1999

Mechanisms of First Language Forgetting.

Ludmila Isurin

Louisiana State University and Agricultural & Mechanical College

Follow this and additional works at: https://digitalcommons.lsu.edu/gradschool_disstheses

Recommended Citation

https://digitalcommons.lsu.edu/gradschool_disstheses/6996

This Dissertation is brought to you for free and open access by the Graduate School at LSU Digital Commons. It has been accepted for inclusion in LSU Historical Dissertations and Theses by an authorized administrator of LSU Digital Commons. For more information, please contact gradetd@lsu.edu.
INFORMATION TO USERS

This manuscript has been reproduced from the microfilm master. UMI films the text directly from the original or copy submitted. Thus, some thesis and dissertation copies are in typewriter face, while others may be from any type of computer printer.

The quality of this reproduction is dependent upon the quality of the copy submitted. Broken or indistinct print, colored or poor quality illustrations and photographs, print bleedthrough, substandard margins, and improper alignment can adversely affect reproduction.

In the unlikely event that the author did not send UMI a complete manuscript and there are missing pages, these will be noted. Also, if unauthorized copyright material had to be removed, a note will indicate the deletion.

Oversize materials (e.g., maps, drawings, charts) are reproduced by sectioning the original, beginning at the upper left-hand corner and continuing from left to right in equal sections with small overlaps. Each original is also photographed in one exposure and is included in reduced form at the back of the book.

Photographs included in the original manuscript have been reproduced xerographically in this copy. Higher quality 6" x 9" black and white photographic prints are available for any photographs or illustrations appearing in this copy for an additional charge. Contact UMI directly to order.

Bell & Howell Information and Learning
300 North Zeeb Road, Ann Arbor, MI 48106-1346 USA
800-521-0600

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
MECHANISMS OF FIRST LANGUAGE FORGETTING

A Dissertation

Submitted to the Graduate Faculty of the Louisiana State University and Agricultural and Mechanical College in partial fulfillment of the requirements for the degree of Doctor of Philosophy in The Interdepartmental Program in Linguistics

by

Ludmila Isurin
M.A. St. Petersburg State University (Russia), 1981
August 1999
Dedicated to my dearest daughter Polly who never had a chance to live in the country of her first language.
# TABLE OF CONTENTS

## DEDICATION

## LIST OF TABLES

## LIST OF FIGURES

## ABSTRACT

## CHAPTER 1. LANGUAGE FORGETTING. GENERAL REVIEW

1.1 Can we forget our native language? ............................................. 1

1.2 What is forgetting................................................................. 2

1.3 What is language forgetting ................................................... 4

1.4 L1 vs. L2 forgetting ............................................................... 4

1.5 Factors affecting L2 forgetting

   1.5.1 Length of exposure to L2 ............................................... 8

   1.5.2 Length of the period of non-use .................................. 8

   1.5.3 Level of original proficiency ................................... 8

   1.5.4 Age............................................................................ 9

   1.5.5 Other factors............................................................. 9

1.6 Factors affecting L1 forgetting

   1.6.1 Length of exposure to L1 and L2 ................................ 10

   1.6.2 Length of the period of non-use ................................ 11

   1.6.3 L1 and L2 proficiency ................................................ 11

   1.6.4 Age and the Critical Period Hypothesis ....................... 13

   1.6.5 Other factors............................................................. 22

1.7 Mechanisms of L1 forgetting

   1.7.1 Decay........................................................................ 23

   1.7.2 Replacement ............................................................... 23

   1.7.3 Interference or retrieval failure ................................. 24

   1.7.4 Direction of interference............................................ 24

   1.7.5 Interference and processing simplicity ....................... 25

   1.7.6 Interference and notion of markedness ....................... 26

   1.7.7 Retrieval failure due to the lack of practice ............... 28

   1.7.8 Forgetting and level of processing ............................ 28

1.8 Areas of L1 forgetting

   1.8.1 Phonology................................................................. 30

   1.8.2 Vocabulary................................................................. 31

   1.8.3 Morphology............................................................... 36

   1.8.4 Syntax.................................................................. 40

1.9 Summary............................................................................. 53

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
CHAPTER 2. CASE STUDY

2.1 Introduction .......................................................................................... 56
2.2 Subject .................................................................................................. 57
2.3 Method .................................................................................................. 59
2.4 Stimuli and tasks ................................................................................ 59
   2.4.1 Morphology and syntax .................................................. 59
   2.4.2 Vocabulary ......................................................................... 62
2.5 Findings: Morphology ....................................................................... 65
   2.5.1 Russian morphology ......................................................... 65
   2.5.2 Changes in case marking ............................................... 67
   2.5.3 Changes in plural marking .............................................. 70
   2.5.4 Generalization error .......................................................... 72
   2.5.5 Loss of reflexive particle ................................................ 74
   2.5.6 Omission error with change of semantics .................. 76
2.6 Findings: Syntax ............................................................................... 77
   2.6.1 Objects in verbal phrases ............................................... 77
   2.6.2 Word order in English and Russian ............................... 79
   2.6.3 Changes in word order ................................................... 82
   2.6.4 Changes in sentence structure ...................................... 90
   2.6.5 Code-switching ................................................................ 93
2.7 Findings: Vocabulary ........................................................................ 96
   2.7.1 General trends ................................................................... 96
   2.7.2 Nouns vs. verbs ................................................................ 99
   2.7.3 Across item analysis ....................................................... 103
   2.7.4 Cognates ............................................................................ 103
   2.7.5 Non-distinguished categories ........................................ 111
   2.7.6 Loss of high-frequency words ....................................... 113
   2.7.7 Retrieval practice and forgetting ................................... 117
   2.7.8 Within-category confusion ............................................ 118
   2.7.9 Idiosyncratic findings ....................................................... 119
   2.7.10 Level of language activation ......................................... 121
   2.7.11 Blocking effect ................................................................. 126
2.8 General discussion ............................................................................ 128
   2.8.1 Findings in morphology ................................................... 128
   2.8.2 Findings in syntax ............................................................ 129
   2.8.3 Findings in vocabulary .................................................... 130
2.9 Summary ............................................................................................. 133

CHAPTER 3. RETROACTIVE INTERFERENCE. LITERATURE REVIEW

3.1 Introduction .......................................................................................... 136
3.2 Language forgetting: rate and amount .............................................. 136
<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>5.4.2</td>
<td>Semantic overlap and proactive language interference</td>
<td>222</td>
</tr>
<tr>
<td>5.4.3</td>
<td>Semantic overlap and mutual exclusivity bias</td>
<td>222</td>
</tr>
<tr>
<td>5.4.4</td>
<td>Degree of L1 loss</td>
<td>223</td>
</tr>
<tr>
<td>5.4.5</td>
<td>Language factor</td>
<td>226</td>
</tr>
<tr>
<td>5.4.6</td>
<td>Nouns vs. verbs</td>
<td>226</td>
</tr>
<tr>
<td>5.4.7</td>
<td>L1 forgetting vs. L2 acquisition</td>
<td>227</td>
</tr>
</tbody>
</table>

**Chapter 6. Conclusions**

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>6.1</td>
<td>Major issues</td>
<td>229</td>
</tr>
<tr>
<td>6.2</td>
<td>Semantic overlap as a major mechanism of L1 forgetting</td>
<td>230</td>
</tr>
<tr>
<td>6.3</td>
<td>L1 forgetting due to L2 interference</td>
<td>231</td>
</tr>
<tr>
<td>6.4</td>
<td>Nouns vs. verbs</td>
<td>233</td>
</tr>
<tr>
<td>6.5</td>
<td>Summary</td>
<td>234</td>
</tr>
</tbody>
</table>

**References**

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
</table>

**Appendixes**

<table>
<thead>
<tr>
<th>Section</th>
<th>Title</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>A.</td>
<td>Case study data</td>
<td>244</td>
</tr>
<tr>
<td>B.</td>
<td>Experimental study stimuli</td>
<td>261</td>
</tr>
</tbody>
</table>

**Vita**

vi
<table>
<thead>
<tr>
<th>Table</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>Schedule of tasks across sessions</td>
</tr>
<tr>
<td>2.2</td>
<td>Gender and number in Russian</td>
</tr>
<tr>
<td>2.3</td>
<td>Russian declensions</td>
</tr>
<tr>
<td>2.4</td>
<td>Russian verb conjugations</td>
</tr>
<tr>
<td>2.5</td>
<td>Cognates across sessions</td>
</tr>
<tr>
<td>2.6</td>
<td>Near-cognates across sessions</td>
</tr>
<tr>
<td>2.7</td>
<td>Non-distinguished categories</td>
</tr>
<tr>
<td>2.8</td>
<td>Word frequency and word accessibility</td>
</tr>
<tr>
<td>2.9</td>
<td>Blocking effect</td>
</tr>
<tr>
<td>5.1</td>
<td>ANOVA: Means on test x overlap condition x trials</td>
</tr>
<tr>
<td>5.2</td>
<td>ANOVA: Means on test x L1 x trials</td>
</tr>
<tr>
<td>5.3</td>
<td>ANOVA: Means on test x trials</td>
</tr>
<tr>
<td>5.4</td>
<td>ANOVA: Means on test x overlap condition x trials</td>
</tr>
<tr>
<td>5.5</td>
<td>ANOVA: Means on test x L1 x overlap condition x trials</td>
</tr>
<tr>
<td>5.6</td>
<td>ANOVA: post hoc (SNK)</td>
</tr>
<tr>
<td>5.7</td>
<td>ANOVA: post hoc (SNK) on groups with Russian as L1</td>
</tr>
<tr>
<td>5.8</td>
<td>ANOVA: post hoc (SNK) on groups with Hebrew as L1</td>
</tr>
<tr>
<td>5.9</td>
<td>ANOVA: Means on word type x L1 overlap condition x trials</td>
</tr>
<tr>
<td>5.10</td>
<td>ANOVA: Means on word type x L1 overlap condition x trials</td>
</tr>
<tr>
<td>5.11</td>
<td>ANOVA: Means on word type x L1 overlap condition</td>
</tr>
<tr>
<td>5.12</td>
<td>ANOVA: Means for the loss and chance ratio</td>
</tr>
</tbody>
</table>
LIST OF FIGURES

<table>
<thead>
<tr>
<th>Number</th>
<th>Description</th>
<th>Page</th>
</tr>
</thead>
<tbody>
<tr>
<td>2.1</td>
<td>L1 retention vs. L2 acquisition</td>
<td>97</td>
</tr>
<tr>
<td>2.2</td>
<td>L1 retention vs. L2 acquisition (RT)</td>
<td>97</td>
</tr>
<tr>
<td>2.3</td>
<td>Nouns: L1 retention vs. L2 acquisition</td>
<td>100</td>
</tr>
<tr>
<td>2.4</td>
<td>Nouns: L1 retention vs. L2 acquisition (RT)</td>
<td>100</td>
</tr>
<tr>
<td>2.5</td>
<td>Verbs: L1 retention vs. L2 acquisition</td>
<td>101</td>
</tr>
<tr>
<td>2.6</td>
<td>Verbs: L1 retention vs. L2 acquisition (RT)</td>
<td>101</td>
</tr>
<tr>
<td>2.7</td>
<td>Language activation</td>
<td>122</td>
</tr>
<tr>
<td>2.8</td>
<td>Language activation (RT)</td>
<td>122</td>
</tr>
<tr>
<td>5.1</td>
<td>RT on correct responses</td>
<td>209</td>
</tr>
<tr>
<td>5.2</td>
<td>RT on groups with Russian as L1</td>
<td>211</td>
</tr>
<tr>
<td>5.3</td>
<td>RT on groups with Hebrew as L1</td>
<td>212</td>
</tr>
<tr>
<td>5.4</td>
<td>L1 retention vs. L2 acquisition</td>
<td>215</td>
</tr>
</tbody>
</table>
ABSTRACT

The present research explored the processes and mechanisms of first language forgetting from linguistic and psychological perspectives. Two studies, one - a case study, another - a controlled experimental study, yielded evidence on L1 loss.

The case study involved a 9 year old Russian girl who was adopted by an American family, brought to the US and completely taken out of a Russian-speaking environment. Over the course of one year, changes in L1 morphology, syntax, and vocabulary were investigated using various tasks, e.g. picture description, picture naming, story telling. Data on L1 retention, L2 acquisition, and reaction time were gathered.

The results of the study suggested that L2 transfer may cause certain morphological and syntactic errors. However, the major findings in this study involved vocabulary, where three groups of words showed high vulnerability to loss, i.e. cognates, non-distinguished categories (pairs of words lexically distinguished in L2 and non-distinguished in L1), and high-frequency words. Fast loss of these lexical items was related to the acquisition of their equivalents in L2. Thus, this semantic overlap between L1 and L2 labels may cause L1 forgetting.

The experimental study further investigated semantic overlap by comparing the performance of the experimental group who learned lexical
labels in two languages for the same concepts and the control group who learned lexical labels for non-overlapping concepts. The number of L1 learning trials remained the same, while the number of L2 trials varied across groups. Reaction time was precisely measured in this study.

The results of this study confirmed the hypothesis of semantic overlap as a cause of L1 loss: that is, experimental participants showed more forgetting than control participants, particularly with a high number of L2 trials.

Thus, both studies converged on the conclusions that L1 loss is determined by L2 interference, and that semantic overlap is a mechanism of L1 loss and is noticeable with high amounts of L2 learning. The findings of this research may have implications for studies on L1 loss, L2 acquisition, and psychological studies on retroactive interference.
1.1 Can we forget our native language?

When we hear that someone forgot the name of a movie star, a friend’s telephone number, or some information learned at school, like the chemical formula of sulfuric acid or Latin, it never surprises us. It is taken for granted that our memory, no matter how limitless it might be, often fails to provide access to the information we need. So we can supposedly forget all kinds of information - except the information which is thought to be unforgettable. If your friend complains that he forgot his Spanish which he had studied at college for two years, you would never doubt this information. But if the same friend admits that he is forgetting English which is the mother tongue for both of you, you would probably laugh at him and suggest that he should see a psychotherapist. Many people express their disbelief when I say that I am interested in mother tongue forgetting. “How can you forget your mother tongue?”, “No, it is absolutely impossible!”, “Can it really happen to normal speakers without any brain trauma?”. 

Can it really happen that you lose such viable knowledge like the language you have been speaking since you remember yourself? Unfortunately, yes, it can happen. If you moved to another country where the language of the majority is different from your mother tongue, you are
likely to experience first language forgetting, which can take various forms. One day you can find yourself looking at a familiar object and feeling frustrated that you cannot remember its name in your native language, and a word in your other language comes to mind instead. Or when you come for a visit to your native country, your old friends whom you have not seen for years would tell you that you are speaking your mother tongue with some peculiar foreign accent. Or you might be listening to your friends talking and all of a sudden you would realize that many words that they are using have not been in your active vocabulary for a long time.

We forget our mother tongue as well as we forget any other information stored in our long term memory. The question is how does it happen? What mechanisms are responsible for language forgetting? How can we access the information which is believed to be well forgotten? These are the most intriguing and challenging questions faced by psychologists and linguists. But in order to answer these questions we first need to define what we mean by forgetting in general.

1.2 What is forgetting?

Forgetting is one of the controversial issues in psychology. May some details that we learn be permanently lost from memory? According to this statement, such inaccessible items would never be able to be recovered, because they are no longer in memory. Is everything we learn permanently stored in the mind? If we accept this statement, then forgetting can be
defined as a problem in accessing certain items in memory which could eventually be recovered.

There are three hypotheses pertaining to forgetting. The decay theory states that unless the information stored in memory was periodically attended to or used in some fashion, the memory would become weaker and weaker as time goes on. At some point, a memory would become so faded that it would cease to exist for all practical purposes (Searleman & Herrman, 1994). The second hypothesis suggests that the certain information in our memory can be overwritten by some other similar information which replaces the original information and makes it absolutely disappear from our memory. The final hypothesis, the interference theory, or retrieval failure, assumes that while there is no practical limit to how much information can be stored in memory, there is a limit in our ability to retrieve information. Forgetting occurs due to those activities or events that intervene between learning and retrieval. These intervening events cause interference which disrupts our memories. There are two forms the interference can take - when prior learning acts forward in time to cause proactive interference (PI), or when newer information acts backward in time to cause retroactive interference (RI). According to these three hypotheses, retrieval of forgotten items might be possible only in case of interference, whereas decay and replacement might result in an absolute loss of information in memory.
1.3 What is language forgetting?

If we go back to two statements defining forgetting, i.e. information which is lost will never be recovered, or information can become inaccessible rather than lost, we find they contradict each other. In order to define the topic of the present discussion, language forgetting, we have to decide which hypothesis to choose or maybe how to combine both hypotheses to arrive at something which would meet our understanding of forgetting. When we lose competence in a tongue, does it mean that it will never come back? If we have a problem in retrieving a word from our memory, does it mean that it is no longer there, or is it simply blocked by some verbal information in another language? Talking about language forgetting, my preference is not going to be given to either of these two definitions. Rather, I would combine both of them and say that language forgetting involves the problem of temporary inaccessibility of some items in memory as well as permanent loss of other elements. It is here, between these two statements, where we have to seek an answer to a very puzzling question: How do we forget our mother tongue?

1.4 L1 vs. L2 forgetting

Research on language forgetting can be divided into two categories: L1 (first language) forgetting and L2 (second language) forgetting. Further subdivision in both categories can take a sociolinguistic or psycholinguistic approach to the phenomenon. If we consider the number of research papers
devoted to each of the categories, one would conclude that research on L2 forgetting in L1 environment far outnumbers research on L1 forgetting in an L2 environment, and sociolinguistic research has been much more extensive than psycholinguistic research (Weltens, 1987).

