordC)	.38	.56	.73	.76
Pseudoword Naming Croatian (pseudoC)	.49	.63	.73	.77
Lexical Decision Croatian (lexdecC)	.48	.61	.69	.87

-----  
 \* all correlations above .38 are significant at  $p < .05$ ;  
 all correlations above .52 are significant at  $p < .01$ ;  
 all correlations above .62 are significant at  $p < .001$ ;  
 all correlations above .68 are significant at  $p < .0001$ .

Table 3

Correlations for Speed and Accuracy in Croatian and English\*

## accuracy

<b>speed</b>	letterC	wordC	pseudoC	lexdecC	letterE	wordE	pseudoE	lexdecE
letterC	-.06	.01	.05	.18	-.07	-.21	-.18	.01
wordC	.07	-.18	-.69	-.31	-.35	-.52	-.18	-.19
pseudoC	.02	-.01	-.56	-.18	-.43	-.39	-.19	-.01
lexdecC	-.06	.09	-.77	-.38	-.44	-.50	-.36	-.22
letterE	-.03	.09	-.19	.14	-.35	-.33	-.04	-.12
wordE	.06	.01	-.35	-.12	-.16	-.36	.01	-.24
pseudoE	.14	.07	-.47	-.09	-.30	-.27	.02	-.16
lexdecE	-.01	.08	-.71	-.15	-.46	-.59	-.35	-.15

-----  
 \*all correlations above .38 are significant at  $p < .05$ ;  
 all correlations above .52 are significant at  $p < .01$ ;  
 all correlations above .62 are significant at  $p < .001$ ;  
 all correlations above .68 are significant at  $p < .0001$ .

Table 3 summarizes the correlations among Croatian and English speed and accuracy indices. Means and standard deviations associated with these indices appear in Table 4 and 5. Accuracy in Croatian letter and word naming did not correlate with any speed measures. Given that performance was at ceiling on these accuracy measures (see Table 4) this finding is not surprising. Yet, accuracy in lexical decision in Croatian is negatively and significantly related to speed. Further, accuracy in naming pseudowords in Croatian is

negatively correlated with speed in naming words, pseudowords and lexical decision in Croatian as well as with speed in lexical decision and naming pseudowords in English. Similar relations were obtained for accuracy in naming words in English. Specifically, accuracy in naming words in English is negatively related to speed in naming words, pseudowords and lexical decision in Croatian, and speed in lexical decision in English. Speed in naming pseudowords and lexical decision in Croatian and speed in lexical decision in English are all negatively related to accuracy in naming letters in English.

In other words, the participants who were faster in naming words, pseudowords and lexical decision in Croatian, and who were faster in lexical decision in English were more accurate in naming pseudowords in Croatian. In addition, the participants who were faster in naming words and pseudowords and lexical decision in Croatian and lexical decision in English also made fewer errors in naming words in English. Furthermore, the participants who obtained faster RTs in lexical decision task in Croatian were also more accurate in that task. Likewise, speed in lexical decision in both languages and pseudoword naming in Croatian was negatively correlated with accurate letter naming in English.

The above mentioned results suggest that on the whole reading skills in L1 correlate with the reading skills in L2. This is true both for accuracy and speed measures. Where the correlations are low

this can be explained by fairly high accuracy obtained on the reading tasks in Croatian.

### **Are Reading Processes in L1 Similar to Reading Processes in L2 Regardless of the Differences in Language Proficiency and Orthography?**

Means and standard deviations were calculated only for the correct responses for each experimental task. Means and standard deviations associated with the accuracy and speed data for all variables and memory are presented in Tables 4 and 5, respectively.

Average accuracy rate for Croatian tasks was 93%, but for English tasks it was 85%. The participants made an average of 7% errors on the Croatian tasks and 15% errors on the English tasks. However, even when they were accurate, they were slower in the L2. Their RTs were 26% - 30% slower in English than on the Croatian parallel tasks.

Table 4

Means, Standard Deviations and t-Test for Accuracy (%)

		Croatian	English	t	p
Letter Naming	M	.997	.920	3.96	.0001
	SD	.010	.104		
Word Naming	M	.974	.894	4.76	.00001
	SD	.031	.092		
Pseudoword Naming	M	.839	.768	3.00	.001
	SD	.122	.109		
Lexical Decision	M	.944	.875	4.00	.00001
	SD	.063	.119		
Text Comprehension	M	.881	.815	2.41	.01
	SD	.083	.159		
Digit Span	M	10.148			
	SD	2.892			

Naming letters was the task with the highest accuracy rate in L1 and L2, and naming pseudowords was the task with the lowest accuracy rate for both languages. For these data, t-tests were carried out, and the results showed that there was a significant difference between parallel English and Croatian accuracy measures for all tasks. This pattern is represented graphically in Figure 3.

Not surprisingly, although the subjects were highly accurate on all tasks in L1 and L2, their accuracy was superior in their native language. These results indicate that the participants were proficient readers in both languages.

Figure 3: Parallel Accuracy Measures in Croatian and English (mean correct items)

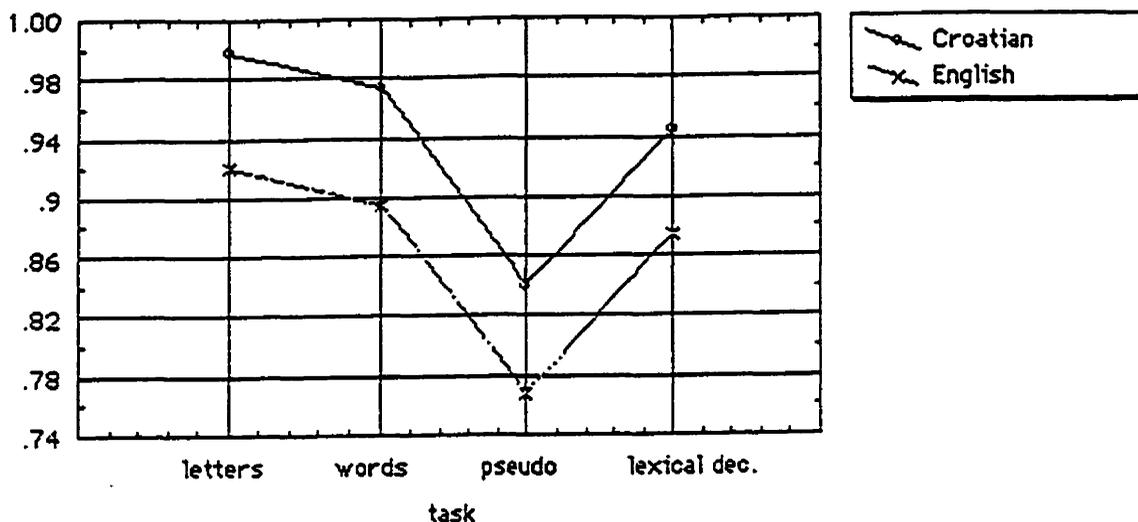


Table 5

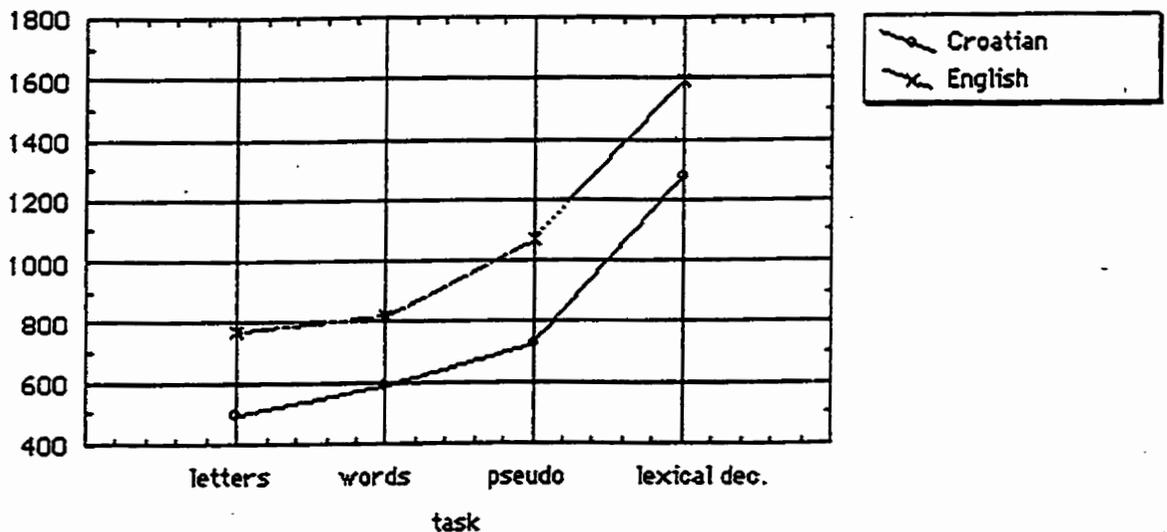
Means, Standard Deviations and t-Test Values for Speed Measures in Croatian and English (RTs in ms)

		Croatian	English	t	p
Letter Naming	M	492.07	768.14	-5.68	.00001
	SD	49.69	272.81		
Word Naming	M	588.91	823.88	-3.50	.001
	SD	115.18	400.26		
Pseudoword Naming	M	724.14	1066.05	-4.60	.00001
	SD	175.98	496.73		
Lexical Decision	M	1280.35	1597.46	-3.15	.001
	SD	392.08	827.96		

As can be seen in Table 5 and Figure 4, the RT means on parallel Croatian and English measures were consistently lower on English tasks. The t-tests indicated (Table 5) that these differences were statistically significant, showing a second language effect on all speed measures.

Clearly, participants were significantly faster in naming in their native language than in the L2. One may, however, also notice the identical profile across languages, and that a gap between phonological and lexical properties was consistent across tasks. The participants achieved the fastest RTs in naming letters in both languages and the slowest RTs in naming pseudowords. The participants were the fastest in both languages in naming letters and familiar printed words. They were significantly slower in naming pseudowords in both languages (a point discussed in an earlier section).

Figure 4: Parallel Speed Measures in Croatian and English



Tables 6 to 9 provide a summary of intercorrelations for accuracy and speed among reading measures within L1 and L2. As one can see in Table 6 the only significant correlation involving accuracy measures in L1 is between lexical decision and pseudoword naming: participants who name pseudowords more accurately also are more likely to read accurately the two letter strings in each pair and make an accurate decision about the one that is a real word in Croatian.

Table 6

Intercorrelations for Accuracy Among Reading Measures in Croatian\*

	letterC	wordC	pseudoC	lexdecC
letterC	1.00			
wordC	-.12	1.00		
pseudoC	-.13	.05	1.00	
lexdecC	-.03	.07	.52	1.00

-----  
 \*all correlations above .38 are significant at  $p < .05$ ;  
 all correlations above .52 are significant at  $p < .01$ ;

Table 7 presents intercorrelations for accuracy in L2. One notes the positive and significant intercorrelations between naming words and naming letters, and between naming pseudowords and words.

Table 7

Intercorrelations for Accuracy Among Reading Measures in English\*

	letterE	wordE	pseudoE	lexdecE
letterE	1.00			
wordE	.45	1.00		
pseudoE	.25	.54	1.00	
lexdecE	.09	.27	.12	1.00

-----  
 \* all correlations above .38 are significant at  $p < .05$ ;  
 all correlations above .52 are significant at  $p < .01$ ;  
 all correlations above .62 are significant at  $p < .001$ ;  
 all correlations above .68 are significant at  $p < .0001$ .

As can be seen in Table 8 the correlations are high between speed in lexical decision and naming words, and naming words and pseudowords in Croatian (while letter naming speed does not correlate with any of these variables apparently due to a ceiling effect). The pattern of intercorrelations among the speed indices in English (Table 9) is almost identical, except that in English letter naming, speed also correlates with the other speed measures.

Table 8

Intercorrelations for Speed Among Reading Measures in Croatian\*

	letterC	wordC	pseudoC	lexdecC
letterC	1.00			
wordC	.05	1.00		
pseudoC	.11	.82	1.00	
lexdecC	-.02	.76	.77	1.00

Table 9

Intercorrelations\* for Speed Among Reading Measures in English

	letterE	wordE	pseudoE	lexdecE
letterE	1.00			
wordE	.82	1.00		
pseudoE	.74	.83	1.00	
lexdecE	.63	.69	.66	1.00

-----  
 \*all correlations above .38 are significant at  $p < .05$ ;  
 all correlations above .52 are significant at  $p < .01$ ;  
 all correlations above .62 are significant at  $p < .001$ ;  
 all correlations above .68 are significant at  $p < .0001$ .

In sum, while correlations involving accuracy measures within each language do not reveal common patterns, as one can see in Table 8 and 9, speed measures within each language correlate highly with

each other. More importantly, these results indicate the presence of an underlying naming speed factor in L1 and L2. The evidence therefore supports hypothesis H3 that word-based processes in L1 are driven by similar cognitive processes in spite of differences in orthography and language proficiency. Children appear to approach the various tasks in a similar manner. At the same time, as might be expected, they are more accurate and faster in the L1.

### **Individual Differences in Component Processes of Text**

#### **Comprehension : Is Their Role Similar in L1 and L2 Reading?**

In this section I examine the extent to which individual differences in word-based processes and memory can explain individual differences in reading comprehension. As a first step the relations between short term memory, accuracy and speed of naming measures were computed. The results are summarized in Tables 10 and 11. As can be seen in Table 10, text comprehension in Croatian was not significantly related to any of the accuracy measures, yet text comprehension in English was significantly and positively related to accuracy in naming letters and words in English. Digit span in Croatian was significantly and positively related only to accuracy in naming pseudowords in Croatian.

Table 10

Correlations Among Text Comprehension, Memory and Parallel L1 and L2 Accuracy Measures\*

	letterC	wordC	pseudoC	lexdecC	letterE	wordE	pseudoE	lexdecE
texcompC	.10	-.10	.23	-.09	.29	.19	.03	.03
texcompE	.16	-.23	.35	.10	.68	.40	.28	.31
digspanC	.07	.03	.54	.20	.34	.12	.10	.00

-----  
 \*all correlations above .38 are significant at  $p < .05$ ;  
 all correlations above .52 are significant at  $p < .01$ ;  
 all correlations above .62 are significant at  $p < .001$ ;  
 all correlations above .68 are significant at  $p < .0001$ .

The results presented in Table 11 reveal very similar patterns for the correlations between text comprehension in Croatian and English, and word-based speed measures. In particular, text comprehension in Croatian was negatively and significantly related to all the word-based speed measures in English. Likewise, text comprehension in English was negatively correlated with the same word-based speed measures in English as well as with speed in lexical decision in Croatian. In other words, the subjects with higher accuracy rate in text comprehension in Croatian and the subjects with higher accuracy rate in text comprehension in English named letters, words and pseudowords more quickly and made faster lexical decisions in English, and conversely, those participants who were poorer comprehenders were slower in performing the naming and decision

tasks in English, their L2. The same pattern was also noted for the relationship between reading comprehension in English and speed of word-based processes in English.

Short term memory was significantly related to speed in naming words and lexical decision in Croatian. In other words, participants with good short term memory were able to carry out the lexical decision task in their L1 faster. Short term memory was not significantly related however, to any of the English measures.

Table 12 summarizes the correlations among comprehension and memory measures: The only significant correlation is between text comprehension in Croatian and English.