Sociolinguists have been concerned primarily with lack of linguistic transfer from one generation to the next. Language is lost in the sense that it has been "lost for posterity" rather than in the sense of an individual or group who forgot the language they once knew. Such inter-generational studies of language loss by linguists and socio-linguists, with their focus on whole language communities, are closely related to the study of language shift, maintenance, and languages in contact.

Psycholinguists, on the other hand, have focused on the more immediate deterioration of language skills in particular individuals or groups in a single life span. Such research has traditionally focused on second language or foreign language forgetting. The psycholinguistic study of L1 forgetting which, until relatively recently, was devoted almost entirely to forgetting caused by aphasia (brain trauma), has moved toward investigating the L1 forgetting in normal individuals in L2 environments (Kouritzin, 1999).

The present discussion will be focused on psycholinguistic research in L1 forgetting. It would be appropriate to distinguish L1 forgetting from L2 forgetting. But before we do that, I would like to make a very important point. Second language in my discussion is defined as a language which is
learned second or third after mother tongue. Getting away from a controversial dispute in the literature above, who is a bilingual - a person who speaks both languages with equal proficiency or one who simply speaks two languages, I would define a second language, or a foreign language, as a language which is acquired after mother tongue, which has an initial level of proficiency lower than that of the mother tongue and which can eventually reach the level of mother tongue proficiency.

Second language forgetting may occur when people who have been staying in a foreign country and learned an L2 there, start losing it after their return to the L1 community. It may also occur to people who learned a foreign language in an instructional setting, but use it to an insufficient degree after the course has finished, and consequently forget it. First language forgetting in normal speakers, in contrast, may happen when people emigrate to the country where the language of the majority is different from their mother tongue. In this case, the elements of L1 may disappear from a person's repertoire due to an extensive exposure to L2.

The question is whether the mechanisms responsible for L2 loss in the L1 environment will be the same as those which cause L1 forgetting in the L2 environment. Since the memory construct seems to be the same for all verbal information, no matter in what language it has been encoded, the mechanism underlying language forgetting might be the same both for L1 and L2. On the other hand, L2 acquisition begins at the point when L1 has
already developed to a certain level of proficiency. This implies that the links connecting lexical representation units of the two languages to the common conceptual store may have different strength (Kroll & Scholl, 1992). If so, it can be hypothesized that the strength of the effects that these mechanisms produce may be different in L1 and L2 forgetting, although the pattern would remain the same. The different strength of the mechanism effects can result in different forgetting outcomes. For example, lack of L2 practice may result in permanent loss of L2 lexical items, whereas lack of L1 practice can make certain L1 items inaccessible rather than lost. Or the time required for significant decay of some parts of knowledge in both languages may be different, e.g. L2 elements may be forgotten faster than L1 elements due to the fact that temporal and environmental exposure to L2 is generally less than the exposure to L1. Certainly, there are many factors that can affect the general pattern of language forgetting, like age of the speaker, amount of exposure to both languages, degree of proficiency, etc. But for the simplicity of this discussion, I would suggest distinguishing L1 forgetting from L2 forgetting in terms of the strength of the effects that similar operating mechanisms might produce rather than in terms of the different nature of the underlying principles. Now let us look into the factors which might affect L2 forgetting.
1. Factors affecting L2 forgetting

1.5.1 Length of exposure to L2

L2 forgetting can be determined by different factors. The overall length of exposure to L2, which is closely related to proficiency, may affect L2 forgetting. A number of studies used the length of exposure to foreign language as a rough measure of proficiency level (Weltens, 1987).

1.5.2 Length of the period of non-use

One of the obvious factors that should be considered in L2 forgetting is the length of the period of non-use. The length of the non-use period is closely related to the issue of the time which elapsed since the active contact with L2. Both of these time factors may affect L2 forgetting (McLaughlin, 1984). Most studies have measured foreign language forgetting over a period of three months, because that is about the length of the summer recess in schools (Cohen, 1975; Smythe et al, 1973). But there is also a well known study which measured Spanish retention over the period of 50 years of non-use (Bahrick, 1984). It was found that the amount of retention declines exponentially for the first 3-6 years of non-use, after that retention remains unchanged for periods of up to 30 years before showing a final decline.

1.5.3 Level of original proficiency

In addition, the original level of proficiency in L2 might be decisive for the ultimate L2 retention. The amount of L2 knowledge retained in LTM
after many years since the language was learned was found to depend on the level of original proficiency in that language. A higher level of initial proficiency in L2 results in a higher amount of the retained information in that language (Bahrick, 1984).

1.5.4 Age

The age of the person at the point when the contact with L2 may is lost may be decisive for L2 forgetting. Children seem to forget languages more quickly than adults do (Hatch, 1983; Berman & Olshtain, 1983). Thus, L2 forgetting is not a function of how early a second language is introduced, but when it is no longer used. A child brought up in a bilingual environment from birth may lose that bilingualism when contact with one of the original languages is lost.

1.5.5 Other factors

There are a number of other factors which might also affect L2 forgetting, such as motivation, opportunities for L2 use, method of instruction, cognitive style, sex, handedness, intelligence, etc. (Weltens, 1987).

Now we will look into those factors which might affect L1 forgetting and see whether they can be paralleled with those affecting L2 forgetting.

1.6 Factors affecting L1 forgetting

The factors which affect L2 forgetting can be partially applied to L1 forgetting. For example, length of exposure to L1 and proficiency in L1 are
directly correlated with similar factors in L2 forgetting. However, L1 forgetting is closely related to L2 acquisition, which forces one to consider additional factors in L1 forgetting, such as proficiency in L2, length of exposure to L2, and the age at which the person was exposed to L2 acquisition.

1.6.1 Length of exposure to L1 and L2

L1 forgetting, like L2 forgetting, is determined by the time factor. But in L1 forgetting, we consider not only the length of exposure to L1 but also the length of exposure to L2. These two time factors determine the extent of L1 forgetting.

The time factor in first language forgetting seems the most obvious and the least disputable in the literature. Most of the studies on language forgetting (Leyen, 1984; Levine, 1996; Silva-Corvalan, 1991; Schaufeli, 1996) involve questionnaires in which subjects are supposed to answer a question regarding the time which has passed since they were submerged into the L2 environment. However, the main difference in L1 and L2 forgetting lies in the rate of forgetting. It is clear that mother tongues, no matter how well they have been established, do not automatically disappear as L2 structures and words are learned. They are more persistent and long-lasting in memory than L2 structures due to their well learned and extensively practiced nature. Yet, second languages, although often at native-like proficiency, may disappear rather fast if contact with that
language is lost. This is evident especially in case of bilingual children (Isurin, 1997). The time factor, or a length of exposure to L2, as well as the time of L1 non-use may play a decisive role in first language forgetting.

1.6.2 Length of the period of non-use

The problem of non-use in L1 forgetting is much more complicated than in L2 forgetting. Very rarely is L1 forgetting caused by absolute disuse of the language. Rather, we can talk about limited use of L1 due to the loss of active contact with the L1 environment. That makes it harder to measure the amount of lost information in L1 over short periods of time. The longitudinal studies on L1 forgetting (Kaufman & Aronof, 1991; Leopold, 1939; Turian & Altenberg, 1991) report data collected over long periods of time, like several years. In summary, L2 non-use cannot be directly related to L1 limited use.

1.6.3 L1 and L2 proficiency

Language proficiency can be another factor which might influence language forgetting. But contrary to L2 forgetting which is determined by the level of proficiency only in L2, L1 forgetting relies both on the level of proficiency in L1 and in L2. The degree of knowledge of L1 by the time of exposure to L2 may determine the extent of either loss or inaccessibility of L1 structures. On the other hand, a high degree of knowledge in a newly acquired L2 can make a bilingual equally competent in both L1 and L2, or
even more competent in L2, which might result in a higher likelihood of L1 forgetting.

But evaluation of the level of proficiency or competence in a language poses another problem, which can be more easily solved in L2 research. In most of the studies on L2 forgetting, especially in control studies, the level of acquisition of a foreign language prior to forgetting could be easily measured. Generally such studies involve a group of college students who started learning a foreign language at the same time, then they were pre-tested and after some time interval (summer recess, for instance) post-tested, and the results were compared with those of the control group (Cohen, 1986; Olshtain, 1986). This type of research design (control group design) is not always applicable to L1 research. First, there may be a problem in finding a group of subjects who would be of the same level of first language proficiency at the time of their exposure to a foreign language (especially in the case of children). Second, a control group should be formed of those subjects who are still living in the L1 environment.

Moreover, there is a common problem in measuring the level of language proficiency in both types of research, involving the difficulty in separating language elements which were lost from those which had never been learned. L1 research will suffer even more from that problem, since it is not always clear how mature speakers were in their mother tongue at the time of their first arrival in an L2 country (Levine, 1996). Thus, we have
to be aware of that problem when choosing either children as subjects for research on L1 forgetting or adults who were children at the time of their exposure to an L2 environment.

However, I would like to mention one study which contributed to the issue of L1 competence as a function of L2 proficiency. Pease-Alvarez, Hakuta, and Bayley’s (1996) study looked into Spanish proficiency among children of Mexican descent in the US. The study employed multiple tasks to determine whether there is a simple linear relationship between amount of exposure to a language and proficiency in that language. The findings of the study converged on the conclusion that the type of exposure and the social context in which it occurs are of greater importance than simple amount of exposure. In other words, language choice and attitude, the range of language use (i.e. whom the language is spoken with), as well as the amount of exposure to English, might be decisive for Spanish maintenance. For example, until English becomes a dominant language, fairly good Spanish maintenance was reported among the subjects. Also, it was suggested that aspects of the native language that are acquired early appear to be relatively immune to effects of language contact. This brings up another issue, which is the factor of age in L1 forgetting.

1.6.4. Age and the Critical Period Hypothesis

The factor of age is closely related to proficiency and might affect language forgetting. The age factor in L1 forgetting concerns the age at
which a person lost contact with the L1 environment. The problem of age for language acquisition has been one of the most controversial in studies on second language acquisition. Although there has not been much research in the field of language forgetting in terms of the age factor we can examine the findings from studies on L2 acquisition, since the age of the person at the moment of active exposure to an L2 environment can be decisive for his L2 acquisition and, perhaps, for his L1 forgetting.

The Critical Period Hypothesis was proposed for first language acquisition by Lenneberg (1967) and later was applied to second language acquisition. First, we will briefly discuss the main points of the theory of the critical period for second language acquisition, and then, in the next section, we will see what implications this theory might have for L1 forgetting.

There are different opinions on the effect of age on second language acquisition. Most of the studies (Krashen, Long, & Scarcella, 1982; Hakuta & Braine 1987; McLaughlin, 1984, etc.) support the Critical Period Hypothesis claiming that the best age for second language acquisition is between about age 2 to puberty. After puberty the natural acquisition of language is thought to be blocked by a loss of "cerebral plasticity" resulting from the completion of the development of cerebral dominance through lateralization of the language function. In addition to this biological argument, the ability of young children to acquire a language quickly and
efficiently and without an accent is regarded as support for the critical period notion (McLaughlin, 1984).

Support for the Critical Period Hypothesis comes from a few cases of “wild” children or children raised in environments of extreme social isolation (e.g. Genie who was 13 years and 9 months at the time of her discovery). Those cases (Curtiss, 1980) have shown that many language skills, like vocabulary, can be acquired after a “critical period”, though language capacity significantly atrophies from disuse and more sophisticated linguistic skills like mastery of syntax can become rather deficient.

The argument about the critical period for L2 acquisition is partially caused by the failure to distinguish between the level of initial learning and the degree of ultimate attainment (Johnson & Newport, 1989). The latter is usually shown by children’s advantage in phonology. If we admit that younger children can eventually speak their second language at the level of native-like fluency, does it mean that they are doing much better in the early stages of L2 learning? The following discussion on the Critical Period Hypothesis will illustrate that the opponents and proponents of the theory bring up evidence which does not contradict the theory itself, but reflects different stages of L2 acquisition.

There have been quite a few studies on L2 acquisition among different age groups. For example, Hakuta & Braine (1987) refer to an experiment which was designed to find a correlation between the length of exposure to
a foreign language, the age of arrival to a new country and degree of accentedness in L2. The results of the experiment revealed that the younger the child was when he came to an L2 environment and the longer he stayed there, the less foreign accent could be traced in his L2. This research supports the Critical Period Hypothesis in terms of the level of ultimate attainment, i.e. it can be assumed that the level of interference is correlated positively with age and negatively with the length of exposure to L2. Moreover, bilingual children may suffer from interference only at the very early stage of their second language acquisition, when they transfer the syntactic and morphological structure of their first language on the second, but “once the languages are distinguished, the child appears to keep them apart and does not impose first language structures on second language syntax” (McLaughlin, 1984, p. 125). However, from this statement it remains unclear whether there is no interference whatsoever later in the child’s language development.

The Critical Period theory found support in the study (Johnson & Newport, 1989) with 46 Korean or Chinese speakers who had arrived in the United States between the ages of 3 and 39, and who had lived in the US between 3 and 26 year by the time of testing. These subjects were tested on a wide variety of structures of English grammar, using a grammaticality judgment task. Tests showed a clear and strong advantage for earlier arrivals over late arrivals. Test performance was linearly related to age of
arrival up to puberty; after puberty, performance was low but highly
variable and unrelated to age of arrival.

There were two important aspects in this study which should be
emphasized. First, Chinese and Korean were chosen as the native languages
because of their typological dissimilarity to English. Closely related
languages could have produced a facilitation effect in the second language
learners, which might have yielded confounding experimental results.
Second, ultimate attainment was tested not in phonology, as it is usually
done in support of the Critical Period Hypothesis, but in acquisition of
grammar, and the findings still supported the Critical Period Hypothesis.

However, another group of scientists have provided evidence against the
Critical Period Hypothesis by demonstrating that older children produced
better or the same test results in a second language than younger children.
Snow & Hoefnagel-Hohle (1978) found that older children, with more
cognitive capacity, pick up vocabulary faster. A study by Asher & Price
(1967) compared four age groups in acquisition of Russian as a foreign
language. The tasks of the experiment closely approximated the way in
which languages are acquired in the natural setting, i.e. adults vs. children.
The results revealed that children displayed no superior language acquisition
capabilities. Note that these studies providing evidence against the Critical
Period Hypothesis are based on comparing the rate of initial learning
between children and adults (which proved to be higher in adults) rather than ultimate attainment.

In addition, Thompson's (1991) study on the English pronunciation of Russian immigrants suggested that probably the age of exposure to L2 in terms of accent is not as crucial a factor as a level of proficiency in L1. In other words, she thinks that "the acquisition of fully accentless speech in L2 may not be possible if L1 is maintained at a high level of proficiency, no matter how young the age at which the individual started to acquire the second language" (p. 178). This claim should not be taken for granted regarding accent per se, since it is possible that acquisition of different aspects of language, like phonology, semantics, and syntax, may show different patterns, and acquisition of phonology may be quite different from acquisition of syntax and semantics.

However, if we get away from the problem in the dispute on the Critical Period Hypothesis as to whether we consider initial learning or ultimate attainment in L2, in all, the evidence against the Critical Period Hypothesis is rather scanty in the literature. There is much more convincing evidence supporting the Critical Period Hypothesis, i.e. acquisition of a second language is easier before the age of 12.

Now we will examine how the age of second language acquisition might affect first language forgetting. The only available indirect evidence that positively correlated the age of acquisition of English as a second
language with the level of proficiency in a native language has been found in Palij (1990), and Schiff-Myers, Djukic, McGovern-Lawler, and Perez (1993) studies.

Palij (1990) looked into the problem of the English displacement effect, that is the positive correlation between age of English acquisition and ability in the non-English language. There were three groups of subjects, i.e. those who acquired English before age 6, between ages 6 and 12, or after age 12. The results of the study revealed that age of English acquisition correlated negatively with rated English abilities and positively with rated ability in a non-English language. In other words, the earlier children started learning English as a second language, the higher their proficiency was in English and the more negatively affected their native language was. The finding was ascribed to either a bilingual's inability to maintain two languages, or to the lack of opportunities to use one's native non-English language. The interest of this study for the present discussion lies not only in the fact that it provided some evidence supporting the Critical Period Hypothesis, but in that it showed a positive correlation between the age of second language acquisition and the level of proficiency in a native language. It can be concluded that the younger children were at the time when they started learning English as a second language, the more likely they are to diminish their proficiency in a native language.
Schiff-Myers et al. (1993) carried out a case study of a bilingual Spanish-English girl showing that an early exposure to a second language before the first one is fully mastered may cause a temporary delay of development in both languages. Their case subject, a Hispanic girl of 6 years 7 months, was born in the United States but had a very limited exposure to English (3 days a week at the nursery school since the age 3) and by the time she entered her first grade she had severe language problems both in English and Spanish and was classified as having a language-learning disorder by a child study team. The authors concluded that the learning of a second language before the primary language is fully developed may result in arrested development or loss of proficiency in the first language. It supports the point made earlier in our discussion that age at which a child was broadly exposed to a second language is closely related to the level of proficiency in his/her mother tongue which might have never been fully developed. However, I would argue with the authors of this study that an early exposure to both languages might result in temporary deficiency in the second language. It might have placed the child at a level lower than that of her English-speaking peers but not at the level which is classified as demonstrating serious language deficiency unless the child initially had some language disorders. Remember that the girl was born in the U.S. and attended a nursery school three days a week. Support for this comes from personal observations of bilingual children in Israel and in the U.S. and from
the present author's child who was bilingual in Hebrew-Russian and who is now bilingual in English-Russian. After less than three years in the U.S., her English proficiency has not yet reached the level of her American peers but it does not hinder her academic progress.