Table 11

Correlations Among Text Comprehension, Memory and Parallel L1 and L2 Speed Measures\*

-

	letterC	wordC	pseudoC	lexdecC	letterE	wordE	pseudoE	lexdecE
texcompC	-.25	-.37	-.37	-.35	-.68	-.57	-.62	-.46
texcompE	-.32	-.24	-.34	-.39	-.64	-.41	-.40	-.57
digspanC	.21	-.38	-.35	-.42	.06	-.11	-.21	-.35

-----  
 \*all correlations above .38 are significant at  $p < .05$ ;  
 all correlations above .52 are significant at  $p < .01$ ;  
 all correlations above .62 are significant at  $p < .001$ ;  
 all correlations above .68 are significant at  $p < .0001$ .

Table 12

Correlations Among Memory and Text Comprehension\*

	texcompC	texcompE	digspanC
texcompC	1.00		
texcompE	.44	1.00	
digspanC	.28	-.01	1.00

-----  
 \*all correlations above .38 are significant at  $p < .05$ ;

In sum, the results indicate that accuracy and speed in English letter and word naming play a significant role in reading comprehension in English. Furthermore, all English speed measures were negatively and significantly correlated with reading comprehension in both languages. That is, the subjects who are fast in English word-based measures are likewise better comprehenders in L1 and L2.

A set of forward, stepwise, multiple regression analyses was completed in order to investigate what cognitive/linguistic measures predict text comprehension in L1 and L2. It was noted that results were not affected by the order in which the independent variables were entered. The number and the order in which the predictive measures were entered into the prediction battery was based upon

results of the correlation matrix. The following measures were entered in the first set: accuracy in naming words, accuracy in lexical decision and memory (Croatian measures ); and accuracy and speed in naming letters, accuracy in lexical decision and accuracy in naming words (English measures). Multiple Regression results are presented in Table 13.

For Croatian comprehension, only two predictors emerged as significant: speed in naming letters in English, which explains 47% of the variance, and short term memory which explains additional 10% of the variance. Individual differences in English text comprehension are explained by four measures: accuracy in letter naming in English, which explains 46% of the variance; speed in letter naming in English, which explains additional 19% of the variance, accuracy in naming words in Croatian, an additional 6%, and accuracy in lexical decision in English which explains additional 6%. It must be emphasized that finding such "predictors" does not establish a casual role for the predictor variables. Such a role is rather indicated by the theory used in setting up the regression analysis.

In sum, the regression analyses suggest that speed of letter naming in English, the L2, and short term memory are good predictors of text comprehension in Croatian. Further, accuracy and speed of naming letters in English, accuracy in lexical decision in English and accuracy in word naming in Croatian are important predictors of text comprehension in the L2.

The evidence therefore suggest the following answer to the question concerning the role of individual differences similar in L1 and L2 reading:

Speed of word-based processes in English, the L2, are highly correlated with text comprehension in both languages. In fact, speed of letter naming in English emerged as a potent common predictor for text comprehension in L1 and L2, alike.

Table 13

Predictors of Croatian and English Text Comprehension: Forward Stepwise Multiple Regression Analysis Summary:

	Text Comprehension Croatian			Text Comprehension English		
	Multiple R-Square	R-Square change	F Change	Multiple R-Square	R-Square change	F Change
Accur. letterE	n.s.	n.s.	n.s.	.46	.46	21.00**
Speed letterE	.47	.47	21.77***	.65	.19	12.95***
Accur. wordC	n.s.	n.s.	n.s.	.71	.06	4.75*
Accur. lexdecE	n.s.	n.s.	n.s.	.77	.06	5.85*
Dig SpanC	.57	.10	5.53 *	n.s.	n.s.	n.s.

\* p < .05, \*\* p < .001, \*\*\* p < .0001

## Summary of Status of Hypotheses

<b>H1</b> The subjects will name real words faster than pseudowords in both languages. The difference between naming times for real words and pseudowords in the native and the English language will be substantial enough to indicate whether or not the assembled phonology is used to name real words.	<b>supported</b>
<b>H2</b> The attained reading skills in first language correlate with the reading skills in a second language.	<b>supported</b>
<b>H3</b> Reading processes in L1 are similar to reading processes in L2 regardless of the differences in language proficiency and orthographies.	<b>supported</b>
<b>H4</b> Individual differences in component processes play a similar role in reading comprehension in both languages.	<b>supported</b>

## CHAPTER 4 : GENERAL DISCUSSION

### Discussion

The present study investigated the effect of orthographic depth on word recognition across Croatian and English orthographies, the extent to which reading processes in these orthographies are similar, and the extent to which there is evidence of similar sources of individual differences underlying reading processes in L1 and L2.

#### *Processing Words and Pseudowords: Is the Route the Same for Both Languages?*

According to the ODH, naming words in Croatian is qualitatively different from naming regular words in English, and naming pseudowords in both languages is accomplished through an assembled route. In this study, in Croatian and in English, the L2, the participants named real (regular) words significantly faster than pseudowords. The finding that the differences between naming times for real words and pseudowords are significant, is important. It suggests that the participants were mostly utilizing the same route when naming real words in both languages. It is important to note that naming tasks in English consisted of regular words and pseudowords.

The error analysis conducted on naming pseudowords showed that the errors in pseudoword naming task where the

participants named Croatian pseudoword as Croatian real word were statistically significant. One may speculate that participants viewed some Croatian pseudowords as more similar to the real words than others and named them so. As mentioned before, the pseudowords were developed by changing either a vowel or a consonant in the real word. The same type of error was present in naming English pseudowords, but the number of pseudowords named as real English words compared to the number of mispronounced pseudowords resulting in a new nonword, was not statistically significant. The reason for this difference between Croatian and English pseudoword naming errors might lie in the participants' inferior orthographic and phonological knowledge in the L2 as well as in their more limited lexicon also in the L2.

The presence of this type of errors is consistent with connectionist models in which phonological and orthographic knowledge is represented in terms of weights on connections between units, and processing of letter strings depends on activation of the weights (Seidenberg, 1992) and not on the independent addressed and assembled routes. Hypothetically, the data could be explained as follows: the participants named a pseudoword as a real word due the activation of weights on connections between units, and because of the close similarity between pseudowords and words (e. g., SUSREP vs. SUSRET in Croatian or WIMTER vs. WINTER in English) they named the pseudowords as the real words.

In sum, the results do not support the postulated effects of orthographic depth in processing words and pseudowords in both languages, and suggest that the participants name real words using the same route in L1 and L2. Further, evidence regarding processing pseudowords in Croatian indicates (based on the pseudoword error analysis) a parallel utilization of phonological and visual-orthographic routes in both languages. Results from this and other studies involving shallow orthographies (e. g., Sebastián-Gallés, 1991; Tabossi and Laghi, 1992) indicate that word recognition processes across different alphabetic Latin-based orthographies are similar, and that the ODH, insofar as it may explain processes of word recognition, needs to be modified. Specifically, high frequency words with a similar orthographic structure are read in a similar manner in Croatian and English. We suggest that this is so due to strong connections between the orthographic patterns and phonological information. Pseudowords in both languages are named more slowly because the participants did not have strong connections between the orthographic patterns and phonological and lexical information. The finding that children were more likely to name pseudowords as real words in Croatian but not in English, the L2, is consistent with this explanation. Also, it is important to note that in the studies conducted on the Serbo-Croatian language, the authors did not carry out error analysis on pseudoword naming tasks and did not address the issue of word-based processes in a shallow orthography from this aspect.

*Do Attained Reading Skills in L1 Correlate with Reading Skills in L2 Regardless of the Orthography?*

The results of this study indicate that due to the participants' extremely high accuracy and very low variability on letter and word naming in Croatian, there were no significant correlations associated with these measures. On the other hand, involving pseudoword naming and lexical decision suggests that these measures are more demanding and less automatized skills in both languages.