In any event, the two studies discussed above have shown that the earlier the child was exposed to L2, the more severe the mother tongue proficiency was affected. In other words, L1 forgetting is determined to a great extent by the age of L2 acquisition. Thus, it must be emphasized that when we talk about L1 forgetting as a function of age, we mean the age of L2 acquisition which is usually directly related to the age at which broad contact with L1 was lost. It seems obvious that children, with their lower degree of L1 proficiency, have a higher likelihood than adults of forgetting their native language when broadly exposed to an L2 environment.

Again, we could see that this factor is not as simple as it is for L2 forgetting, since L1 forgetting considers not the age at which the person left his L1 native country but the age at which he started L2 acquisition. This age happens to be the same in most cases, i.e. the person loses an active contact with the L1 environment and begins learning of L2 roughly at the same age, but the emphasis in L1 forgetting is placed on the age of L2 acquisition and its possible implications for the L1 retention.
1.6.5 Other factors

In addition to the above major factors which may affect L1 forgetting, there may be other factors contributing to this process. Like in L2 forgetting, motivation can be one of these factors (Merino, 1983). Motivation for retaining the native language is, in turn, determined by the social status of the language, its prestige in the society, the opportunities the speaker envisions for its future use, etc. And again, the motivation for retaining the first language, like other factors, is closely related to the motivation for acquiring the second language. The higher the motivation for L2 acquisition, the less the person may hold on to his native language.

In summary, the factors affecting L2 and L1 forgetting are similar. The length of the period of exposure to the language, initial proficiency in the language, time elapsed since the active contact with the language, as well as the age of the person at the time s(he) terminates broad exposure to the language are the major factors which can be paralleled when talking about L2 and L1 forgetting. However, the issue of L1 forgetting in an individual cannot be considered separately from the issue of L2 acquisition by the same individual.

We know are able now to hypothesize what might affect L1 forgetting but it still remains unclear how it happens, that is, what mechanisms underlie the process of L1 forgetting.
1.7 Mechanisms of L1 forgetting

The factors which might affect L1 forgetting do not explain the mechanisms of language forgetting. The mechanisms of language forgetting, in turn, are closely related to those mechanisms responsible for forgetting in general, which were briefly mentioned before. Below I review these mechanisms in detail and note how they apply to L1 forgetting in specific.

1.7.1. Decay

The principle mechanism of forgetting from sensory memory and a contributing factor with regard to forgetting information from short-term memory (STM) has been thought to be decay. Though many current theories reject the idea that time per se has much to do with forgetting of long-term memories (LTM), it can be hypothesized that decay might be one of the mechanisms responsible for L1 forgetting. In this case some kinds of language knowledge, like culturally specific terms, may gradually disappear from memory due to a long disuse.

1.7.2 Replacement

Another mechanism which may result in permanent loss of certain linguistic elements from memory is the mechanism of replacement. The elements in one language may be replaced or overwritten by the elements in another language. It may occur when an L2 word is used more often than its equivalent in L1, or when the code-switching mechanism keeps only the
L2 element activated and its equivalent suppressed. Replacement can affect all spheres of language, like phonology, syntax, vocabulary. The replaced element in L1 becomes lost from memory and might no longer be recoverable.

1.7.3 Interference or retrieval failure

The other two mechanisms do not cause permanent loss of linguistic elements from memory but result in temporary inaccessibility. The theory of retrieval failure has been opposed to the theory of decay. This theory of retrieval failure assumes that while there is no practical limit to how much information can be stored in memory, there is a limit in our ability to retrieve information.

Retrieval failure can be caused by interference. Interference is thought to be one of the reasons for memory failure, or forgetting. If we recall that there are two forms the interference can take - proactive interference (PI), or retroactive interference (RI), then first language forgetting, as new L2 (second language) interferes with old L1 (first language) lies in the realm of retroactive interference.

1.7.4 Direction of interference

Studies on language interference (McLaughlin, 1984) have mostly focused on the effect of L1 on L2 or L2 on L3. In other words, the direction of interference has been assumed to be from the acquired language to a new language, or from a stronger to a weaker one. There is contradictory
evidence supporting bi-directional nature of interference from my recent case study (Isurin, 1997) and from a study done by Py (1986) among Spanish migrant workers in French-speaking Switzerland. These investigations found that L1 habits become influenced by the L2 and the competence of L1 decreased due to L2 interference.

1.7.5 Interference and processing simplicity

Smith & van Buren (1991) offer two hypotheses which might shed light on the direction of interference in language loss.

The first hypothesis claims that

"the learner (implicitly or explicitly) recognizes the relative processing simplicity of given structures in L1 or L2, and adopts L2 structures into the mother tongue where the result will be a reduction in complexity" (p.225).

The second hypothesis is an expanded form of the first one and it runs as follows:

"the learner will adopt into either L1 or L2 structures from the other language that will lead to overall processing simplicity. Those subsystems which are relatively easier to process will be less easily lost, more easily acquired, or more likely to remain fossilized in L2" (p.226).

Levine's (1996) study on elderly second-generation speakers of Yiddish also deals with the above theoretical observations and is discussed later in the dissertation.
1.7.6 Interference and notion of markedness

Another approach to predicting the direction of interference is based on employing the notion of markedness. The concept of markedness was first developed for phonological systems but later it was applied across all linguistic and many non-linguistic categories (Jacobson, 1966; Eckman, 1986). The core hypothesis of markedness theory concerns correlations; i.e. pairs of “marked” and “unmarked” language structural entities. One member of the pair that is consistently more widely distributed and/or simpler is called “unmarked”, its complement is the “marked” member of opposition. For example, the English 3rd person verb (“he works”) is more marked than the 1st and the 2nd person verbs (“I work”, “you work”), or the Russian SVO (subject-verb-object) word order is less marked than any other word order, though Russian has a very flexible word order. The theory of second language acquisition claims that

“the areas of difficulty that a language learner will have can be predicted on the basis of systematic comparison of the grammars of the native language, the target language and the markedness relations stated in universal grammar, such that those phenomena in the target language which differ from and are typologically more marked than corresponding phenomena in the same context in the native language will be difficult” (Eckman, 1985, p.305).

In language attrition phenomenon, according to Seliger & Vago (1991),

“unmarked forms are better preserved than and substitute for marked ones, but not vice versa... Internally induced attrition phenomena encompass what elsewhere is called generalization, simplification, regularization, naturalness...”(p.10).
Thus, it is possible to make certain predictions as to what elements or structures are going to remain in the mother tongue and what elements are going to be substituted for by less marked equivalents of the second language. Seliger & Vago (1991) hypothesize the following linguistic relationships which might be found in first language forgetting:

a. L2 unmarked and L1 unmarked → L1 unmarked
b. L2 marked and L1 unmarked → L1 unmarked
c. L2 marked and L1 marked → L1 marked
d. L2 unmarked and L1 marked → L1 unmarked

In other words, if both L1 and L2 contain the unmarked form of a rule (a), the attrition is unlikely to occur. In case of a marked form in L2 and an unmarked form in L1 (b), the tendency towards simplification will leave the L1 feature unchanged. When both L1 and L2 are matched for marked forms in a construction (3), each language would maintain autonomy with regard to these rules so that the L1 construction would not be lost. Relationship between L2 unmarked and L1 marked (d) is most likely to produce language attrition. In this case an unmarked form will replace a marked form. For example, if English and Russian come into contact, a possible area of Russian attrition may be in the word order. The Russian SVO word order, though unmarked in comparison with other Russian word orders, is more marked than an absolutely unmarked English SVO word order, which could result in the ultimate replacement of all other word orders in Russian with the only acceptable English word order, SVO.
Thus, we have discussed different issues closely related to the problem of interference for first language forgetting. To summarize, interference may be one of the reasons for language forgetting which would make certain elements in L1 temporarily inaccessible due to competition with the corresponding L2 elements for processing capacity.

1.7.7 Retrieval failure due to lack of practice

Another assumption on which the theory of retrieval failure works is that regardless of how well learned something is, the information will become increasingly inaccessible unless it is periodically retrieved. In other words, lack of practice may lead to the inaccessibility of some kinds of knowledge which were once well learned. Loss of retrieval strength due to long-term disuse will make it more difficult to gain access quickly to the most relevant information stored in LTM. Low-frequency words might be an example of this type of information which is more likely to become inaccessible. Lack of retrieval practice can weaken links between the lexical representation of a low-frequency word and its corresponding concept. It will, in turn, make it temporarily inaccessible and will require more cognitive activity to gain access to this word.

1.7.8 Forgetting and level of processing

Retrieval from long-term memory may also depend on depth of processing. Elements that have been learned only superficially (e.g. words learned by heart with one or two repetitions, or nonsense words) are very
much prone to loss, while more deeply processed elements (e.g. words that have been applied in a number of different syntactic and semantic contexts) will be more resistant to loss. However, Weltens (1987) in his review of the research in L2 forgetting points out that

"it will be extremely difficult to use "depth of processing" as an explanation for loss of individual elements, because there may be considerable variation between individual learners in this respect (and) ....it is impossible to show that an element has not been processed deeply" (p.23-24).

The problem of "depth of processing" will be much harder to solve in L1 forgetting research than in L2 research, since most of the linguistic information in L1, if not all, was supposedly encoded by a deep level of processing.

1.8 Areas of L1 forgetting

As mentioned earlier, language acquisition can show different patterns in different areas of language. Language forgetting can also occur differently in different areas, like phonology, morphology, syntax, and vocabulary.

"A certain type of knowledge might be more liable to attrition than another. Massive lexical loss might be accompanied by minor syntactic loss, surface morphology might change faster than more basic grammatical features, pragmatically conditioned aspects of word order may change before more purely syntactic aspects..." (Smith & van Buren, 1991).

Below I examine the studies on first language forgetting from the perspective of different linguistic components. But first it is necessary to define what we are going to consider forgetting in language. The easiest
thing to be detected as a forgotten item is the one which has been absolutely erased from memory and is no longer retrievable. Unfortunately, that constitutes the smallest part in the process of forgetting. I would broaden the term of forgetting to those language structures which have become hard to retrieve, have changed their form under the influence of the second language, or have been replaced by the similar structures in L2.

1.8.1 Phonology

Kaufman & Aronoff’s (1991) study has been the only study so far found in the literature which reported some phonological violations in L1 due to the contact with L2. But the main concern of the study was morphological disintegration which will be discussed later in detail. A few examples will be provided of how morphological code blending (insertions of the structures of one language into the structure of another language within the same word) affected the phonology of L1. The use of Hebrew (L1) bound infinitive prefix variant le, li, or la is determined by the first phoneme in the word. For example, initial [f], [v], [s] would require prefix li-. Phonological violation was reported when code blending resulted in the use of the phonologically inappropriate prefix, e.g. la-flush from the English verb “flush”, or le-step from the English verb “step”. Standard Hebrew phonological rules are violated in this case as the use of li- would be required in both cases. (cf. li-flos “invade”, li-stor - “contradict”). The authors suggested that children’s use of the infinitive prefix is not
motivated by phonological rules but is probably acquired with the verb as one unit. However, the code blending of the L1 bound infinitive prefix with the L2 verb shows that the analysis of the verbal unit as prefix + verb has been made. The child, for example, treated the English verb "blow" as a two consonantal Hebrew verb CVCCV, /belou/ (like the verbs kara, bala, etc.) and inflected them accordingly, e.g. bala-ti ("blow").

Unfortunately, no other studies on first language forgetting with an emphasis on phonological changes in L1 have been found, although there are a few studies on phonological aspects in L2 acquisition (Thompson, 1991; Snow & Hoefnagel Hohle, 1977). A possible reason for the lack of research in this area might reside in the difficulty of tracing those changes in L1 forgetting. Apart from the intonational pattern which may change rapidly in contact situations, phonology is not the area in which significant changes are likely to occur. It is likely that phonological structures are acquired very early in the process of language development and are thus well established by the time the contact with another language occurs. In general, insufficient data on phonological changes due to L1 attrition does not allow us to make any predictions as to what extent and in which way the L1 phonology might suffer in a contact situation.

1.8.2 Vocabulary

Perhaps the most vulnerable area in language forgetting is vocabulary. Words are supposedly the most easily learned aspect in second language.
acquisition as well as the most susceptible to loss in first language attrition. A well-known study in language development of a bilingual child was done by Leopold (1939). He analyzed his daughter's vocabulary to the age of two years and suggested the following possible reasons for the mortality of words in the child's vocabulary:

- Phonetic form: certain words dropped out because of phonetic difficulty.
- Homonymy: other words may have lost certain meanings in the child's early speech. For example, Leopold's daughter used mama to mean food and mother; but its use with the first meaning was discontinued, perhaps because it interfered with its use with the second meaning.
- Acquisition of more specific terms: overextended words were abandoned in favor of specific names of objects.
- Change of interest: the word Schnee (snow) disappeared from the child’s vocabulary when winter passed; the word measles was used only during the family epidemic; and so forth.
- Rejection of nonstandard terms: emotional and self-expressive words such as [bu:] for thunder appeared sporadically but were not established.
- Struggle with synonyms: some words were abandoned as synonyms took their place. This happened within both languages as overextensions were abandoned for terms with more precise meanings. In addition, there were shifts from a word in one language to its equivalent in the other. For
example, the author noticed that his child’s vocabulary was subject to shifts when the German word was replaced by its English equivalent (e.g. Augenblick replaced by wait), but there were cases where the English gave way to the German (e.g., mitten to Handschuh).

- Lack of stability: no specific reason for instability was found. The use of the word appeared simply to be a passing vogue.

However, only one of these reasons which might account for the mortality of words, i.e. struggle with synonyms, is relevant to the topic of the present discussion. The shift from a word in one language to its equivalent in the other language can eventually result in replacement of an L1 word with its semantic equivalent in L2, which might gradually erase the L1 word from memory. Semantic overlap between the two languages in the bilingual setting may be an important mechanism of L1 forgetting. Some studies supporting this claim are described below.

Leyen (1984) did a study on vocabulary decline among Spanish residents in the U.S. The study consisted of two parts: a descriptive investigation which looked into language attrition in different linguistic fields, and an experimental study focused on vocabulary decline. The experiment involved two groups of native speakers of Spanish with three to six years and more than ten years of residence in the U.S. These subjects were asked to perform two vocabulary generation tasks involving the production of the
Spanish lexicon to a set of line drawings depicting objects and actions, and the generation of lexical items in conceptually related task. Their responses were then compared to those of a control group of monolingual Spanish speakers whose length of residence in the U.S. had not exceeded three months. Three major findings reported in the study provide support for the points made earlier in our discussion. First, profound native language decline occurred only among individuals who had left their native language setting during early childhood. This shows that language forgetting depends on the age at which a person leaves his L1 environment. Second, language loss was mostly observed in the area of vocabulary. In other words, vocabulary proved to be the most vulnerable in language forgetting. And third, the production of lower frequency native language words became impaired over time, which supports the idea that retrieval of low-frequency words can cause a problem due to a lack of practice in using these words.

Another study investigating lexical retrieval difficulties in adults was done by Olshtain & Barzilay (1991). This study with English-speaking immigrants to Israel was aimed at tracing L1 forgetting in a unique language setting where low forgetting of English was to be expected due to the highly prestigious status of English in the social structure of the Israeli society. The results of the experiment showed some reduction of lexical accessibility in English when certain lexical specification was necessary. The technique involved having 15 subjects tell two “frog stories” based on two books that
show a story but use no print. The stories tested memory for specific low-
frequency words. The sessions were tape-recorded and transcribed, no
reaction time was measured. The data was compared with that obtained
from testing 6 Americans living in the U.S. on the same “frog stories”. The
results of the experiment showed, for example, that 5 out of 6 Americans
named “pond” correctly, whereas only 3 out of 16 Israeli Americans named
it correctly, the other 13 offered a variety of appropriate synonyms, such as
swamp, puddle of water, water, riverbed, etc. Or the picture showing a jar
was labeled correctly by all Americans, whereas 5 Israeli Americans offered
less appropriate names like bottle, bowl, jug. The picture of a gopher was
named correctly by 2 out of 6 Americans and by only 1 out of 15 Israeli
Americans.

The weakness of this study lies in the absence of some robust tasks
which would require the subjects to access those specific words chosen for
analysis (like, for example in Leyen’s, 1984, study). It is unlikely that the
picture itself in a “frog story” can always give a precise idea about whether
we see a pond or a swamp. If instead of telling the story the subjects
would have been asked to name the items shown in the pictures, the data
might have been different. The replacement of the word with a word with
similar meaning which is more accessible in the semantic memory during
the task of telling a story does not necessarily mean that this specific word
is inaccessible. As long as these words are not replaced with the words
from a different language lexicon we cannot state that these words are
gone from the memory. They may be potentially accessible if some proper
cues are provided for retrieval. Thus the conclusion of the above study that
adult speakers of English living in a Hebrew-dominant environment
evidenced reduction in specific lexical accessibility does not seem
convincing enough.

To summarize, the major findings in the earlier studies suggest that (1)
vocabulary might be more vulnerable than other linguistic areas in the L1
loss; (2) low-frequency words might be lost faster than high-frequency
words; (3) semantically related words might be highly susceptible to loss.

High vulnerability of vocabulary in language forgetting can result in a
significant decline of L1 proficiency. However, loss of vocabulary items
from memory can be later compensated for by re-acquisition of these
items. The situation seems more complicated when other language
structures, like morphology or syntax, are lost. Here the processes of
transfer or interference may not be as fast as in case of vocabulary loss but
they might result in a permanent change in the native language proficiency.

1.8.3 Morphology

Morphological changes are likely to occur when two languages in contact
have different morphological structures, e.g. where one language is highly
inflectional and another is non-inflectional. In this case, according to the
theory of markedness mentioned earlier in our discussion, we may expect
that an inflectional language will lose its inflections, since a large number of inflections represent a more highly marked morphological structure.

The issue of morphological disintegration and reconstruction in first language forgetting was addressed in a study with a Hebrew-speaking girl who was placed in a dominant English-speaking environment. Kaufman & Aronoff (1991) looked into morphological changes in the child’s Hebrew, a language with elaborate inflectional markings, under the influence of English, which has relatively fewer inflections. The child was 2 years and 6 months old when she entered the United States, and three months later the onset of Hebrew attrition was noted. Her English exposure constituted 7 hours a day five days a week and Hebrew, L1, remained the home language. At the end of the study she was 4 years 6 months. At the outset of the study and prior to the onset of attrition, the child’s language exhibited good command of Hebrew morphology and syntax, - at the level of her Hebrew-speaking peers. The attrition process initially affected the lexicon (as predicted and discussed above), while all the features of L1 morphology and syntax acquired by the child were still present. The first morphological changes were noticed in verbs when L1 verbs were code-blended with L2 verbs (e.g. “la-flash” which comes from the L1 infinitive prefix “la” and L2 verb “flash”). By the age of 3 years 1 month, seven months after initial exposure to L2, the child reached the stage of balanced bilingualism which was extremely short. L1 syntax still remained intact and
there were still correct morphological features such as the infinitive prefix, correctly realized according to the verb stem, the object marker and appropriate verbal inflections. This stage was followed by a period which showed the initial signs of the disintegration of L1 morphology and syntax.

At this stage, the Hebrew inflectional and derivational morphology was disintegrating and being replaced; that is, some inflections disappeared from L1, while some emerged from L2 (e.g., the L2 suffix “-ing” used with L1 verbs to mark the present progressive, which is non-existent in Hebrew). Prefix and suffix systems in L1 as well as gender and plural marking were severely affected by contact with L2. Reconstruction of L1 morphology resulted in a single idiosyncratic verbal template, similar to an actual L1 form (Semitic morphology is characterized by the combination of consonantal verb roots with a small number of fixed derivational templates in which vowels and syllable structure are specified. There are seven such templates in Modern Hebrew). Thus, the child has adopted one particular form of the verb which she treated as an L2 stem and conformed to the morphosyntactic L2 environment, while retaining L1 phonetic form (e.g. “My room is isader-ed” which comes from “lesader” in L1 and “arrang-ed” in L2”).

This longitudinal study provides linguistic information about the child’s speech before the exposure to L2, at the onset of L1 attrition, and at the bilingual period, which enables us to follow the pattern of language changes.
in a particular individual rather than to make a speculative analysis based on standard norms of language acquisition. That makes this study very significant.

Another recent study on morphological changes in a contact situation (Levine, 1996) involved elderly Yiddish speakers. The subjects of the study had acquired Yiddish as their mother tongue but had not used it on a regular basis since their childhood. Thus their speech diverged from accepted norms in many ways. The researcher's interest was to see whether those changes were due to L1 attrition, due to incomplete L1 acquisition, or due to processing complexity of certain grammatical forms. The data reported in the study was collected through open-ended interviews conducted in Yiddish with 14 speakers of Yiddish in the US. In addition, each subject of the study was asked to perform a translation task and a grammaticality judgement task. The findings showed that although certain grammatical forms were not produced by the speakers in the interviews, they were produced in other tasks. The general finding in the study was that nominal morphology, which is a complex aspect of the Yiddish language, might be sacrificed for the sake of the immediate on-line communication, but the subjects indicated their mastery of this linguistic aspect in different tasks. In other words, all subjects could correctly produce irregular plurals, but in conversation they tended either to ignore plural markings or to overgeneralize them. As to the verbal morphology, the speakers
occasionally produced the correct form of the past participle, though they tended to produce ungrammatical forms more often. Also, they demonstrated their knowledge of the two auxiliaries in forming the present perfect by occasionally using both of them, but more often they would use only one form. The latter led the author to suggest that the L1 speakers in L2 environment may reduce redundancies in the first language in order to facilitate its processing. The general conclusion of the study was that

"speakers do not seem to lose knowledge of a language once acquired, even if it was acquired incompletely, rather speakers seem to lose the ability to process that knowledge on line. They then appear able to compensate for these difficulties by dealing rather creatively with complexities and redundancies in the system, all to the end of effective communication" (Levine, 1996, p. 119).

Again, the above speculative conclusion was based upon preliminary, qualitative analysis of data and thus should be considered rather carefully. The further quantitative analysis the author indicates he intends to carry out might substantiate the qualitative findings of this study. Thus, we can summarize that the reported studies on morphological changes due to L1 loss emphasized (1) the high likelihood of severe damage to the inflectional systems due to the contact with L2; (2) the possibility that some morphological aspects may be inaccessible rather than unavailable.

1.8.4 Syntax

There are a few studies on first language forgetting in the area of syntax. One of them, Merino (1983), was done with balanced bilingual Spanish-
English children in the age range from kindergarten through the fourth grade in an English-dominant environment. The proficiency in the use of the following features was measured: number, gender, tense, word order, relatives, conditionals, and Spanish subjunctive and their English equivalents in both production and comprehension. The tests were administered twice, with the second administration being done two years after the first one. The results of the second test showed that while performance in English continued to improve for the sample group as a whole, performance in Spanish production deteriorated to a significant degree, especially for categories like past tense, relatives, and the subjunctive. No loss was reported in the gender or number categories. This latter finding was surprising to the researcher, since these features, gender and number marking, have often been reported as susceptible to loss among second language learners. Merino suggested that loss may affect first language learners differently than second language learners, or it may be that loss of these features is likely to happen only when acquisition is interrupted in its very early stages.

Another finding was that the kindergarten children appeared to be less influenced by loss than first and third graders, and second graders were not affected by loss at all. The author suggested that it may be that the full impact of predominantly English-speaking environment had not yet reached the children at the kindergarten age. It is likely that L1 loss can be
significantly affected by acquisition of a second language in a formal educational setting, which may be absent in kindergartens. However, it remains unclear why the second grade performance in Spanish did not show any signs of deterioration, and in contrast, revealed an insignificant improvement. The author fails to provide any convincing explanation of this finding and concludes that age and exposure to influence of the majority English-speaking society will not automatically bring about loss. This makes the study's data somewhat problematic.

The study also revealed that production in Spanish turned out to be more susceptible to loss than comprehension, which remained unimpaired. This is a very important finding, as it indicates that the L1 items were not really erased, or lost, from the memory; they simply became inaccessible for active production. Unfortunately, this study investigating the changing pattern of performance in English and Spanish in terms of acquisition and loss of certain syntactic structures did not suggest whether the changes in the pattern reflected any language transfer. In other words, it would be interesting to see whether deterioration in the correct use of past tense, relatives, and subjunctives in Spanish showed any influence of the equivalent features in English. Any study investigating the pattern of second language acquisition and first language forgetting in an individual or in a group of individuals should look into the mechanisms which might work
between the two languages involved in bringing about specific changes in L1 when two languages are brought into contact.

While the above study examined the syntactic changes both in production and comprehension finding impairment only in production, the following study (Liu, Bates & Li, 1992) examined L1 forgetting only in the area of sentence comprehension in English-Chinese and Chinese-English bilinguals.

There were three groups of subjects: monolingual controls, late second language speakers, and early second language speakers. The latter group was further divided into three subgroups, based on the age of exposure to the second language. All the instructions and the test sentences were recorded by native speakers and then played back. During a session, only the test language was spoken by the experimenter and the subjects. There was a set of short sentences which had two objects and one action between the two objects. The task was to determine which entity in the sentence performed the action in the sentence. Sentence processing strategies are believed to be different in English and Chinese, i.e., word-order strategies being used in English and animacy-based strategies in Chinese, and the experiment yielded some data regarding transfer of the strategies from one language into another. The study made a distinction between four types of transfer which might be expected in adult bilinguals:
1. **differentiation**: a clear separation in the strategies used for each language, equivalent to the performance of monolingual listeners in each language type;

2. **forward transfer**: transfer of first language strategies (L1) in the interpretation of sentences into the second language (L2), which is proactive interference (PI);

3. **backward transfer**: a process whereby strategies that are appropriate for L2 feed back on L1, effectively supplanting the listener's initial approach to sentence processing, which is retroactive interference (RI); or

4. **amalgamation**: the development of a single set of strategies for use in both languages, reflecting a merger of cue hierarchies across the two language types.

The results of the study indicated that late bilinguals display strong evidence for forward transfer (PI): late Chinese-English bilinguals transfer Chinese-based animacy strategies to English sentences; late English-Chinese bilinguals transfer English-like word order strategies to Chinese (PI). Early bilinguals showed a variety of transfer patterns, including differentiation (use of animacy strategies in Chinese and word order strategies in English), and backward transfer (RI), which indicated L1 loss. So we can see that backward transfer (RI), from L2 to L1, which can be indicative of first
language loss was detected only in early bilinguals. However, this tendency for backward transfer was reported only in those early bilinguals who were American-born Chinese exposed to English before age 4, or who came to the United States between 12-16 years of age. Early bilinguals, who were exposed to English between 6-10 years of age, showed a robust pattern of differentiation, performing very much like monolinguals in each of their two language types. It was surprising to find such an age-related discrepancy in the effect of backward transfer. The authors offered an empirical explanation both in terms of sociological and psycholinguistic factors that might be responsible for their findings. The sociological factor has to do with the desire of immigrant teenagers (the 12-16 years olds who showed signs of L1 loss) to fit into the American society and to "be like other people". The authors offered a rather speculative explanation of this effect, that is backward transfer, in general, might occur more often at a midpoint in the acquisition of a second language. The second language may be spoken fluently, but it still requires far more attention and effort than it does in a native speaker, resulting in some degree of inhibition of L1. In any event, neither of these two explanations are without problems and consequently this finding needs support by further research.

What is interesting for the present discussion is the following: (1) evidence of backward transfer in sentence interpretation by at least some bilingual subjects illustrated L1 loss in the area of syntax; (2) the study
revealed that first language comprehension can be impaired by L1 forgetting. The previous study, Merino (1983), showed that only L1 production was affected by loss, comprehension remaining unchanged; (3) the Critical Period Hypothesis gains further support with some implications for L1 forgetting: that is, early acquisition may facilitate entry in L2, but it can also (in combination with other factors) result in loss of sensitivity to aspects of L1.

Another study exploring the issue of sensitivity of L1 syntactic structures for comprehension was done by Altenberg (1991) with a married couple of German native speakers who have been living in the U.S. for more than forty years. There were three experiments reported in the study: (1) an untimed sentence judgement task which investigated the vulnerability of first language (German) surface word order under the influence of second language (English) word order; (2) an untimed sentence judgment task which examined the vulnerability of first language selectional restrictions under the influence of second language idiomatic verb usage; (3) an untimed fill-in task which assessed the vulnerability of first language gender and pluralization information and the relationship of this information to the factors of frequency and predictability.

The subjects were asked to evaluate four types of German and four types of English sentences and indicate each sentence’s acceptability. Some of the sentences were intentionally ungrammatical in one of the two
languages. The next task involved judgement of acceptability of idiomatic verbs in German. Lexical retrieval of high-frequency and low-frequency words was tested on a list of words of various frequency where there were nouns with predictable plural forms and nouns with unpredictable plural forms.

The results of the study revealed that most L1 knowledge remained intact, though there were changes in some syntactic rules which might have been due to transfer from the second language. L1 verb usage under the influence of L2 was found to be affected, especially in cases where L1 and L2 verbs were phonetically similar. For example, the verbs "brechen" ("break") and "nehmen" ("take") were used for evaluation. Half of the sentences were constructed with each of these verbs in ways which are acceptable in German, and half of the sentences with each of the verbs were constructed in ways which are unacceptable in German. The subjects were asked to rate the acceptability of each German sentence, with instructions to pay particular attention to the question of whether the verb can be used this way in German. Sentences with "brechen" and "nehmen" were rated separately. Both subjects judged seven out of the nine ungrammatical German sentences with "brechen", which is phonologically related to its English equivalent "break", as acceptable in German. With "nehmen", which is phonologically unrelated to its English
equivalent “take”, only one to two out of eight unacceptable sentences were judged as acceptable.

The loss of plural information as well as the possible loss of gender information was also reported in the study. The greater vulnerability of plural over gender information was found to support the suggestion that L1 and L2 similarity is a necessary condition for transfer.

It should be emphasized that the findings of this study show the same pattern of language transfer which was reported in Liu et al.’s (1992) study, in that comprehension of syntactic structures was found to be affected by loss, and contradict the findings in Merino’s (1983) study which reported that comprehension remained intact. Further contradiction with Merino’s (1983) study lies in the categories that were reported to have been affected by attrition. Altenberg (1991) found some loss of plural and gender information, while Merino (1983) was surprised not to find any indication of loss in these areas which are usually considered the most susceptible to loss.

Another study in the area of syntax, with fifty Spanish-English bilinguals, was reported by Silva-Corvalan (1991). The subjects were divided into three groups, based on the age at which a person came to the U.S., i.e. 1) after the age of eleven, 2) before the age of six, 3) or who was born in the U.S. to at least one parent who came to the U.S. before the age of six. Generally speaking, we can combine Silva-Corvalan’s groups into two
categories of subjects: those who might have developed their mother tongue by the time they moved to the L2 country, and those who never had a sufficient input to do that. The analysis of subjects' conversations with the author revealed a great number of morphological simplifications in the Spanish verb system, including the absence of future morphology, and simplification of the preterite (past action), the imperfect subjunctive, the pluperfect indicative (equivalent of past perfect in English) and subjunctive. The analysis also showed that there were two extreme ends in the bilingual continuum, i.e., the most developed system of Spanish was used by the first group (those who came to the U.S. after the age of eleven) and the most simplified system used by the third group (those American-born subjects whose parents came to the U.S. before the age of 6). It provides further support to the idea that native language vulnerability to loss depends, among other factors, on the amount and type of L1 input the person had received by the time he moved to an L2 environment and the amount of L1 input that is probably still available. The amount of the original L1 input is, in turn, determined by the age at which the child moved to an L2 environment.

The author concludes that the reason for the simplification found in Spanish may lie in cognitive complexity. Complex forms may be abandoned by the bilingual in favor of the simpler forms of the second language which are transferred into L1.
An interesting study on word order patterns in contact was done by Schaufeli (1996). The experimental design incorporated two groups of Turkish speakers in the Netherlands and a control monolingual Turkish group. The two experimental groups were those which consisted of people who were born and brought up in Turkey before they moved to the Netherlands, and those who either were born in the Netherlands to two Turkish-speaking parents or were brought to the Netherlands before the age of three. There were two major tasks involved in the experiment, i.e. one was aimed at testing L1 sentence interpretation and another - at testing L1 sentence production. The L1 sentence interpretation was tested in a so-called cue-validity experiment, i.e. the task was to see whether bilinguals and monolinguals use linguistic cues, like number, agreement, case marking and animacy, in interpreting sentences in the same way or not. The major interest of the researcher was in the role of word order in assigning semantic and/or syntactic roles. The L1 sentence production was tested by a story telling task. The subjects were asked to pretend that they were telling the story (Frog, where are you?) to their child or a grandchild, or to a younger brother or sister. The semi-spontaneous language was then recorded and analyzed. The two tasks employed in the experiment brought about contradictory results. From the cue-validity experiment it appeared that the immigrant groups tend to be more rigid in interpreting sentences, whereas in spontaneous speech they show more variation in the use of
word order patterns. Moreover, in the perception task, the immigrant group was found to rely on word order in sentence interpretation, whereas the control group did not take word order into account. There were two explanations offered by the author for the registered changes in word order patterns: cross-linguistic influence from Dutch and language internal pressures. The former concerns a strategy to adopt word order as a clue when interpreting sentences, which is common among Dutch speakers and might have been transferred by the Turkish immigrants into Turkish sentence interpretation. The latter concerns language internal restructuring towards a more consistent pattern. For example, the more common word order in L1 might become the only word order used by an L1 speaker living in the L2 environment, and this change might be independent of whether this word order pertains to L2 or not. The evidence came from the preference shown by the Turkish immigrants to stick to the canonical SVO order. The conclusion was that the language changes were partly induced by L2 interference and partly caused by universal intra-language processes, or what was defined earlier as language internal pressures. The latter is also known as 'language internal universal principles'. One of the universal principles is particularly relevant to word order contact induced changes. The principle states that

"an ongoing word order change will always move towards a consistent basic word order pattern, in terms of the general Head-Modifier order" (Schaufeli, 1996, p. 156).
To conclude, the major syntactic changes reported in the above studies concerned the possible effect of L2 transfer on the L1 structure in different areas, like gender, plural information, word order. However, the latter study also suggested that those changes might be induced by the process of L1 generalization.