Relatedly, speed in naming letters in Croatian is the task on which the participants were the fastest, and it apparently shows a ceiling effect. This probability explains the lack of significant correlations of letter naming speed in Croatian with any other English component measures except for letter naming in English. Parallel indices of the other speed measures in L1 and L2 intercorrelate highly, indicating that transfer of an underlying common cognitive mechanism from L1 to L2 takes place.

*Are Reading Processes in L1 Similar to Reading Processes in L2 Regardless of the Differences in Orthography?*

The issues involving comparisons between the first and second language reading are not resolved yet. Some might argue that level of L2 proficiency is the main factor which determines the scope of differences between reading in L1 and L2. Others maintain that the reading processes in L2 are analogous to L1 processes (Barnett, 1989).

In this study an additional dimension is added to this argument, the potential difference in the orthographic depth between L1 and L2.

Results of the research reported here point to similarities between L1 and L2 processes. For example, an examination of results concerning parallel L1 and L2 speed measures results reveals that in both languages the participants obtained the highest speed in naming letters and the lowest speed when naming pseudowords. These findings support results of other studies where a lexicality effect was observed (e. g., Balota and Chumbley, 1984; Seidenberg, 1985) and underscore the relevance of this phenomenon to L2 reading in alphabetic languages. The results indicate a second language effect and a transfer of reading skills from L1 to L2.

Segalowitz (1986) found that reduced automaticity in L2 reading is present even in highly skilled bilinguals. According to Segalowitz, second language reading is slower because of a less deep activation of semantic representations and constraints on representation in working memory which reduces automaticity. Biemiller (1981) and Ehri and Wilce (1983) have shown that accuracy develops before speed in reading English as L1. Results of the present study extend Ehri and Wilce's finding to the development of reading skills in English as a second language. The participants were slower on English than on parallel Croatian tasks, and they made more errors on English than on Croatian tasks.

Likewise, the pattern of correlations between speed and accuracy indices across L1 and L2 indicate that although the participants' language proficiency levels differ in L1 and L2, the reading processes in a second language correlate with the processes in L1.

The results pertaining to the naming tasks in both languages show that the participants were significantly faster and more accurate in their L1 than in L2. These results do not come as a surprise, but they confirm the presence of linguistic differences between L1 and L2 proficiency. At the same time, it is important to note that the pattern across languages was identical, and that a gap between phonological and lexical properties was consistent across the tasks.

Furthermore, intercorrelations involving speed measures within each language indicate the presence of a common underlying speed factor in both languages.

There were no significant intercorrelations involving accuracy in Croatian due to the extremely high accuracy across the tasks. However, intercorrelations involving L2 accuracy revealed that L2 letter naming is moderately related to word recognition. This finding supports the results of the other authors who determined that for beginning readers proficient letter identification is an essential indicator of efficient decoding (e.g., Ehri, 1991). Since participants in this study were grade 8 students who are skilled readers in their

native language, these results suggest that accurate letter naming is an indicator of efficient decoding in a second language.

*Individual Differences in Component Processes of Text*

*Comprehension: Is Their Role Similar in L1 and L2 Reading?*

Not surprisingly perhaps, individual differences in text comprehension in English, the L2, were related to accuracy in naming letters and words in the L2.

More interesting is the finding that speed of naming letters in English, the L2, is highly related to text comprehension in Croatian and English. In addition speed in lexical decision in both languages is related to text comprehension in English, and speed of L2 word and pseudoword naming is related to comprehension in both languages. Again, speed of lexical access appears to be an important aspect of comprehension. Thus it appears that efficiency in carrying out basic word-level processes correlates with discourse processing in both languages. Furthermore, L2-based measures seem to be more sensitive to individual differences and thus they play a significant role in explaining individual differences in text processing in L1 and L2 alike.

The present results suggest that there is another underlying factor in naming letters, besides phonological sensitivity, and that speed of naming is an important indicator of text comprehension in L1 and L2. These results support Bowers et al. (1994) and Wolf et al. (1994). These authors argued that slow naming speed interferes

with forming precise orthographic representations of words and accessing them efficiently.

Stanovich (1992) also pointed out that, besides phonological sensitivity, there must be another cognitive variable, the lack of which may cause the failure in developing reading skills. Ehri (1991) and Baron (1986) emphasized that lexical access depends upon the verification of accurate orthographic representations in memory.

The present findings indicate that speed of naming may represent the "missing" cognitive variable that may enable children to acquire reading rapidly. Relatedly, the regression analyses indicate that speed of letter naming in English emerged as the most significant predictor for Croatian text comprehension followed by working memory. Accuracy and speed of letter naming in English emerged also as the most significant predictors for English text comprehension. These findings undermine the contention that speed of letter naming is significant only in lower level reading processes. Given the cross-linguistic relevance of letter naming speed suggest that the key variable is not language-specific. Instead, it appears that an underlying cognitive-linguistic mechanism which involves the speed with which verbal codes can be named is a driving force. Note that Geva (1997) reports similar results between English and Hebrew.

### *General Conclusion*

In sum, the results of this study indicate the following:

(a) Reading processes in Croatian and English orthographies have more in common than the ODH allows, because real regular words in both languages are apparently processed utilizing a similar route. Such results contradict those of the authors who conducted single-language studies with the Serbo-Croatian language (e. g., Katz and Feldman, 1981, 1983; Feldman and Turvey, 1983; Lukatela and Turvey, 1980, 1985; Feldman and Turvey, 1983; Turvey, Feldman and Lukatela, 1984; Lukatela, Popadic, Ognjenovic and Turvey, 1980), and they support finding from authors who focused on examining word recognition processes with other languages with shallow orthographies (e. g., Tabossi and Laghi, 1992; Sebastián-Gallés, 1991). The results of this study indicate that the ODH needs to be re-evaluated more carefully. (b) Attained reading skills in the native language correlate with reading skills in a second language. (c) There are similarities in reading processes across the orthographies. (d) Speed of naming may represent (or be linked with) an underlying variable that is important for word recognition and text comprehension in both languages; differences between the participants may be explained in terms of developmental and individual differences in naming speed or variable linked with it.

## Implications

### **Practical Implications**

One of the results indicates that accuracy and speed of naming letters is the most significant predictor of text comprehension, and that speed of naming letters is highly related to speed in naming words and pseudowords in English. These results may indicate the importance of considering not only accuracy, but also speed when evaluating or assessing reading in L2. The effects of intervention regarding this variable must be empirically determined. Yet, the results of this study also suggest that good readers in their native language will acquire reading skills more easily in a second language than poor readers. Poor readers may stay poor readers unless additional attention is paid to the development of efficient (i. e., accurate and fast) word recognition processes.

### **Implications for Future Research**

Although much attention has been paid to the influence of the orthography on reading processes, the results are inconsistent, and more research is needed with languages with shallow orthographies before there will be a clearer account of the influence of

orthographic depth on reading processes. As research on second language reading still relies on the theories of reading in a first language (first language being mostly English), it is necessary likewise to proceed to investigate the area of second language reading with English and other languages .

This study was conducted with a small sample of Croatian children without English controls. It is necessary to replicate this research with a larger sample, more difficult tasks and differently designed stimuli (e.g., semantic priming, English irregular words and pseudowords, letter case alternation) in order to corroborate these results and obtain additional insight on reading processes in Croatian and other orthographies.

## References

- Adams, M. J. (1979). Models of Word Recognition. Cognitive Psychology 11, 133 - 176.
- Adams, M. J. (1990). Beginning to Read: Thinking and Learning About Print. Cambridge, MA: MIT Press.
- Akamatsu, N. (1996). The Effects of First language Orthographic Characteristics on Reading in English as Second Language. Unpublished doctoral dissertation, Graduate Department of Education, University of Toronto, Toronto.
- Assink, E. M. H. and Kattenberg, G. (1994). Higher-Order Linguistic Influences on Development of Orthographic Knowledge: Illustrations from Spelling Problems in Dutch and Assessment Tools. In V. H. Berninger (Ed.) The Varieties of Orthographic Knowledge I: Theoretical and Developmental Issues (pp. 111-136). Dordrecht, The Netherlands: Kluwer Academic Publishers.
- Balota, D. and Chumbley, J. (1984). Are Lexical Decisions a Good Measure of Lexical Access? The Role of Word Frequency in the Neglected Decision Stage. Journal of Experimental Psychology: Human Perception and Performance. 10 (3), 340-357.
- Baluch, B. and Besner, D. (1991) Visual Word Recognition: Evidence for Strategic Control of Lexical and Nonlexical Routines in Oral Reading. Journal of Experimental Psychology: Learning, Memory and Cognition, 17 (4), 644-652.