A case study with a Russian-English bilingual child, Turian & Altenberg (1991), addresses the question whether the same compensatory strategies are used in first language forgetting as in second language acquisition. Compensatory strategies are strategies used by second language speakers when they desire to communicate a particular meaning to a listener but believes there is a lack in their second language linguistic system. The authors expand this definition to include a lack in the speakers first language linguistic system. Though the question was answered positively, it is not the primary concern of the present discussion. What does interest us here is the fact that a syntactic transfer from English into Russian was found, e.g. incorrect use of the accusative in place of the nominative ("That is I" instead of "That is me" though the first form is grammatically correct in English but almost never used). Unfortunately, this study does not contribute much to the research in first language forgetting. The subject of the study was a child who had been exposed since his birth to two languages, English with his mother and Russian with his father. Though it was stated that by the age of 3 and a half his dominant and preferred
language was Russian, we must not forget that he also spoke English, and that the influence of the second language on the first language could be quite possible, no matter how restricted the exposure to L2 was. Moreover, taking into consideration the extremely young age of the subject we can hardly expect his Russian to have been developed to the extent for which significant language loss can be reported. The interference, or transfer, between the two languages occurred at the point when most of the syntactic structures had not yet been developed.

1.9 Summary

The review of the literature on first language forgetting has shown that there have been a limited number of studies, mostly case studies, which explored L1 forgetting among different age groups and in different linguistic areas. It was found that the early exposure to L2 acquisition before L1 is fully established results in the most severe L1 loss (Palij, 1990; Schiff-Myers et al., 1993, Silvia-Corvalan, 1991, Liu et al., 1992). However, there was no consistency in the age-related data in some studies. For example, Merino (1983) found much greater loss in 3rd and 4th graders than in kindergarteners and no loss in 2nd graders, while Liu et al. (1992) reported no loss (backward transfer, RI) in those who were exposed to L2 between 6 and 12 years old and found loss in the other two groups (i.e. those who were exposed to L2 before age 4 or between 12-16). Both
studies failed to provide any convincing explanation of the obtained age-related discrepancies in their data.

No studies which looked specifically into the phonological changes by L1 forgetting have been found in the literature. A number of the studies provided evidence that vocabulary is the most vulnerable area to loss (Leopold, 1939; Leyen, 1984; Olshtain & Barzilay, 1991; Kaufman & Aronoff, 1991). In addition, morphological and syntactic changes due to L1 forgetting have been addressed from different perspectives. Kaufman & Aronoff’s (1991) study examined the gradual process of L1 forgetting in the Hebrew-speaking child who experienced morphological and syntactic changes over the same period. It was found that loss affected derivational morphology, like verb inflections. Also plural and gender markings disappeared from L1. The latter was supported by the data from the other study (Altenberg, 1991). However, no changes in gender and plural categories were reported in Merino’s (1983) study. There were also contradictory findings as to whether L1 comprehension is impaired by L1 forgetting. Merino (1983) indicated that only production was impaired but comprehension remained intact, while Altenberg (1991) found that comprehension was also affected by loss. In addition, one of the studies (Schaufeli, 1996) suggested that contact-induced L1 changes might come partly from L2 influence, and partly from tendencies for generalization.
There were several other interesting findings in the reported studies. Semantic overlap between the equivalents in two languages was suggested to account for the mortality of L1 words (Leopold, 1939). Low-frequency words were found hardest to retrieve (Leyen, 1984). Compensatory strategies in L1 forgetting were found to be the same as in L2 acquisition, which makes these two areas, L1 forgetting and L2 acquisition, even more closely related. Moreover, the problem of processing simplicity in language production was brought up by Levine (1996).

Unfortunately, methodological problems in some studies made the data rather questionable (Olshtain & Barzilay, 1991) or unconvincing (Liu et al., 1992, Merino, 1984). The insufficient amount of studies on L1 forgetting together with methodological deficiencies in some of them leaves many questions unanswered and requires further scientific research.
CHAPTER 2
CASE STUDY

2.1 Introduction

Most of the case studies reported in the literature have been focused on examining the L1 changes in a specific language area, like vocabulary, morphology, or syntax. There are advantages and disadvantages in analyzing the process of L1 forgetting as it is reflected in a narrow linguistic field. The more careful and intensive attention to a specific linguistic area in the individual’s L1 repertoire can provide a better understanding of how this particular area is subject to attrition, or forgetting. However, it might make the research on L1 forgetting incomplete.

The present study focused on examining L1 loss in all three major areas susceptible to attrition: vocabulary, morphology, syntax, though forgetting of vocabulary constituted the major part of the research. I believe that the overall picture of L1 forgetting in an individual with a main focus on one of the fields is more important than detailed speculative analysis of certain changes in one isolated linguistic area (which can never be isolated in reality). This kind of approach might contribute to our final understanding of how L1 forgetting occurs.

Also, there have been just a few longitudinal case studies on L1 forgetting which looked into the process of L1 changes since the moment an individual lost active contact with the L1 environment. Most of them
were conducted on subjects who had been staying in the L2 country for many years and the data on L1 forgetting was based on comparing the registered level of L1 proficiency at the moment of the study with a hypothetical initial level the subjects might have had when they moved to a new country. In this respect, the present investigation is somewhat unique, not only because it reflects the L1 changes from the very first moment when the subject came to the L2 environment, but also because it shows the process of L1 forgetting in the subject whose L1 input was suddenly switched off and completely replaced by an L2 input.

2.2 Subject

The case study was based on the year-long monitoring of a subject that might be ideal for research on L1 forgetting. This kind of a subject is often referred to in the literature as a “deserted island” in a sense that a person’s exposure to the native language is completely terminated, which results in a fast process of L1 forgetting due to the acquisition of a new language with the absence of L1 input.

A Russian girl, S., was 9 years old when she was adopted by the American family and brought to the US in May, 1997. Her Russian (L1) had been well developed by that time and her fluency in Russian paralleled that of her Russian speaking peers. Her English (L2) was non-existent at the time when she entered the US. Since then, the only exposure to Russian has been limited to my brief monthly visits and occasional telephone
conversations at the early stage of her adaptation to a new environment when I had to act as an intermediate communicator between her, speaking no English, and her parents knowing no Russian. In other words, a monthly 30 minutes session in Russian, occasional telephone conversations (not more than 30 minutes a month) with me, and another 15 minutes of S. playing with my child during my visits constituted a bit more than an hour in all of S.’s monthly exposure to Russian. Three months after she came to the US my help over the phone was no longer required, i.e. another 30 minutes of contact with Russian were eliminated. Six months after extensive exposure to English, S. switched to English as a “game language” even when playing with my Russian-speaking child. That further shortened Russian exposure to an approximately 30 minutes session a month. Beyond the session, S. did not feel like speaking Russian to me, though she has so far shown intact comprehension of the language.

In September, 1997, S. started the third grade in a regular American school, and by the end of the first semester of the first academic year in America her English proficiency was evaluated at the first grade level, which means that it had not yet paralleled that of her English-speaking peers but demonstrated great progress in L2 acquisition. By the end of her first year at school, her English proficiency almost met the requirements of the third grade. By January 1998, S. could read English and that made it possible to test L1 accessibility using a task with L2 blocking (see 2.4.2).
The child’s attitude to languages has dramatically changed, from the initial reluctance to accept English as a dominant language to the final unwillingness to speak Russian to me a year later, when S. started to admit that she had already forgotten Russian. I have monitored S. for almost a year and the data collected over that period of time was used for the present research.

2.3 Method

The regular tests consisted of taping different linguistic tasks, first only in Russian, and later in both Russian and English. My interest was to see the changes in L1 competence as a function of L2 acquisition. The major tasks involved free talks (L1, later also in L2), picture description (L1, later also in L2), story telling (L1), and different variants of picture naming (L1 and L2). Free talks were introduced in the first session (only L1) and in the last two (#7, #8) sessions (L1 and L2). All tasks were aimed at testing the L1 production skills in the attrition situation. Table 2.1 shows which tasks were used in each session.

2.4 Stimuli and tasks

2.4.1 Morphology and syntax

The free talks, picture descriptions, and story telling tasks were aimed at detecting syntactic and morphological changes which might occur by L1 forgetting. The topic in the first sessions was “Tell me about yourself”, and in the last two sessions the same two topics were switched across
languages, that is, "School year" and "Summer Recess" were discussed both in English and in Russian but in alternative sessions. This hopefully minimized the possibility of using a translation strategy.

The picture description task was based on three colored pictures from a children’s book showing both objects (e.g. house, swings, trees, barn, path, fence, pets, children, dolls, etc.) and actions (e.g. chasing, fighting, flying, hanging, lying, playing, crying, etc.). The story telling task was based on the well-known "Little Red Riding Hood" depicted in the book written in Hebrew (this eliminated any possibility of child’s reading the story instead of telling it). The same two pictures and a story were given twice, the first time - in June, 1997, a month after S. entered the US, the second - in March-April, 1998, almost a year later. Such a long interval was used to minimize any possibility of better retention due to repetition, and the data obtained using the same testing material should be less confounded. The third, new picture, was introduced in the last session (#8) to test the level of syntactic and morphological control a year since the contact with L1 was lost. The analysis of the data was focused on (1) looking into the possible changes in Russian inflections, which were expected to be the most vulnerable morphological area in L1 forgetting; (2) comparing the original level of syntactic complexity with that registered later in time; (3) evaluating the possible changes in word order; (4) detecting any code switching at the later testing period.
Table 2.1 Schedule of tasks across sessions

<table>
<thead>
<tr>
<th>Session</th>
<th>Task (Russian, L1)</th>
<th>Task (English, L2)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. June, 1996</td>
<td>1. introduction interview</td>
<td>N/A</td>
</tr>
<tr>
<td>(a month since S.</td>
<td>2. picture description (#1)</td>
<td></td>
</tr>
<tr>
<td>came to the US, two</td>
<td>3. story telling</td>
<td></td>
</tr>
<tr>
<td>weeks after S.</td>
<td></td>
<td></td>
</tr>
<tr>
<td>started a summer</td>
<td></td>
<td></td>
</tr>
<tr>
<td>camp)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>September, 1997</td>
<td>1. picture description (#2)</td>
<td>picture naming</td>
</tr>
<tr>
<td>(S. started school)</td>
<td>2. picture naming (nouns/verbs)</td>
<td>(nouns/verbs)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3. December, 1997</td>
<td>1. picture naming (nouns/verbs)</td>
<td>picture naming</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(nouns/verbs)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>2. picture naming in a free choice language</td>
<td>(nouns/verbs)</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5. March, 1998</td>
<td>1. picture description (#1)</td>
<td>picture naming</td>
</tr>
<tr>
<td></td>
<td>2. story telling</td>
<td>(nouns/verbs)</td>
</tr>
<tr>
<td></td>
<td>3. picture naming (nouns/verbs)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. picture naming in a free choice language</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. picture naming in Russian</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with an English name provided (blocking)</td>
<td></td>
</tr>
<tr>
<td>6. April, 1998</td>
<td>1. picture description (#2)</td>
<td>picture naming</td>
</tr>
<tr>
<td></td>
<td>2. picture naming (nouns/verbs)</td>
<td>(nouns/verbs)</td>
</tr>
<tr>
<td></td>
<td>3. picture naming in a free choice language</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. picture naming in Russian</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with an English name provided (blocking)</td>
<td></td>
</tr>
<tr>
<td>7. May, 1998</td>
<td>1. free talk (school year)</td>
<td>1. free talk (summer recess)</td>
</tr>
<tr>
<td></td>
<td>2. picture naming (nouns/verbs)</td>
<td>2. picture description (#1)</td>
</tr>
<tr>
<td></td>
<td>3. picture naming in a free choice language</td>
<td>3. picture naming (nouns/verbs)</td>
</tr>
<tr>
<td></td>
<td>4. picture naming in Russian</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with an English name provided (blocking)</td>
<td></td>
</tr>
<tr>
<td>8. June, 1998</td>
<td>1. free talk (summer recess)</td>
<td>1. free talk (school year)</td>
</tr>
<tr>
<td></td>
<td>2. picture description (#3)</td>
<td>2. picture naming (nouns/verbs)</td>
</tr>
<tr>
<td></td>
<td>3. picture naming (nouns/verbs)</td>
<td></td>
</tr>
<tr>
<td></td>
<td>4. picture naming in a free choice language</td>
<td></td>
</tr>
<tr>
<td></td>
<td>5. picture naming in Russian</td>
<td></td>
</tr>
<tr>
<td></td>
<td>with an English name provided (blocking)</td>
<td></td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
2.4.2 Vocabulary

There were three vocabulary tasks employed in the present study, i.e. picture naming, free languages choice, and blocking tasks. All three tasks were based on the same stimuli, that is flash cards depicting objects and actions. Pictures represented basic concepts familiar to a child of S.'s age and did not have any culturally specific connotation. Several pictures were found ambiguous and their naming had to be cued in the first few sessions and took a long time. For example, a picture of a mask was named "clown", "clapping" was identified as hand washing, or "baking" was named cooking. Later they were named without any difficulty. RT measurement for those pictures in the first sessions was excluded from the analysis. The set of pictures varied from session to session to eliminate any possibility of better retention due to repeated retrieval practice. There were about 90 object picture words and 90 action picture words. The cards used for one task were never used for the other two tasks in the same session.

The presentation of a picture lasted until it was named, or rejected with an answer "I don't know" , or until the pause was too long (e.g. 20,000 ms) to expect any recall. The words which were not recalled were never named by the experimenter to avoid the possibility of better L1 retention due to an additional L1 input. The answers were tape recorded and later transcribed.
**Picture naming task.** The picture naming task was offered consistently in this study from session (#2) through session (#8). The picture naming task in each session involved about 40 words in each category; approximately 50% of the words were repeated in the same task next session. The obtained data was interpreted in terms of the percentage of L1 lost items and L2 learned items, and also in terms of accessibility of the vocabulary units which is reflected in the reaction time data. Again, the concept of loss or forgetting as it is viewed by the present research is broader than just the actual loss of lexical items. Thus, not only the percentage of lost items, but also the pauses exhibited in trying to access the target word can be indicative of language forgetting. The percentage of lost items together with the length of the pauses were used as dependent variables in plotting the forgetting curves.

The two other vocabulary tasks, free choice and blocking, were introduced in the later sessions (#4 - #8) when the level of L2 proficiency had become high enough to provide sufficient L1 blocking in the experimental setting.

**Free choice task.** In this task, 20 object pictures varying from session to session were presented for naming. The task was to name the pictures as fast as possible in whatever language came to mind first. Since stimuli varied across tasks and sessions, the accessibility of the same word in two different tasks might be compared: e.g. in the picture naming task where
only one language store is supposedly activated and in the free choice task where activation of the language store can take a different pattern. In addition, the purpose of this task was to see whether there is any shift in language preference which might occur with time.

**Blocking task.** Another experimental task on vocabulary accessibility could be compared with the Stroop task widely used in experimental psychology. S. was presented with a set of 10 object pictures different from those already used in the previous tasks in the same session. This time the pictures had printed English names. S. was asked to name the pictures in Russian ignoring the provided names in English. The English labels were intended to provide additional L1 blocking. The RT taken to recall the target word in this task was compared with the RT on retrieving the same word in a picture naming task offered in the preceding or following session. The analysis of the data might contribute to a better understanding of the process of L1 blocking due to the extensive exposure to the L2 environment. It should be acknowledged, however, that this would work only if S. could read an L2 label. Since reading skills were not tested in either language in the present study, it is possible that the absence of blocking effect on some of the words could be attributed to S.’s unfamiliarity with the printed name of the word.
2.5 Findings: Morphology

2.5.1 Russian morphology

In order to better understand morphological changes found in the present study, a brief comparative analysis of Russian and English morphology will introduce this section.

Russian has a two-way number distinction: singular-plural; three-way gender distinction: feminine, masculine, neuter (Table 2.1); three-way declension distinction: 1, 2, 3; and a six-way case distinction: nominative, accusative, genitive, dative, instrumental, prepositional in nouns (Table 2.2). Plus there is a two-way conjugation distinction (1 and 2) in verbs (Table 2.3).