Banac, I. (1984). Main Trends in the Croatian Language Question. In Aspects of the Slavic Language Question (Vol. 1). New Haven: Yale. Russian and East European Publications.

Barnett, M. A. (1989). More Than Meets the Eye - Foreign Language Reading: Theory and Practice. Prentice Hall Regents, New Jersey.

Barron, R. (1986). Word Recognition in Early Reading: A Review of the Direct and indirect Access Hypothesis. Cognition, 24 , 93 - 119.

Berninger, W. V. (1994). Introduction to the Varieties of Orthographic Knowledge I: Theoretical and Developmental Issues. In W. V. Berninger (Ed.), The Varieties of Orthographic Knowledge I: Theoretical and Developmental Issues (pp. 1 - 25). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Besner, D. (1989). On the role of outline shape and word-specific visual pattern in the identification of function words: None. The Quarterly Journal of Experimental Psychology, 41A (1), 91-105.

Besner, D. and Johnston, J. (1989). Reading and the mental lexicon: On the uptake of visual information. In W. Marslen-Wilson (Ed.), Lexical representation and process, (pp. 291-316). Cambridge, MA: MIT Press.

Besner, D. and McCann, R. (1987). Word frequency and pattern distortion in visual word identification and production: An examination of four classes of models. In M. Coltheart (Ed.), Attention and Performance XII: The Psychology of Reading, (pp. 201-219). New Jersey: Lawrence Erlbaum Associates.

Besner, D. and Chapnik Smith, M. (1992). Basic Processes in Reading: Is the Orthographic Depth Hypothesis Sinking? In L. Katz & R. Frost (Eds.), Orthography Phonology, Morphology, and Meaning (pp. 45-66). North-Holland, Elsevier Science Publishers B.V.

Borowsky, R. and Besner, D. (1991). Visual Word Recognition Across Orthographies: On the Interaction Between Context and Degradation. Journal of Experimental Psychology: Learning, Memory, and Cognition, 17 (2), 272-276.

Bowers, P., Golden, J., Kennedy, A. and Young, A. (1994). Limits upon Orthographic Knowledge Due to Processes Indexed by Naming Speed. In V. W. Berninger (Ed.), The Varieties of Orthographic Knowledge I: Theoretical and Developmental Issues (pp. 1 - 25). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Brozovic, D. (1975). Deset teza o hrvatskom jeziku. Journal of Croatian Studies, XVI, 10-16. New York.

Carello, C., Lukatela, G., Peter, M. and Turvey, T. (1995). Effects of Association, Frequency, and Stimulus Quality on Naming Words in the Presence or Absence of Pseudowords. Memory and Cognition, 23 (3), 289-300.

Carello, C., Lukatela, G. and Turvey, T. (1992). Can Theories of Word Recognition Remain Stubbornly Nonphonological? In L. Katz & R. Frost (Eds.), Orthography Phonology, Morphology, and Meaning ( pp. 211-226). North-Holland, Elsevier Science Publishers B.V.

Chitiri, H. F., Sun, Y., Willows, D. M. and Taylor, I. (1992) Word Recognition in Second-language Reading. In R. J. Harris (Ed.), Cognitive Processing in Bilinguals (pp. 283-297). North Holland, Amsterdam: Elsevier Science.

Chitiri, H. F. and Willows, D. M. (1994). Word Recognition in Two Languages and Orthographies: English and Greek. Memory and Cognition, 22 (3), 313-325.

Colombo, L. and Tabossi, P. (1992). Strategies and Stress Assignment: Evidence from a Shallow Orthography. In L. Katz & R. Frost (Eds.), Orthography Phonology, Morphology, and Meaning (pp.319-340). North-Holland, Elsevier Science Publishers B.V.

Cunningham, A. and Stanovich, K. E. (1991). Tracking the Unique Effects of Print Exposure in Children - Associations with Vocabulary, General Knowledge and Spelling. Journal of Educational Psychology, 83 (2), 264-274.

Ehri, L. C. (1991). Learning to Read and Spell Words. In M. Wolraich and D. Routh (Eds.), Advances in Developmental and Behavioral Pediatrics. Greenwich, CT: JAI Press.

Ehri, L. C. and Wilce, L. S. (1983). Development of Word Identification Speed in Skilled and Less Skilled Beginning Readers. Journal of Educational Psychology, 75 (1), 3-18.

Fawcett, A. J. and Nicolson, R. I. (1994). Naming Speed in Children with Dyslexia. Journal of Learning Disabilities, 27 (10), 641-646.

Feldman, L. B. and Turvey, M. T. (1983). Word Recognition in Serbo-Croatian is Phonologically Analytic. Journal of Experimental Psychology: Human Perception and Performance, 9(2), 288-298.

Feldman, L. B., Lukatela, G. and Turvey, M. T. (1985). Effects of Phonological Ambiguity on Beginning Readers of Serbo-Croatian. Journal of Experimental Child Psychology, 39, 492-510.

Frost, R. (1994). Prelexical and Postlexical Strategies in Reading: Evidence From a Deep and a Shallow Orthography. Journal of Experimental Psychology: Learning, Memory, and Cognition, 20 (1), 116-129.

Frost, R. (1995). Phonological Computation and Missing Vowels: Mapping Lexical Involvement in Reading. Journal of Experimental Psychology: Learning, Memory, and Cognition, 21 (2), 398-408.

Frost, R., Katz, L. and Bentin, S. (1987). Strategies for Visual Word Recognition and Orthographical Depth: A Multilingual Comparison. Journal of Experimental Psychology: Human Perception and Performance, 13 (1), 104-115.

Geva, E. and Clifton, S. (1993). The Development of First and Second Language Reading Skills in Early French Immersion. Canadian Modern Language Review, 50 (3), 646-667.

Geva, E. and Siegel, S. L. (under review). Orthographic and Cognitive Factors in the Concurrent Development of Basic Reading Skills in Two Languages.

Geva, E. and Wade-Woolley, L. (in press). A Longitudinal Study of the Concurrent Acquisition of Literacy in English and Hebrew. In A. Durungulu and L. Verhoven (Eds.) , Acquisition of Literacy in a Multilingual Context: A Cross-Cultural Perspective. Cambridge: Cambridge University Press.

Geva, E., Wade-Woolley, L. and Shany, M. (1993). The Concurrent Development of Spelling and Decoding in Two Different Orthographies. Journal of Reading Behaviour, 25 (4), 383 - 406.

Geva, E., Wade-Woolley, L. and Shany, M. (1997). The Development of Reading Efficiency in First and Second Language. Journal of Scientific Study and Reading, 1 (2).

Geva, E. and Willows D. (1994). Orthographic Knowledge is Orthographic Knowledge. In V. Berninger (Ed.), The Varieties of Orthographic Knowledge I: Theoretical and Developmental Issues (pp. 359 - 380). Dordrecht, The Netherlands: Kluwer Academic Publishers.

Glushko, R. J. (1979). The Organization and Activation of Orthographic Knowledge in Reading Aloud. Journal of Experimental Psychology: Human Perception and Performance, 5 (4), 674 - 691.

Glushko, R. J. (1981). Principles for Pronouncing Print: The Psychology of Phonography. In A. Lesgold and C. Perfetti (Eds.) , Interactive Processes in Reading (pp. 61-83). Hillsdale, N.J.: Lawrence Erlbaum Associates.