Russian belongs to the category of fusional, flectional, or even inflectional languages, as they are called in the literature. There is no clear-cut boundary between morphemes, the characteristic of a fusional language being that the expression of different categories within the same word is fused together to give a single morpheme (Comrie, 1989). For example, if we take a genitive plural *dom-ov* "of houses" we can see that suffix *-ov* cannot be segmented into a suffix for number and a suffix for case. And even knowing that *-ov* is the genitive plural affix in declension "1", we have no way of predicting the genitive plural suffix in declension "2", which happens to be zero. Thus each such ending is morphologically indivisible where it does not make any sense to ask what part of the ending indicates
Table 2.2 Gender and number in Russian

<table>
<thead>
<tr>
<th>Number/Gender</th>
<th>Feminine</th>
<th>Masculine</th>
<th>Neuter</th>
</tr>
</thead>
<tbody>
<tr>
<td>singular</td>
<td>gazet-a</td>
<td>dom (house)</td>
<td>pisjm-o (letter)</td>
</tr>
<tr>
<td></td>
<td>(newspaper)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>plural</td>
<td>gazet-y</td>
<td>dom-a</td>
<td>pisjm-a</td>
</tr>
</tbody>
</table>

Table 2.3 Russian declensions

<table>
<thead>
<tr>
<th>Case</th>
<th>1 declension</th>
<th>2 declension</th>
<th>3 declension</th>
</tr>
</thead>
<tbody>
<tr>
<td>Nominative</td>
<td>slon (elephant)</td>
<td>stran-a (country)</td>
<td>mysh (mouse)</td>
</tr>
<tr>
<td>Genitive</td>
<td>slon-a</td>
<td>stran-y</td>
<td>mysh-l</td>
</tr>
<tr>
<td>Dative</td>
<td>slon-u</td>
<td>stran-e</td>
<td>mysh-l</td>
</tr>
<tr>
<td>Accusative</td>
<td>slon-a</td>
<td>- stran-u</td>
<td>mysh</td>
</tr>
<tr>
<td>Instrumental</td>
<td>slon-om</td>
<td>stran-oi</td>
<td>mysh-ju</td>
</tr>
<tr>
<td>Prepositional</td>
<td>slon-e</td>
<td>- stran-e</td>
<td>mysh-l</td>
</tr>
</tbody>
</table>

Table 2.4 Russian verb conjugations

<table>
<thead>
<tr>
<th>Person and number</th>
<th>1 conjugation</th>
<th>2 conjugation</th>
</tr>
</thead>
<tbody>
<tr>
<td>1(^1) singular</td>
<td>je</td>
<td>rabota-yu (work)</td>
</tr>
<tr>
<td>2(^{nd}) singular</td>
<td>ty</td>
<td>rabota-esh</td>
</tr>
<tr>
<td>3(^{rd}) singular masculine</td>
<td>on</td>
<td>rabota-et</td>
</tr>
<tr>
<td>3(^{rd}) singular feminine</td>
<td>ona</td>
<td>rabota-et</td>
</tr>
<tr>
<td>3(^{rd}) singular neuter</td>
<td>ono</td>
<td>rabota-et</td>
</tr>
<tr>
<td>1(^{st}) plural</td>
<td>my</td>
<td>rabota-em</td>
</tr>
<tr>
<td>2(^{nd}) plural</td>
<td>vy</td>
<td>rabota-ete</td>
</tr>
<tr>
<td>3(^{rd}) plural</td>
<td>oni</td>
<td>rabota-jut</td>
</tr>
</tbody>
</table>

case, and what part indicates number. Comrie (1979, p.106) comparing English and Russian in this respect points out that “English tends not to have affixes combining a number of categories, though there are some exceptions, such as the verbal ending -s, as in “He hits”, which combines person (the third person, compare with “I hit”), number (the singular, compare with “They hit”), and tense (the present, compare with “He hit”).” In other words, comparing morphological marking in Russian and English, we have a general rule in one language, and an exceptional case in the
other, that is an English verb morpheme "-s" is probably the only morphological marker combining a few features, while all inflectional Russian morphemes represent a few indivisible grammatical categories.

2.5.2 Changes in case marking

One of the hypothesis which might explain morphological changes in an inflectional language when it comes in contact with a non-flectional language, would be the theory of markedness. If we apply this theory to the present study, we might expect loss of inflections in Russian due to its contact with English. My concern in the present study was to see whether there are any inflection errors in the subject’s L1 speech, which were reported in the earlier studies (Kaufman & Aronoff, 1991). The analysis of morphological and syntactic changes reflected by L1 loss in this study has been based on the data pulled out from different tasks and mostly on the data obtained through free talks, picture descriptions, and story telling. However, I need to acknowledge that in the later stage of data gathering only insignificant amount of that kind of data could be collected. No spontaneous speech could be recorded at that time unless it was cued by the experimenter. Vocabulary gaps resulted either in incomplete sentences, or switches into English, or silent pauses. S. no longer felt comfortable in Russian; her motivation to speak L1 was tremendously decreased. That left us with little pure Russian data for analysis. For example, she could not finish the sentences because of unavailability of a certain vocabulary unit.
The word was cued by an experimenter's question and it might have triggered the right case marking.

(1) Ex.: S.: *The man .... I mean .... malchik.... daet ... mjachik.....
The man......I mean .... a boy ....is giving .... a ball
Experimenter: Komu? (To whom?)
S.: Sobak-e (dative)
    To the dog

The number of case errors might have been much higher if we had had more data available and if S. could have talked fluently in the language which happened to be so much suppressed for maintaining any simple conversation. That prevents us from making any big claims in the morphological and syntactic areas of the present study.

However, the comparison of the data across eight sessions has shown that S. started omitting some case markings or using them incorrectly as early as in session (#5), or ten months after her Russian input terminated. Until then, no significant changes deviating from acceptable irregularities in a child's speech were observed. The most frequent morphological error was found in using nominative instead of accusative case marking.

(2) Ex: *Ja vizu malchik ...., instead of Ja vizu malchik-a ....
    I see a boy
or: *Ja vizu devochk-a..., instead of Ja vizu devock-u
    I see a girl

This type of error repeated over the last four sessions, where the picture description task was introduced with the researcher's question: "What do you see in this picture?". Altogether, there were 4 such errors with
feminine nouns and 5 errors with masculine nouns. However, the frequency of this error in the present study might be caused by S.’s attempt to directly answer the question using the “Ja vizu...” (I see...) phrase which takes the accusative object rather than by any severe loss of this particular case distinction. Moreover, this type of error should be interpreted very carefully, since it cannot be treated separately from a serious syntactic violation it was involved with, which is going to be discussed later (see section 2.6.4). Taking it as a morphological error we could claim that accusative case marking is the most vulnerable in Russian loss. But as it will be shown later in this section, the occurrence of this error could be caused by a syntactic transfer from English, and as such it fits perfectly well with a new sentence structure, no matter how severe this new structure might violate the Russian syntax. The similar finding with the incorrect use of accusative instead of nominative case as a result of English transfer was reported in Turian’s (1991) study.

Other errors in case markings have been noticed, like nominative case marking was used instead of instrumental (1 error):

(3) Ex:  *Malchik igraet s kot,
instead of Malchik igraet s kot-om
The boy is playing with a cat.

Or accusative was used instead of prepositional

(4) Ex:  *Ja edy v shkolu na mashin-y
instead of Ja edu v shkolu na mashin-e
I go to school by a car,
However, no specific pattern in case errors was noticed. On the whole, case markings are still preserved and used correctly. Rather, random occurrence of such errors suggests that L1 loss is accompanied by a general confusion of a very complicated L1 system due to its disuse.

2.5.3 Changes in plural marking

Another focus of the morphological analysis was to see whether there is any early loss of plural vs. singular marking in S. speech. Contrary to English, Russian does not have such a clear cut distinction between number markings. As mentioned earlier, a Russian morpheme cannot be segmented into a suffix for number and suffix for case, and both plural and singular numbers are expressed through suffixes. Thus, it would be unlikely to expect any loss of plural markings in our case study. Such loss might have occurred, for example, in English or any other language that mark only plural nouns. A tendency to bring about linguistic simplification in those languages might result in the omission of plural markings.

Nevertheless, S. has demonstrated some confusion with number markings on verbs since session #6, or 11 months since her exposure to English. Number errors were detected in the picture naming task where she was supposed to name the action depicted in a flash card. During the first two sessions, she would specify the agent when naming the action, though it was not required by the task.
Later the agents were dropped out, but number markings were correct. And then from session #6 on, she started making number mistakes. Oftentimes, an action represented by a single agent was named in the plural (3 errors), or an action represented by a more than one agent was named in the singular (7 errors). Since no regular pattern of this kind of error was found and it was not registered in the picture description or story telling tasks, it could be perhaps explained by lack of attention to such "insignificant" details as number markings in the picture naming task when so much cognitive load was placed on retrieval of the words per se. However, a closer analysis of the data showed that the erroneous plural markings found in this study could be affected by the plural marking of the previously named word. These errors were found always to match the number marking of the preceding word.

But one number error which might be indicative of English interference should be mentioned here. One of the words in the picture naming task was the word "posud-a" (dishes), which belongs to the category of nouns used only in singular. These nouns have no plural forms and consequently must be used with singular modifiers, even when the meaning is obviously plural. Until session #7 this word had been correctly retrieved only in Russian and had not yet been acquired in English. In Session #7, the word was not
retrieved in Russian, but it was named for the first time in English. And at the very last session #8, S. named "dishes" correctly in English and incorrectly in Russian, using a plural number marking, "posud-y". It could indicate that a new acquired word in L2 interfered with the L1 word by having changed the number marking in the L1 name according to the pattern in the L2 equivalent.

This interference error violated the grammatical but not semantic aspect of the word and did not occur with another Russian noun, "chas-y" (watch/clock) which is used only in plural. Change of its ending into a singular suffix (or in this case, it would be zero suffix - "chas") in accordance with the English equivalent "watch/clock" used in singular would have changed the meaning of the word (i.e. in Russian ,"chas" means "hour"). We can hardly make any conclusions on the basis of a single error, but it could be hypothesized that morphological changes in L1 caused by L2 interference might be more likely to leave L1 semantics intact, at least, at the very early stage of L1 loss.

Altogether, the analysis of error on plural marking suggests that this type of error was registered at a very early stage of L1 forgetting and might become more abundant with time.

2.5.4 Generalization error

Another interesting category of errors was a generalization error which resulted in a change of the verb morphemes to correspond to a more regular
Pattern. For example, an inflection error was found in the verb ‘est’ (eat). This verb belongs to a category of verbs of special or mixed conjugation, that is, verbs fully deserving of the term “irregular”. The verb “est” has irregular conjugations in singular (1st person - em, 2nd - esh, 3rd - est), and a more regular endings in plural (e.g. 1st person - ed-im, 2nd - edi-te, 3rd - ed-jat), plus a stem consonant “s” changes into “d” in plural. In Russian, the most regular verb suffix for the 3rd person in singular is -it or -et (e.g. svist-it - whistle; naliva-et - pour; chita-et - read; otkryva-et - open; smotr-it - look, etc.). Until session (#5), S. did not show any difficulty in correctly naming the action represented by 3rd person agent (“est”). In session (#5), there was the first hesitation in naming the action when an incorrect “ed-it” following “svist-it” (whistle) was retrieved. The incorrect word was immediately rejected (“ed-it? No, I don’t know”) but the experimenter did not comment on that error. Then, in the next session (#6), the same incorrect word was retrieved after an extremely long pause (5060 ms.) but it was not rejected as incorrect that time. Long reaction time could be explained by the fact that S. detected some error but lost access to the correct word. It found support in the next two sessions, when the same picture was deliberately used to see whether the error would be self-corrected or would persist. The result of the last two sessions (#7, #8) did not support either of my predictions. S. neither used the same incorrect word nor accessed the correct one, she found a synonym “kusha-et” (eat)
to name the picture, which again took a very long RT (5130 ms. in #7 and 16410 ms. in #8). Long reaction time might be explained by S.'s awareness of the error in ed-it and her attempt to access the correct verb “est”. After a failure to do so, she came up with a synonymous term “kusha-et” which has a regular suffix -et.

The analysis of this error showed that an irregular form in a language can be replaced by a more regular one and can be eventually lost due to a person’s awareness of a malfunction of the decoding mechanism of memory. However, we do not have enough evidence on this type of error to warrant such claims.

2.5.5 Loss of a reflexive particle

Another morphological error was related to the reflexive particle for verbs. The reflexive particle - sja is used in Russian to differentiate reflexive verbs (“odevaet-sja” - getting dressed) from non-reflexive verbs (“odevaet” - dress or put on). A great many verbs have both the transitive, non-reflexive form, which takes a direct object in the accusative, and the intransitive, reflexive form, which cannot take a direct object. Lack of the reflexive particle in some verbs implies that the verb is used non-reflexively and thus it requires a complementary object to specify the action. It would be incorrect to say both in English and in Russian *“Ona odevaet” or *“She is dressing” (She is getting dressed), since the sentence is incomplete.
without an object. Ex: *Ona odevaet platje* (She is putting on a dress), or *Ona odevaet syna* (She is dressing her son).

However, I have to acknowledge that the error I am going to analyze now, can be considered a severe error only when it occurs in a sentence. Since the picture naming task did not require naming an action in a sentence form, the change observed here might be interesting only in terms of a morphological change which occurred with a particular verb across a few sessions.

The only particle omission error S. started to make since session (#5) on was an error with a reflexive verb "prichesyvaet-sja" (is brushing herself) which can be either in the intransitive, reflexive form ("prichesyvaet-sja" - is brushing herself) or the transitive, non-reflexive form ("prichesyvaet" - is brushing), the latter always takes an object, which specifies the action "prichesyvaet volosy" (is brushing her hair) or "prichesyvaet doch'" (is brushing her daughter). S.'s data showed that the reflexive particle "-sja" has been lost in this verb and a non-reflexive verb "prichesyvaet" (is brushing) was used without an object. This error would be more severe if it occurred in a sentence. Provided the nature of the picture naming task where the error was registered, it would not have been classified as a big error, no matter how weird it might sound to a native Russian speaker, unless S. had not used the reflexive form of the verb, which would be more acceptable in Russian, in the first few sessions. That was the only verb in
the picture naming task which could be used both as a reflexive (without an object) and non-reflexive (with an object) to describe the action. Other reflexive verbs used in the experiment were either the ones found only in reflexive forms, or those which could not be used as non-reflexive verbs due to the explicit "reflexive" nature of the depicted actions, like "kataet-sja na konjkah" (skating) rather than "kataet kalyasku" (pushing a stroller). Thus, we can offer a rather speculative interpretation of this error, that the omission of the reflexive particle in this example might be brought about by the process of attrition of an additional morphological marker (the verb "prichesyva-et-sja" has a prefix and two ending morphemes, one for the case and number, another for the indication of reflection) without damaging the grammatical and semantic aspect of the word. However, the insufficient evidence on this type of morphological error restrains us from making prediction as to what extent reflexive particle can suffer in the further language attrition.

2.5.6 Omission error with change of semantics

However, the analysis of another omission error found in this study has shown that loss of a morpheme caused the change of the word semantics. The verb "hvat-a-et" (is catching) in the singular 3rd person has two ending morphemes, one "-a" for indication of a verb (cf. noun "hvat-ka" - grasp), another "-et" for 3rd person singular verb of the first conjugation. In session (#5), S. named the action as "hvat-it" and then immediately rejected it as
incorrect but failed to provide the correct name. The word "hvat-it" is used in Russian as an adverbial modifier that means "enough". Thus we can see that omission of a morpheme damaged the semantics of the word, and it was recognized by the subject as an incorrect word, though the correct one could not be accessed at that time.

In general, the analysis of morphological changes by L1 loss has shown that Russian inflections are a vulnerable category which can be easily confused or lost in the contact with a non-inflectional language, like English. In addition, some morphological changes might indicate the presence of language transfer, where an L2 impact resulted in L1 changes reflecting the L2 grammatical pattern. However, it seems that loss of morphological markers at the early stage of L1 loss did not affect the semantic aspect of the language. Unfortunately, we cannot claim that semantics remains intact longer than morphology in a contact situation due to insufficient amount of the morphological data in the present study. The same reason does not let us make a conclusion as to what hypothesis on language forgetting, e.g. processing simplicity, interference, or markedness, might find support in this study.

2.6 Findings: Syntax

2.6.1 Objects in verbal phrases

One of the grammatical errors that was registered with verbal phrases might be indicative of English interference. The data obtained in the present
study showed that Russian verbal phrases may have lost their objects due to the absence of any objects in the similar English equivalents. To illustrate, English verbs “skiing”, “skating”, and “swinging” do not require any object, like “to ski skis” or “to swing on swings” since each verb represents a separate concept. In Russian, on the contrary, the same reflexive verb “kataetsja” (riding) refers to different actions and the difference is specified by an accompanying indirect object.

(6) Ex.: On kataetsja na lyzah (He is riding on skis)
    On kataetsja na konjkah (He is riding on skates)
    On kataetsja na kacheli (He is riding on swings)

The first few sessions, S. did not omit objects in these verbal phrases and the data from the English tests indicated that the English equivalents had not yet been learned. However, as soon as she acquired these verbs in English (session #4), the Russian verb “kataetsya” was applied to all three different actions. When asked for clarification (Na chem? - On what?) she would not have any difficulty in naming the object, whether it was “kachel” (swing) or “konjki” (skates). Moreover, when both “skating” and “skiing” were included in the same last session with 15 other intervening action pictures and an object (“konjki” - skates) in Russian was cued by the researcher’s question, the next verb “skiing” was named correctly, though the object was added after some pause.

The analysis of this type of error has shown that loss of some items in the first language could be caused by the tendency to transfer the rules of a
second language on the first language rather than by inaccessibility of those items in L1. This error was detected at the early stage of language forgetting, when the transfer did occur but the accessibility of a correct form was not severely impaired.

2.6.2 Word order in English and Russian

The syntactic changes in L1 have been registered in two major fields: word order and sentence structure. Remember, that word order changes by L1 loss were reported in an earlier study (Scaufeli, 1996).

It would be easier to understand word order changes if I introduce this section with a brief comparative analysis of word order patterns in the two languages, English and Russian, to see whether a language transfer in the area of syntax occurred.

Word order is an important structural category which is generally considered in a typological analysis of languages. In English, an important aspect of basic semantic differentiation of sentences is carried by word order. In general, for a given meaning in English only one word order is possible. That is absolutely irrelevant in Russian. Thus, if we take an English sentence “The boy is reading a paper” and give all possible Russian equivalents in various permissible word orders, we will end up with English non-sentences (2, 3, 4, 5, 6):

(7) (1) Mal’chik chitajet gazetu (SVO)
    A boy is reading a paper
(2) Gazetu *chitajet* mal’chik (OVS)
a paper is reading a boy

(3) Chitaet *mal’chik gazetu* (VSO)
is reading a boy a paper

(4) Chitaet gazetu *mal’chik* (VOS)
is reading a paper a boy

(5) Malchik gazetu *chitaet* (SOV)
a boy a paper is reading

(6) Gazetu *malchik chitaet* (OSV)
a paper a boy is reading

For this reason, Russian is often referred to as a "free word order language". What this means is that differences in word order do not affect the basic semantics of the sentence. By contrast, English is a "fixed word order language" with subject-verb-object (SVO) arrangement. In such a language, differences in word order carry different meanings, and some word orders are not possible at all (Comrie, 1979). However, the visible flexibility of the Russian word order does not imply that there are no dominant word order patterns. Jakobson (1966: 268-269) says that

"the idea of dominance is not based on the more frequent occurrence of a given order: actually what is here introduced into the ‘order typology’ by the notion of dominance is a stylistic criterion. For example, of the six mathematically possible relative orders of nominal subject, verb, and nominal object - SVO, SOV, VSO, VOS, OSV, and OVS - all six occur in Russian .... yet only the order SVO is stylistically neutral, while all the ‘recessive alternatives’ are experienced by native speakers and listeners as diverse emphatic shifts".
Thus we can see that the dominant word order pattern in Russian will be the same as it is in English. The question that may arise is how Russian speakers keep apart those sentences which may be perceived as ambiguous:

(8) (1) mam-a pomogajet pap-e
    mom helps dad
(2) mam-e pomogajet pap-a
    dad helps mom

Russian does not use word order to distinguish subject from object. That is carried out by means of its morphology, that is subject and object have different case endings. But there are cases in Russian when nouns of a particular declension (e.g. decl.3) may have a zero ending in nominative and accusative cases. In those instances where subject and object have the same zero case ending the SVO word order will be used to avoid ambiguity:

(9) Mat' kupajet doch'
    Mother is bathing the daughter

and the reverse order will change the meaning of the sentence:

(10) Doch' kupajet mat'
    Daughter is bathing the mother

It will be interesting now to see whether there were any word order changes observed in the present study. But before we turn to examining the data I would like to point out that typological analysis are usually focused on subject-verb-object arrangement (SVO) and there is a controversy whether the word orders with indirect objects should be included in the
analysis. Since my concern was to see all possible changes in the Russian word order, it was decided to (1) to make a distinction between word orders with direct objects and word order with other sentence structures, e.g. indirect objects, adverbial modifiers, etc., which are going to be referred to as “O” and “X” respectively, (2) to focus on subject-verb position within any permissible word order, whether it involves direct or indirect object, and (3) to consider two-member sentences (subject-verb) as complete sentences.

2.6.3 Changes in word order

At the onset of the case study, we could predict that the less marked SVO word order might become dominant in the subject’s Russian structure due to suppression of other more marked orders in a contact situation, which would find support in the markedness hypothesis. The evidence in a study (Scaufeli, 1996) reported earlier in this paper could contribute to this prediction.

Free talks. The analysis of the early data gathered in the present study has shown that S. had a good mastery of the syntactic structure of Russian using all six variants of word order. The free talk task offered in the first session yielded 24 complete sentences which were not cued by the experimenter. The analysis of these sentences has shown that the distribution of word order patterns was following: SXV (5), XSV (4), SV (7), SVX (3), XVS (3), SVO (1), OVS (1). If we look at these patterns from
the perspective of subject-verb arrangement, we can see that the majority of the sentences (20) had a SV word order with only a few sentences (4) in VS word order. Here are two typical samples of spontaneous speech recorded in the first session.

(11) Ex: V tretie gruppe ja zila (XSV)  
In the third group I lived.  
Or: Tam u nas ne hodyat avtobusy (XVS)  
There at us did not run busses.

Unfortunately, as it has been already mentioned, the later data from the free talk task did not provide enough syntactic information for analysis due to the subject’s reluctance to speak Russian and her constant switching to English. Her motivation to speak Russian has dramatically decreased and no spontaneous speech could be recorded unless it was cued by some rigorous tasks like picture description, which left me with little “pure” Russian data for analysis.

The analysis of the free talk task in session (#7) based on the little available data revealed that out of 4 complete sentences, 2 were in SVX order, 1 in SVO, and 1 in XVS. It would be interesting to look at the sentence which deviated from the predominant subject-verb arrangement.

The researcher asked S. whether they have long recesses at school. Apparently, the word “peremenka” (recess) that S. used in a Russian school lost its meaning for S. and the word ‘recess’ became a more common term she accepted. Her response was the following:
(12) *U nas tam netu peremenki* (XVS).
    At us there is no recess.

And then she added:

(13) *Tam recess we have*
    There recess we have.

Code-switching in the second sentence automatically changes a verb-
subject word order in (#12) into a more acceptable English subject-verb
order in (#13), though the resulting XSV is still more typical of Russian than
English.

In any event, the analysis of samples from the free talk task has shown
that the diverse patterns of word order in the first session did not include
SVO word order, though subject-verb (SV) arrangement remained dominant.
However, the insufficient amount of data in later sessions does not allow
one to make any conclusions as to whether or not Russian word order has
become more structured due to the influence of the syntactic principles
underlying the English grammar.

**Picture description task.** However, the analysis of the data gathered
from the picture description task where the same pictures were used with
an interval of nine months has enabled me to compare word order changes
over that period of time. The same number of complete sentences referring
to the same part of the picture were chosen for analysis. The following data
was received:
session (#1) 12 sentences: 4 (SVO), 4 (SV), 1 (SVX), 2 (XVS), 1 (XSV);

session (#5) 12 sentences: 8 (SVO), 2 (SV), 2 (SVX).

As it is seen from this data, the number of SVO sentences has significantly changed and has become dominant in session (#5). However, in 7 instances of SVO order in the later session (#5) a grammatical violation occurred, which is going to be discussed later in this section (2.6.4). Thus we cannot claim that SVO word order dominance in the later session and absence of other word orders acceptable in Russian suggest loss of grammatical flexibility which occurred over that period of time. Word order change resulting from or produced by a syntactic violation in the language should not be considered separately from the grammatical aspect of the change. On the other hand, we cannot rule out another possibility that the shift to the SVO dominance might have produced the above syntactic violation. In either case, these two syntactic changes should be considered together.

Moreover, it remains unclear why there was no SVO order patterns in the free talk task before the onset of L1 loss, while SVO was found in the picture description task at that time. The only explanation I can provide for this phenomenon is that the nature of the picture description task allows less syntactic flexibility than the free talk task. The visual stimulus, like the picture, might add to a more structured pattern of word order due to a person's attempt to describe an isolated object in the picture with respect
to its name, location, associated action as well as its relation to the rest of the picture. (Ex: I see a house. It is big. A girl is sitting outside the house, etc.). Spontaneous speech, in contrast, is initiated by some mental imagery which might require less specificity and consequently, allow more syntactic flexibility.

If we go back to the syntactic analysis of the data gathered in the picture description task and compare two samples taken from the description of the same objects in the same picture within nine months we will see that the pattern of word order has changed.

Ex: (session #1)

(14) *Na dereve visit malchik* (XVS)
On the tree is hanging a boy

(15) *Tam sidit devochka* (XVS)
There is sitting a girl

(session #5)

(16) *Malchik visit na dereve* (SVX)
A boy is hanging on the tree

(17) *Devochka sidit na balkone* (SVX)
A girl is sitting on the balcony

The comparison of the sentence samples referring to the same objects and recorded at different intervals shows how L1 XVS word order has changed into SVX, which remains acceptable in both languages and the only possible choice in L2.
Thus, loss of syntactic flexibility in L1 word order could be explained by transfer from a more structurally rigid L2. An extensive exposure to L2 without any L1 input might have erased those syntactic patterns in L1 which were inconsistent with the syntactic principles in the dominant L2.

**Story-telling task.** Further evidence for a possible language transfer in the area of syntax has been found in the data gathered from the story telling task. The same Little Red Riding Hood story was offered twice, in session (#1) and, nine months later, in session (#5).

It should be mentioned that VSX word order is often used in Russian fairy-tales which can be compared with a word order acceptable in English folk tales genre (“Once upon a time there lived a king....”). In Russian story-telling, it would be more acceptable to use a sentence like:

(18) *Poshla devochka navestitj babushku* (VSO)
Went a girl to visit her grandma

rather than:

(19) *Devochka poshla navestitj babushku* (SVO)
A girl went to visit her grandma

The analysis of word order in story telling was based on 18 complete sentences in each version. The first S.’s version of Little Red Riding Hood registered 6 (SV), 2 (SOV), 2 (SVX), 2 (VS), 4 (SVO), 1 (VSX), and 1 (XSV) sentences. In other words, there were 3 sentences with VS arrangement and none of such sentences were found in the later session, when the same story was offered for the second time. The word order
distribution in the second version of the story was the following: 4 (SOV), 9 (SV), 2 (SVO), 2 (SVX), and 1 (SXV).

It is interesting also to note that a great amount of the story content had been lost by the time it was offered for the second time and the lost parts were either made up at this time or their recall was cued by the researcher. However, neither original parts nor made up parts in the story had sentences with verb-subject arrangement. Thus, the absence of VS word order, typical of any Russian fairy tale, in this session could be only partially explained by the loss of the content. It could be hypothesized that word order generally used in story-telling and atypical of everyday discourse might be encoded with the content. The loss of the content information might have also caused loss of syntactic information and the new content could have been decoded in accordance with a more acceptable SVO order. But it does not explain why the very beginning of the story, still well preserved in S.'s memory, does not have, at least, one opening sentence with VS order which was registered in the first session and which is pre-requisite in story-telling. It contradicts the hypothesis made earlier in this section that syntactic information might have been encoded with the content. The only possible explanation of this syntactic loss can be found in language transfer which occurred from L2 into L1 and caused VSO word order unacceptable in L2 to be replaced by SVO that is more acceptable in L2 and yet common in L1. However, we should not overestimate this
finding, since the syntactic data obtained in the same session shows that S. was still using word orders which would be unacceptable in English. Thus reduction in the word order variability might be only partially explained by the possible L2 transfer.

Moreover, there might be an argument that the VS arrangement in the English sentence “Once upon a time there lived a king....” is closely related to the Russian VS word order in story-telling and thus did not violate the VS principle and could not be responsible for any language change. However, it is unlikely that at the early stage of English acquisition S. had enough exposure to English folk stories and even if she did I doubt whether she could make such a far-going inference that it would be acceptable to change the rules in the language when you are telling a story.

Thus, the analysis of changes in word order by L1 loss in the story telling task provided further evidence of possible L2 interference into the L1 syntactic structure. However, we can offer another interpretation of this finding. The new word order preference did not violate the acceptable word order pattern in Russian, rather it resulted in using more common word orders at the expense of abandoning less frequent orders (e.g. VS arrangement). This can provide evidence for the markedness hypothesis and support the earlier reported study (Schaufeli,1996), that word order change will always move towards a consistent word order pattern in a language.
2.6.4 Changes in sentence structure

The most striking change in L1 sentence structure occurred with complements. Recall that it was that change which brought about/ or was caused by an increase in SVO sentences and case errors in the picture description task in session (#5).

In English, complement structure can be expressed in two ways: using an uninflected form of the verb after an object

(20) Ex: I see a boy run,

or using a reduced relative clause after an object

(21) Ex: I see a boy running

In Russian, only the second variant, a reduced relative clause would be appropriate, but even then an object supplementing the participle would be required.

(22) Ex: Ja vizu malchika beguzchego po trave
    I see a boy running across the grass,

rather than simply

(23) * Ja vizu malchika beguzchego
    I see a boy running

The absence of the complementary object would require the order of the words in such a sentence be changed, so that a participle would precede the main object,

(24) Ex: Ja vizu beguzchego malchika
    I see a running boy
But the English sentence (20) would be absolutely unacceptable in Russian. In other words, the sentence, like

(25) *Ja vizu malchik bezit
   *I see a boy runs

would violate the rules of the Russian sentence structure.

The present study has shown numerous cases where such a violation occurred. As it has been mentioned earlier, the researcher’s question “What do you see in this picture?” provoked direct answers to the question: “I see....”. But let us compare the samples from different sessions to see how the change occurred over the period of nine months.

In session (#1), a month after S. came to the US, she was asked to describe a picture. There were no syntactic violations registered at that time. Here is a sample from that session.

(26) Ex: (1) *Ja vizu dom. Tam sidit devocka.
   I see a house. There sits a girl.

(2) Ja vizu devochku. Ona padaet.
   I see a girl. She is falling down.

(3) Ja vizu derevo. A na dereve visit malchik.
   I see a tree. And on the tree is hanging a boy.

Now let us look at the samples of the same description part taken nine months later.

(27) Ex: (1) *Ja vizu devochku i the myshka sidit na balcony.
   I see a girl and a mouse sits on the balcony.

(2) *Ja vizu devocka padaet
   I see a girl falls down.
(3) *Ja vizu zajchik bezit.
   I see a bunny runs.

As we can see, all sentences from the later session resemble the structure of a typical English complex object which is unacceptable in Russian.

Moreover, sentence (27, 1) has two more irregularities which should be mentioned here. First, two objects following the same verb in this sentence ("devochk-a" - girl, and "myshk-a" - mouse) are used in different cases, "devochk-u" in accusative, and "myshk-a" in nominative, which is incorrect in Russian, which requires both direct objects taken by the same transitive verb be used in the same grammatical case. Second, the sentence shows an error which was very unlikely to occur. An English definite article "the" was used before a Russian noun ("the myshka"). However, it is unclear whether the word "myshka" (mouse) starts a new sentence which would make the both phrases grammatically correct (i.e. if we ignore the error with the definite article), or we again deal with the same grammatical violation due to the loss of control over the phrase which starts with "Ja vizu..." (I see...).

Going back to the observed violation of a Russian sentence structure, it would be much easier to find support for a syntactic transfer from English if we could trace such a structure in the insignificant amount of the English data available for analysis. Since the primary focus of the present study
was language forgetting and not language acquisition, only vocabulary acquisition was consistently tested across all sessions. The picture description task was offered only once in English and it did not show whether the English complex object structure had been well acquired to cause a syntactic change in the Russian equivalent.

However, we can conclude that both syntactic changes, the word order change and the violation of a sentence structure with complex objects, might be reflective of English interference into Russian syntax, when there is a restructuring of the first language according to grammatical principles found in the second.

2.6.5 Code-switching

Code switching, or intrusion of L2 elements into L1, is not necessarily indicative of attrition. Under normal conditions, the bilingual speaker is able to switch to one or the other of the two languages being mixed, depending on the topic or interlocutor of the discourse. Moreover, autonomy of the language is maintained so that each language is served by its own independent grammar (Seliger & Vago, 1991).

However, I would argue that at least in two cases code switching may cause severe first language loss: first, when it is extensively used by a speaker; second, when it is used by a child whose first language development has not yet established.
Eight months from her arrival to the US., S. tended to switch to English even within the Russian part of the session, though these switches occurred across large discourse units rather than within a sentence and should not be considered as code-switching. For example, negation in English ("I don't know") replaced the Russian negation ("Ja ne znaju") which had been exclusively used in the first four sessions. In addition, the free talk task offered in session (#6) ended up with six sentences in English and only three in Russian, though the experimenter’s questions were only in Russian and S. did not show any problems with Russian comprehension. However, this particular example illustrates a dramatically decreased motivation to speak Russian rather than code-switching.

One of the typical examples of code-switching has been shown earlier when we discussed the changes with word order patterns:

(28) Ex.: Tam recess we have
       There recess we have.

This particular example does not support the idea of each language being served by its independent grammar, since an English object “recess” is placed before the verb which is not common in English.

The following two examples are consistent with the above mentioned hypothesis that code-switching is governed by the grammatical principles of the dominant language of the phrase.
(29) Ex.: (1) *Ja vizu garaz open.*
I see a garage open

(S.'s answer to the question: Do you get a lot of homework to do?)

(2) *Net, oni zadajut toliko....(pause) na Fridays.*
No, they assign only ........ on Fridays.

It should be mentioned that code-switching in sentence (29, 3) caused insertion of two English elements, the noun "Friday" and the preposition "on", but the latter was directly translated into Russian and brought about an error, the incorrect preposition "na" which is never used with time modifiers. The correct preposition would be "po" ("po pjatnitzam" - on Fridays).

In the literature, code switching is distinguished from code blending, the latter is characterized by combining morphemes from one language with morphemes of another language within a single word while the phonological features of the respective source language are retained. There were a few examples of code blending in this case study. For example, an attempt to retrieve the word "knitting" in English ended up with "sheatting" from the Russian "sheat'" ("sew") and the English suffix "-ing", or an action picture representing "baking" (which was found ambiguous and was later excluded from the analysis) was named "put-it cookies", where the Russian 3"d person verb morpheme "-it" was added to the English verb "put". 

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Other interesting examples of code switching observed in the present study concerned retrieval of the vocabulary items in the wrong language; these will be discussed later in this chapter.

In general, the analysis of code-switching has shown that it has been extensively used with time as a compensatory strategy in the process of L1 attrition rather than as a conventional method of communication between two bilinguals speaking the same two languages. Since S.’s only exposure to Russian was limited to my brief monthly visits, it could hardly be expected that she had developed a habit of code-switching which would be common in any other bilingual situation. S.’s switching to English could be explained only by the fact that Russian has become less accessible than English and the failure to access it brought about switching to English. However, the issue of language accessibility will be discussed later, when we look at the data obtained in other tasks that were employed in this study.

2.7 Findings: Vocabulary

2.7.1 General trends

The data on the picture naming task were plotted on two separate charts. One (Fig. 2.1) shows the amount of L1 retention and L2 acquisition across the seven sessions when the task was offered. Another (Fig.2.2)
shows the same two processes in terms of reaction time registered at each session. It should be acknowledged, however, that the lack of any advanced measuring technique available for the research might result in inadequate accuracy of the reaction time data (i.e. a regular stop watch...
was used). Thus, it should be taken as an additional measure in interpretation of the data rather than the major indicator of forgetting.