Humphreys, G. W. and Evett, L. J. (1985). Are There Independent Lexical and Nonlexical Routes in Word Processing? An Evaluation of the Dual-Route Theory of Reading. The Behavioral and Brain Sciences, 8, 689-740.

Jared, D, and Seidenberg, M. S. (1991). Does Word Identification Proceed From Spelling to Sound to Meaning? Journal of Experimental Psychology: General, 120 (4), 358 - 394.

Just, M. A. and Carpenter, P. A. (Eds.). (1987). The Psychology of Reading and Language Comprehension. Carnegie-Mellon University, Allyn and Bacon, Inc.

Katz, L. and Feldman, L. B. (1981) . Linguistic Coding in Word Recognition: Comparisons Between a Deep and a Shallow Orthography. In A.M. Lesgold & C.A. Perfetti (Eds.), Interactive Processes in Reading (pp.85-106). Hillsdale, NJ: Erlbaum.

Katz, L. and Feldman, L. B. (1983). Relation Between Pronunciation and Recognition of Printed Words in Deep and Shallow Orthographies. Journal of Experimental Psychology: Learning, Memory and Cognition, 9 (10), 157-166.

Katz, L. and Frost, R. (1992). The Reading Process is Different for Different Orthographies: The Orthographic Depth Hypothesis. In L. Katz & R. Frost (Eds.), Orthography Phonology, Morphology, and Meaning (pp. 67-84). North-Holland, Elsevier Science Publishers B.V.

Laberge, D. and Samuels, S. (1974). Toward a Theory of Automatic Information Processing in Reading. Cognitive Psychology, 6, 293 - 323.

Lesgold, A. M. and Perfetti, C. A. (1981). In Lesgold, A. M. and C. A. Perfetti (Eds.) Interactive Processes in Reading (pp. 111-141). Lawrence Erlbaum Associates, Publishers, Hillsdale, New Jersey.

Lukatela, G., Popadic, D., Ognjenovic, P. and Turvey, M. T. (1980). Lexical Decision in a Phonologically Shallow Orthography. Memory and Cognition, 8 (2), 124-132.

Lukatela, G. and Turvey, M. T. (1980). Some Experiments on the Roman and Cyrillic Alphabets of Serbo-Croatian. In J. F. Kavanagh & R. L. Venezky (Eds.), Orthography, Reading and Dyslexia (pp. 227-247). Baltimore, MD: University Park Press.

Lukatela, G. and Turvey, M. T. (1987). Loci of Phonological Effects in the Lexical Access of Words Written in Shallow Orthography. Psychological Research, 49, 139-146.

Nizeteo, A. (1984-85). Differences Between the Croatian and Serbian Literary Languages: Reflections and Realities. Journal of Croatian Studies, XXV-XXVI, 104-121.

Olson, D. R. (1991). Writing. In The New Encyclopaedia Britannica (Vol. 29, pp. 1025 - 1063).

Paap, K., McDonald, J., Schvaneveldt, R., and Noel, R. (1987). Frequency and Pronounceability in Visual Presented Naming and Lexical Tasks. In M. Coltheart (Ed.), Attention and Performance XII: The Psychology of Reading, (pp. 221-243). New Jersey: Lawrence Erlbaum

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

Rayner, K. and Pollatsek, A. (1989). Models of Reading. In K. Rayner and A. Pollatsek, The psychology of Reading (pp. 461-478). N. J.: Prentice Hall.

Samuels, S. J. (1987). Information Processing Abilities and Reading. Journal of Learning Disabilities, 20 (1), 18 - 22.

Sebastián-Gallés, N. (1991). Reading by Analogy in a Shallow Orthography. Journal of Experimental psychology: Human Perception and Performance, 17 (20), 471-477.

Segalowitz, N. (1986). Skilled Reading in the Second Language. In J. Vaid (Ed.) Language Processing in Bilinguals: Psycholinguistic and Neuropsychological Perspectives (pp.3-19). Lawrence Erlbaum. Hillsdale, New Jersey.

Seidenberg, M. (1985). The Time Course of Phonological Code Activations in Two Writing Systems. Cognition, 19, 1 - 30.

Seidenberg, M. (1992). Beyond Orthographic Depth in Reading: Equitable Division of Labor. In L. Katz & R. Frost (Eds.), Orthography Phonology, Morphology, and Meaning (pp.85-118). North-Holland, Elsevier Science Publishers B.V.

Seidenberg, M. S. and Vidanovic, S. (1985, November). Word Recognition in Serbo-Croatian and English: Do They Differ? Paper presented at the Twenty -sixth Annual Meeting of the Psychonomic Society, Boston.

Shimron, J. and Sivan, T (1994). Reading Proficiency and Orthography: Evidence from Hebrew and English. Language Learning, 44, 5-27.

Stanovich, K. E. (1986). Matthew effects in reading: Some consequences of individual differences in the acquisition of literacy. Reading Research Quarterly, 21, 360-406.

Stanovich, K. E. (1990). Concepts in Developmental Theories of Reading Skill: Cognitive Resources, Automaticity, and Modularity. Developmental Review, 10, 72 - 100.

Stanovich, K. E. (1992). Speculations on the Causes and Consequences of Individual Differences in Early Reading Acquisition. In P. B. Gough, L. C. Ehri and R. Treiman (Eds.), Reading Acquisition (pp. 307-342). Hillsdale, New Jersey: Erlbaum.

Stanovich, K. E. and Cunningham, A. E. (1991). Reading as Constrained Reasoning. In R. J. Sternberg and P. A. Frensch (Eds.) Complex Problem Solving: Principles and Mechanisms (pp. 3- 60). Hillsdale, NJ: Erlbaum.

Tabossi, P. and Laghi, L. (1992). Semantic Priming in the Pronunciation of Words in Two Writing Systems: Italian and English. Memory and Cognition, 20 (3), 303-313.

Turvey, M. T., Feldman, L. B. and Lukatela, G. (1984). The Serbo-Croatian Orthography Constrains the Reader to a Phonologically Analytic Strategy. In L. Henderson (Ed.), Orthographies and Reading: Perspectives from Cognitive Psychology, Neuropsychology, and Linguistics (pp. 81-89). Lawrence Erlbaum Associates Publishers: Hill, NJ.

Webster's Encyclopedic Dictionary of the English Language. (1988). Lexicon Publications, Inc.

Wolf, M., Pfeil, C., Lotz, R. and Biddle, K. (1994). Towards a More Universal Understanding of the Developmental Dyslexias: The Contribution of Orthographic Factors. In W. V. Berninger (Ed.), The Varieties of Orthographic Knowledge I: Theoretical and Developmental Issues (pp. 137-171). Dordrecht, The Netherlands: Kluwer Academic Publishers.

## **Appendices**

### Example of Printed Text in the Roman Alphabet

Dugo su se natezali s njemačkim osiguranjem i na koncu sklopili sporazum. Otvorili su Poštansku štedionicu, sa sjedištem u Beogradu, preko koje su naši mogli dobivati penzije. Valjda je u tom Beogradu bio Štos. Za mog tatu, koji se nalazio na pola puta između Münchena i Beograda, novac je stizao iz Münchena u Beograd, pa tek onda, tegda- negda, natrag u Zagreb, umanjen za proviziju. Ubrzo su mi bili jasni oni kotačići, koji su mi tada, kad mi je prijatelj objašnjavao, nedostajali.

Nisam želio vjerovati da je sve tako prizemno. Bio sam sretan što su uopće nešto dozvolili, jer se moj tata naglo psihički oporavio, jer nije bio ruku izgubio sasvim uzalud. A i skinuta je bila hipoteka izdajnika naroda s naših glava i moglo se nekako disati. Gastarbajterima se naglo počelo i tepati. Zvalo ih se »našim radnicima na privremenom radu u inozemstvu«, sa svesrdnom željom da tamo ostanu doživotno, a da ovamo familiji šalju devizne doznake preko Poštanske štedionice, Beograd. Da je ostala Savka, doznake bi išle preko Kreditne banke, Zagreb, a gastarbajteri bi za Beograd i dalje bili izdajice naroda, dapače, ustaše, pošto su većinom bili Hrvati.

U mom amaterskom kazalištu počele su se događati čudne stvari. Petar, novi Kreont, postajao je sve mrzovoljniji i mrzovoljniji. Nakon Miškove smrti, on je postao glava ansambla, već po tradiciji, jer se smatralo da je glumac, koji glumi Antigonu, dovoljno opterećen samom naslovnom rolom, da bi se mogao baviti i organizacijskim poslovima. U našem ansamblu, jedino je Antigonu mogla biti zaokupljena isključivo sobom. Svi ostali smo imali i dodatne zadatke. Ja sam, na primjer, bio zadužen za tekstualni dio plakata, koji se mijenjao samo s vremena na vrijeme, tj. kad je ponestajalo starih, pa su se ionako morali raditi novi. Onda bismo mijenjali i sam izgled i tekst plakata.

Kreonta je uvijek zapadala dužnost ugovaranja predstava i prikupljanja financija za rekvizita. Uvijek sam, kad bi Kreont živčano urlikao da moramo paziti na rekvizita, jer nemamo novaca za nova, govorio zašto ne organizira predstavu na ulazu u Narodnu banku, bivšu burzu, pa ne bismo morali toliko paziti da nam ne padne koji stup od šperploče i pukne, jer bismo imali prave, na koje bismo se mogli i nasloniti, a

Example of Printed Text in the Cyrillic Alphabet

са основним елементима у води, ваздуху, огњу или под земљом и са њиховим тајнама, које су у сваком глазбалу удружене на други начин.

\*

Прошло је дуго времена откако сам чуо ову причу. Што се каже, ветрови су ми дуго прали и бичевали кости отада, ја никада нисам зажелео да осим своје деонице научим и оне остале три деонице нашег квартета. Чинило ми се да је Манасијина прича сувише сложена и нисам јој веровао, као што не верујем да ће кратко живети они који нису кинули глухе недеље. Али, ако ви сами нисте сујеверни и не бојите се кад вам црна мачка пређе пут, не знате никад није ли сујеверна црна мачка . . .

Тако сам свирао у квартету на свом виолончелу одбрајајући ногом такт и тако у математичку мрежу ухватио музичке законе не водећи бригу о пореклу бројева који сачињавају трочетвртински или који други ритам. Све је, наравно, испало потаман, из-

### Appendix III

#### Text Comprehension Croatian (texcompC)

Jonathan osjeti da mu je ovo novi dom i da je dobrodošao. Bio je to za njega velik dan, nego / ali se izlaska sunca više nije sjećao. Skrene prema obali udarajući krilima da bi se načas zaustavio, a / pa zatim se lagano spusti na pješčani žal. Niti / i drugi su galebovi sletjeli, ili / ali ni jedan nije zamahnuo ni jednim percem svojih krila. Njihali su se na vjetru široko ispruženih krila, a / i onda nekako čudno promijenili nagib perja. Bila je to čudna vještina, pa / ali je Jonathan bio suviše umoran da i sam pokuša. Čućeći na obali, pa / i dalje bez riječi, zaspi.

Neki je glas progovorio, frula zaspivala iza kazališta; pojavio se čarobnjak. Imao je turban i / a bijelu bradu i / a kao da je iz nje izlazila riječ. Pa / a ta riječ je stvarala čaroban život u toj zlatnoj zemlji položenoj u dno štale, uz hrapav zid s kojega su jos visili strukovi sijena.

Igrali su čistu igru, bez drugog cilja osim da igraju, pa / i bila je to čarolija nad čarolijama, gdje / i se likovi radaju iz glazbe i / niti žive od nje. Nego / a taj je nejasni svijet živio, neukrotljiv, tamo gdje je lebdio, ni / i sudeći po nemiru što ga je izazvao na neshvatljiv način, vidljiva je bajka skrivala nevidljivu.

Jonathan je revno vježbao, od rana jutra prije izlaska sunca niti / pa do poslije ponoći. Nego / a onda, jednog dana, dok je zatvorenih očiju stajao na obali, koncentrirajući se, Jonathan je iznenada shvatio što / nego mu je bilo rečeno.

U pustinji je šalica čaja znak da si dobrodošao kao prijatelj. I / ali mi smo bili posluženi čajem. Beduini znaju da prijatelja nikada nije dovoljno. Koliko puta su jedan drugome pružali ruku u nevolji ali / i ta je pomoć često otrgnula nekoga nevoljnika iz ledenog zagrljaja smrti.

## Appendix IV

### Text Comprehension English (texcompE)

A Safari Park is a very large open space **where / because** you can see a lot of wild animals roaming around. There are many Safari Parks in Great Britain. One of the largest is Woburn. Most of the animals there are imported from Africa. It is fun to see all those animals walking around. They all look friendly **although / but** they are dangerous. People have to follow the instructions **which / where** they can see all over the park. Monkeys are tremendously curious about anything unusual and particularly about human activity. They take a great interest in the cars **which / because** drive through the park, and often jump on to them in their excitement. Younger visitors enjoy Pets' Corner very much. **Where / there** they can play with small animals like guinea pigs, young lions, ponies and lambs.

Cricket is the most popular game in England among boys and man **they / who** play it on cricket pitches. The players use bats made of wood and hard balls made of leather. **If / but** the ball hits a player, he can be badly injured.

**Where / there** are more than twenty bridges over the Thames in London today. Until 1749 there was only one bridge **because / which** was called London Bridge. The old London Bridge looked very strange **so / because** there were houses and shops on it **and / or** the water did not flow quickly under the bridge. The second London Bridge was built in the 19th century. The present London Bridge **which / therefore** is very modern, was opened to the traffic in 1973.

Most people **because / who** work in Central London have their homes in the suburbs **or / but** outside town. They travel to work between 76:30 and 9:30 am. **That / which** time is called "rush hour". In the airport buildings **there / where** are a lot of offices **but / because** you can get information and buy plane tickets.

People have to drive carefully in busy streets **but / or** roads **which / where** the traffic is heavy. In the busy streets near the schools you can see a woman or a man with a special traffic sign **which / because** looks like a lollipop. This person helps the children to cross the street.

## Appendix V

### Word Naming Croatian (wordC)

šafan	plakat
cirkus	prozor
Zagreb	podrum
mjesec	stalak
doktor	leptir
pastir	snijeg
zdenac	vulkan
prizor	dječak
vojniki	parket
bolest	čajnik
zaklon	štakor
jaglac	gavran
grašak	naslov
maslac	špinat
ogrtač	glagol

Appendix VI

Word Naming English (wordE)

winter	silver
pocket	dinner
circus	doctor
summer	carrot
window	sister
father	garden
letter	butter
carpet	monkey
rocket	coffee
writer	parent
waiter	Monday
tunnel	pistol
danger	basket
season	powder
hunger	robber

Appendix VII

## Pseudoword Naming Croatian (pseudoC)

lehtir	golest
vopnik	mjekec
djecik	kravir
vuskan	lesint
masluc	bopest
bragno	slatno
susrep	korost
capnik	faklon
jeglac	plista
safrin	gluran
kulnik	gvagol
gavrap	srinat
mnijeg	zdedac
saptaz	prilag
grasuk	grizva

Appendix VIII

## Pseudoword Naming English (pseudoE)

wimter	sealon
pockit	dinnor
cipcus	hurjer
gummer	dector
windor	pungle
lettar	sisper
fathen	girden
robbor	butner
powdir	ronkey
carget	pirent
ricket	mogday
priter	silven
fogure	pistoh
tumpel	baskel
panger	botkle

## Appendix IX

### Lexical Decision Croatian (lexdecC)

praznik	praznok
prašak	trašak
susret	susrep
korist	koript
pogreb	podreb
fantom	fabtom
čtvrť	četprt
centar	cuntar
čovjek	šovjek
delfin	dilfin
sjever	sjeveg
konvoj	gonvoj
kostur	koptur
kolnik	kolnig
susret	susrep
majmun	mejmun
svemir	svemar
sanduk	sanpuk

Appendix X

## Lexical Decision English (lexdecE)

dollar	follar
button	bitton
fellow	feglow
secret	seeret
corner	cornek
rabbit	rabtit
bottom	botkom
ribbon	ribbun
future	puture
second	pecond
result	resilt
figure	fogure
pencil	pehcil
cotton	cottor
cowboy	cowbon
border	bordur
jungle	jongle
planet	planut

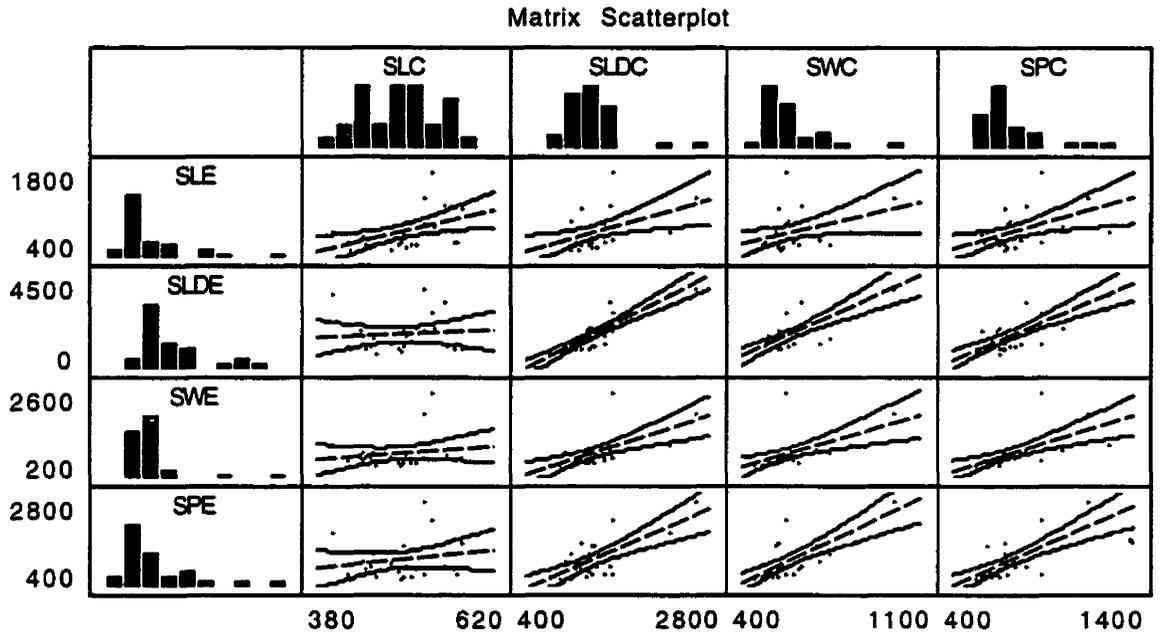
Appendix XI

Means, Standard Deviations and t-Test for LDT According to the Position of a Real Word in Each Item

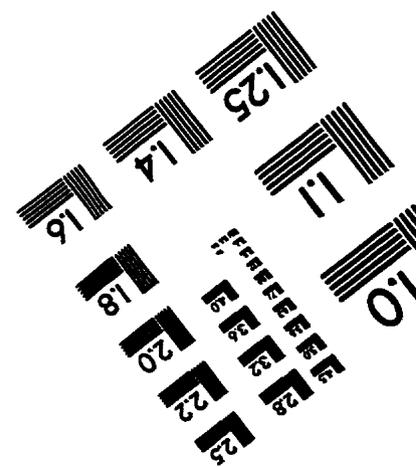
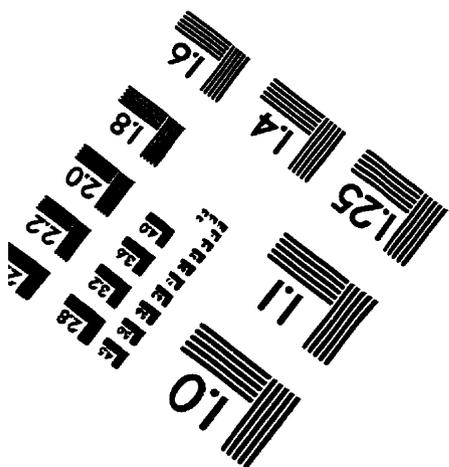
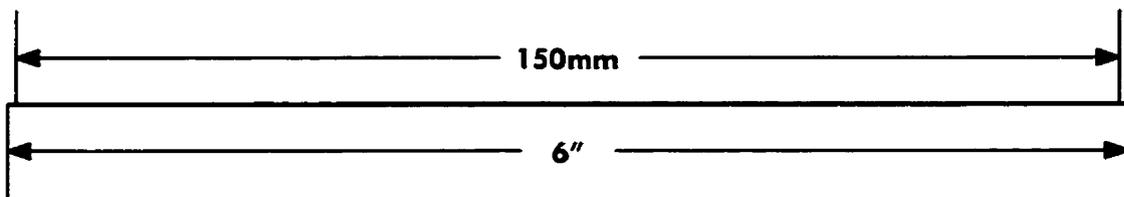
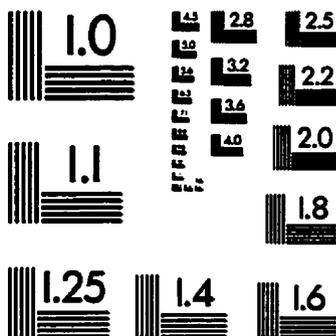
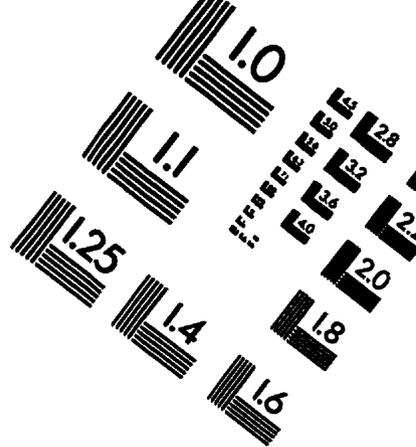
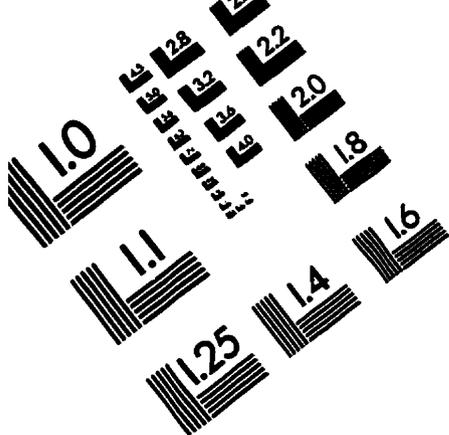
	Croatian	English
Real Word Left <u>M</u>	1275.76	1671.37
<u>SD</u>	456.35	943.00
Real Word Right <u>M</u>	1269.20	1541.84
<u>SD</u>	559.01	963.27
t	.10	.73
p	.92	.49

Appendix XII

Scatterplot for Speed for Parallel Variables in Croatian and English



# TEST TARGET (QA-3)



**APPLIED IMAGE, Inc**  
1853 East Main Street  
Rochester, NY 14609 USA  
Phone: 716/482-0300  
Fax: 716/288-5989

© 1993, Applied Image, Inc., All Rights Reserved