The analysis of the forgetting curve with respect to the acquisition curve (Fig.2.1) shows that L1 retention gradually decreases for the first four sessions and then stabilizes, while L2 acquisition sharply increases between sessions #3 and #4 and then remains almost unchanged. The inspection of the RT curve (Fig.2.2) shows that L1 retention is characterized by an irregular increase, i.e. it becomes slower with time, while L2 acquisition has a flat pattern across all sessions and does not change across sessions. The latter might come from the fact that English (L2) was always offered second, which might have facilitated the lexical access of L2 words after the concepts had been already named in L1.

Also, the last session (#8) shows a slight increase in the amount of L1 retention which is inconsistent with our expectations. This result could be explained by the fact that S. had a very high motivation to do her best during the last session. Apparently, it was caused by the fact that before the session began she was thanked for her participation in the study and given a nice present. Thus, motivation to do as well as she could in both languages to “please” her experimenter could partially account for this unexpected result. Also, the slower RT on that session for both language tasks could come from S.’s being more careful in correctly recalling the words.
In general, the analysis of the curves showed that the rate of L1 forgetting is slower than the rate of L2 acquisition and has a smoother pattern. As to the RT pattern, it seems to be consistent with the general trends, i.e. decrease in the amount of language retention/acquisition is accompanied by slower RT, whereas the increase in the amount of retention/acquisition results in faster RT. Moreover, RT trend for L2 acquisition is more regular than for L1 retention. In order to see what might have affected the general patterns of the above curves, we will break down the data into nouns and verbs and examine both word categories separately.

2.7.2 Nouns vs. Verbs

The separate graphs represent loss/acquisition of nouns and verbs, e.g. Fig.2.3 illustrates nouns, and Fig. 2.5 represents verbs. Moreover, Fig. 2.4 shows RT on nouns, whereas Fig.2.6 illustrates RT on verbs.

The comparison of loss/acquisition curves of the noun category shows that both the loss and acquisition patterns resemble those of the general curves discussed above, i.e. L1 retention on nouns gradually decreases across sessions, while L2 acquisition sharply increases between sessions #3 and #4, and then remains almost unchanged. As to the RT data, it yielded even a more irregular pattern for L1, indicating slowing down with time. RT on L2, on the contrary, shows a consistently flat pattern.
If we look now at the graph representing loss/acquisition of verbs (Fig. 2.5 and 2.6), we will see that these curves differ from those on nouns. As the below charts demonstrate, there is a delay in verb acquisition compared to nouns, which eventually reaches the nouns level in session #5 and then it
seems to stabilize and remain flat. L1 verbs, on the contrary, demonstrate good initial retention until there is a drop in retention between sessions #3 and #5 and then the curve remains almost unchanged. The RT curves
show that the RT on L2 verbs in the early sessions (#2-3) is slower than on L1 verbs, and then it becomes faster and remains almost unchanged till the last session; while the RT on L1 verbs, though not as irregular as it is on nouns, increases across sessions. The highest L1 loss in session #5 is accompanied by the slowest RT.

If we now compare noun and verbs in terms of their retention/acquisition, it is obvious that verbs were better retained and acquired more slowly than nouns for the first two sessions, and their ultimate L1 retention in session #8 was higher than that of nouns, though the process of L2 verb acquisition paralleled that of the nouns in the last session.

Thus, the above analysis suggests that loss and acquisition of two separate categories within a language might follow different patterns, with nouns learned and lost before verbs. But ultimately both patterns fit the same general picture, where there is an increase of L2 acquisition and L1 loss with time. L1 loss is reflected, in turn, in a poorer accessibility of the lexical items which can be seen from the RT data.

If we get away now from the general observations on vocabulary loss registered in the present study and take a closer look at the data, we can get a better understanding of what lexical items might be more susceptible to loss.
2.7.3 Across item analysis

The focus of across item analysis was to see (1) whether there were any specific categories of words which tend to be lost faster, like low vs. high frequency words, cognates, etc., (2) whether acquisition of the words in L2 might be a pre-requisite for loss of their equivalents in L1; (3) and whether the amount of retrieval practice might account for a better retention of L1 words. This analysis will be limited to nouns, since they revealed a more interesting and regular results than verbs.

There were 83 nouns chosen for analysis. The table illustrating the data obtained on these nouns in different vocabulary tasks can be found in appendix (Table A.1 and A.2). The inspection of the data was aimed at revealing those words which were either found to be lost in a few test sessions, or those which showed a significant RT increase across all sessions, or those which demonstrated an unusual pattern of loss. RT increase in word retrieval was considered an important indicator of low accessibility of lexical items in memory.

Three categories of the words that turned out to be most vulnerable to loss have been found in the present study, i.e. cognates, non-distinguished categories, and a few high frequency words.

2.7.4 Cognates

Cognates are words which have the same origin, retain the same semantic meaning and similar phonology in different languages. There were...
a few nouns in the study which could be considered cognates: [ti:ger] - "tiger", [flaːɡ] - "flag", [raketa] - "rocket", [zebra] - "zebra", [maska] - "mask", [telefon] - "telephone", [tri] - "three", [kot] - "cat", and three words which can be considered non-direct cognates (whale, duck, lion), or as they are called here 'near-cognates', and they will be discussed later.

It should be mentioned that one of the cognates [flag] -"flag" was always named in Russian using a diminutive suffix "-ok" which made it sound differently from its English counterpart (cf. "flazok"- flag). Thus it was surprising to find loss in this particular case where a direct cognate turned into a word phonologically less related to its English equivalent and yet was lost. Table 2.5 represents loss/acquisition of cognates reflected in different tasks. The following clarifies the notation in the table.

Predominantly the data was taken from the picture naming task unless indicated otherwise. Thus, "free choice" - L2 would mean that in the free choice task the word was recalled in L2, or "language blocking" - L1 would mean that the word was used in the blocking task (Recall that in this task, the only language the subject was supposed to use was L1). In case the word was retrieved in the wrong language the indication of this language is given in parenthesis, e.g. L1 (L2) means that the word was named in English (L2) instead of Russian (L1) in the Russian part of the test, and vice versa if it is L2 (L1), e.g. the word was named in Russian (L1) in the English (L2) part of the test. RT is given for the instances the word was named,
and N/A means that the word was not included in the set of pictures used
in that particular session.

The general overview of the above Table 2.5 suggests that most cognates
were either not retrieved in Russian, or were replaced by their English
equivalents, or were hard to access, which is seen from the RT data. For
example, if we look at the first cognate “flag” in the table we can see that
in session (#2) it took 3880 ms. to be named in Russian and when it was
offered in the English part of the task it was again named in Russian, but
this time it took 1060 ms. Next session (#3) it took 1970 ms. to be named
in Russian and 810 ms. to be named in English. Session (#4) revealed that
the name in Russian was not retrieved. There was an attempt to name it in
English in the Russian part of the task, but S. rejected it after she probably
had realized that it comes from the wrong language. But it was correctly
named in English (1150 ms.). In session (#5) the word was named in
Russian after a pause of 7720 ms. and it was named much faster in English
(1120 ms.). In session (#6) the word was again not recalled in Russian and
correctly named in English (690 ms.). Session (#7) showed that again the
Russian name for “flag” was inaccessible and this time it was retrieved in
the wrong language in the English part (650 ms.). It is interesting to notice
that though it was named in Russian this time it did not have a diminutive
suffix -ok which S. always used for naming this concept in Russian. But the
phonetic pattern of the word was undoubtedly Russian. The last session
Table 2.5 Cognates across sessions

<table>
<thead>
<tr>
<th>Name</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
<th>#6</th>
<th>#7</th>
<th>#8</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>/ RT</td>
<td>(ms.)</td>
<td>in L1/L2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>tiger</td>
<td>N/A</td>
<td>L1: 1500</td>
<td>L1: 2400</td>
<td>L1: 3150</td>
<td>L1: 3150</td>
<td>free choice - L2: 1280</td>
<td>L1: 1100</td>
</tr>
<tr>
<td>mask</td>
<td>L1: 6750</td>
<td>L1: 3840</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>free choice - L2: 1120</td>
<td>L1: 3930</td>
</tr>
<tr>
<td></td>
<td>L2: not retrieved</td>
<td>L2: 1500</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>L2: 750</td>
<td></td>
</tr>
<tr>
<td>rocket</td>
<td>N/A</td>
<td>L1: 1800</td>
<td>N/A</td>
<td>free choice - N/A</td>
<td>N/A</td>
<td>L1: 4390</td>
<td>L1: 3250</td>
</tr>
<tr>
<td>three</td>
<td>N/A</td>
<td>N/A</td>
<td>L1: 1340</td>
<td>L1: 1840</td>
<td>N/A</td>
<td>N/A</td>
<td>L1: 690</td>
</tr>
<tr>
<td></td>
<td>L2: 1720</td>
<td>L2: 980</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>free choice - L2: 4320</td>
<td></td>
</tr>
<tr>
<td></td>
<td>L2: 1720</td>
<td>L2: 980</td>
<td>N/A</td>
<td>N/A</td>
<td>N/A</td>
<td>L1: 1250</td>
<td>L1: 1250</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
(#8) showed a much longer RT (6630 ms.) for recalling the name in Russian than in English (470 ms.).

In order to illustrate cognates loss, each cognate was matched with a word which was of the same frequency range and which did not fall into any vulnerable categories found in the present study. An across cognate analysis has shown that in 37% of cognate instances the L1 names were either not recalled, or named in the wrong language or were less accessible than their L2 counterparts (see the data from the free choice task), while none of the equal frequency words were reported lost or named in the wrong language, and only in 4% instances those words were preferred to be named in L2 in the free choice task. The RT analysis showed that L1 names were retrieved slower than L2 names, e.g. the mean RT was 3300 ms. for the Russian cognates (cf.: 1865 ms for non-cognates) and 1120 ms. for the English cognates (cf.: 1332 for non-cognates). In addition, in case of cognates, S. frequently indicated that she did not know the word in Russian before she could actually recall it in Russian.

However, three things should be acknowledged. First, the faster RT in L2 could be explained by the fact that L2 was always offered after L1 and that might facilitate lexical retrieval in L2 since the concept had been already accessed in the L1 part. Thus, RT comparison should be made across sessions within the same language rather than across languages within the same session. Then, it remains unclear whether S. was familiar with the
Russian word for "zebra", since this word has never been retrieved in Russian and it should not be considered as a good example of cognates loss. And finally, confusion with cognates has affected not only L1 but also L2, though the latter had far fewer instances of using the wrong language (19%).

It is interesting to notice that the earlier the English word was acquired (Ex.: flag, tiger, zebra, duck, lion) the faster its Russian equivalent became inaccessible or got mixed up with its L2 counterpart. In contrast, the later acquired cognates in L2 (Ex.: mask, rocket, dolphin) seemed not to affect the retention of the L1 equivalents. However, the early acquisition of the English "cat" did not impair retention of the Russian "kot" which contradicts the above statement. Moreover, we do not know whether the English counterparts for two other cognates, "telephone" and "three" had been acquired at the earlier stage of L2 acquisition since they were introduced and named in L2 for the first time only in session (#4). Thus, based on the above discussed data, we could partially hypothesize that an extensive exposure to L2 at a very early stage of L2 acquisition when the L1 input is terminated could lead to an early loss of those L1 words which happen to be semantically and phonologically related to their L2 equivalents. These words (1) may be replaced by their L2 counterparts and accepted as original L1 words, (2) or may get inaccessible due to a person’s awareness that a word is being retrieved in the wrong language and as such
it may be rejected, (3) or the accessibility to such a word in L1 might be extremely difficult which could eventually result in loss.

There were three other words which cannot be called direct cognates but I would nevertheless like to discuss them in this section. One of them is the word [lev] - "lion", which is not a close phonologically related word, since it shares only one onset phoneme with the English equivalent "lion". It was one of the first words S. lost very fast and easily replaced it with the English "lion". It is unclear whether she found that the English "lion" sounds so familiar to her that she did not even notice that it comes from the wrong language or whether there was another reason for such a fast erasure of the Russian name for this concept and its complete replacement by the English equivalent.

Another word which falls out of the cognate category is the word "duck" which S. used to name a "goose". Russian 'gus' is a cognate of English "goose". However, because of the similarity between the two concepts, "goose" and "duck", there was some category confusion in trying to access the right word.

And the last word included in the category of near cognates is the word "kit" (whale) which was named correctly in L1 only once, in session (#2) when it was not yet acquired in L2. Then it was incorrectly named in L2 as "dolphin" (session #3) and since then in both languages it has been called as "delfin" (L1) / "dolphin" (L2), which are direct cognates.

109

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Table 2.6 Near-cognates across sessions

<table>
<thead>
<tr>
<th>Name/RT (ms.) in L1/L2</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
<th>#6</th>
<th>#7</th>
<th>#8</th>
</tr>
</thead>
<tbody>
<tr>
<td>dolphin (whale) N/A</td>
<td>L1: 1600</td>
<td>free choice - L2: 1720 (dolphin)</td>
<td>blocking L1: 2060 (delfin)</td>
<td>L1: 6750 (delfin)</td>
<td>L1: 870 (delfin)</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>L2: 600</td>
<td>L2: 880</td>
<td>L2: 750</td>
<td>L2: 690</td>
<td>L2: 1880</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If we look at the Table 2.6 representing near-cognates we will see that the overall picture with non-cognates resembles that of cognates. The words were either not recalled in Russian, or were replaced by the L2 equivalents, or were preferred to be named in L2. However, the comparison of the RT data for both languages yielded the difference which was not as big as for cognates (e.g. 3230 ms. in L1 and 2090 ms. in L2). Since the nature of the confusion with the near cognates could be due to the mechanisms different from those responsible for the loss of the real cognates, we have to be careful in the interpretation of these results.

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
To summarize, the overall analysis of the data on cognates and near-cognates suggests that the words semantically and phonologically related in both languages can become inaccessible in L1 and either get replaced by their L2 equivalents or require extremely long time to be correctly named in L1, or are said to be forgotten.

2.7.5 Non-distinguished categories

Another interesting group of words vulnerable to forgetting was the non-distinguished category of words, or those words which represent similar concepts that are not distinguished lexically. For example, in Russian one name stands for two concepts, like table-desk ("stol"), watch-clock ("chasy"), ladder-staircase ("lesteńtza"), bed-crib ("krovat'"), float-swim ("płavaet") while in English there is a clear lexical distinction between the members of each pair. The across item analysis of the data in the present study has shown that S. did not have a problem of correctly naming these non-distinguished objects until she probably realized that a different name is used in English for each concept. That made her ascribe the first learned L2 name to one of the members of the category which resulted later in the inaccessibility of the name for that object in L1. There were two pairs of so-called non-distinguished categories used in the study. Table 2.7 illustrates the data on these words.

The analysis of the two pairs of non-distinguished categories shows that one of the words in each pair, that is "clock" and "stairs" was reported
<table>
<thead>
<tr>
<th>session /word</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
<th>6</th>
<th>7</th>
<th>8</th>
</tr>
</thead>
<tbody>
<tr>
<td>clock</td>
<td>L1: 1160</td>
<td>L1: 980</td>
<td>L1: (L2) 5220</td>
<td>L1: 7680</td>
<td>N/A</td>
<td>free choice</td>
<td>L1: not retrieved</td>
</tr>
<tr>
<td>stairs</td>
<td>N/A</td>
<td>L1: 970</td>
<td>L1: 960</td>
<td>L1: 1530</td>
<td>N/A</td>
<td>L1: not retrieved</td>
<td>L1: 9100</td>
</tr>
<tr>
<td>ladder</td>
<td>L1: 910</td>
<td>L1: 1310</td>
<td>N/A</td>
<td>free choice</td>
<td>L1: 750</td>
<td>free choice</td>
<td>L1: 780</td>
</tr>
<tr>
<td></td>
<td>L2: not retrieved</td>
<td>L2: not retrieved</td>
<td>(‘stairs’): 3530</td>
<td>L2: not retrieved</td>
<td>L2: 5380</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

lost, at least, in one of the sessions, while another word, that is “watch” and “ladder” showed good retention in L1 with faster RT in their retrieval.

Comparing the above two examples, it is interesting to notice that the L2 name which was acquired first was initially ascribed to both concepts in the English part of the test (e.g. ‘watch’ and ‘clock’ would be named ‘clock’), then only one concept was named with this word in English and it was this concept which got eventually inaccessible or hard to access in Russian. We can hypothesize that a new notion of distinction acquired in L2 was transferred to the L1 non-distinguished categories and caused inaccessibility of one of the members in L1 concept pairs, and the
inaccessible L1 item was the one which was the first to be acquired in L2 and the first to be falsely recognized as lexically different from its L1 counterpart. But the insignificant amount of data on non-distinguished categories does not allow us to make any strong claims.

Unfortunately, at the onset of the study there were no predictions made that non-distinguished categories might happen to be susceptible to loss and as a result, no other complete pairs were included in the set of the stimuli. Thus we can just make a very speculative judgement that a reason for a long RT in recalling the name “stol” for “desk” (8750 ms. in session #7) and a preference to name this concept in English (session #5) might be grounded in the problem with non-distinguished categories. However, absence of another member of the pair (“table”) which would be also called “stol” in Russian does not allow us to go further with making any conclusions. The future research on L1 forgetting should further explore the present finding.

2.7.6 Loss of high frequency words

Further analysis of the data was based on examining the rest of the nouns used in the study, i.e. those nouns which did not fall into the category of cognates, near-cognates, and non-distinguished categories, which were discussed above. Moreover, the words which were never named in L1 across all sessions and tasks were excluded from the analysis. Table 2.8 illustrates data on the rest of the words in terms of the frequency
of their occurrence (Kucera & Francis, 1967), frequency of their loss (how many words were either not recalled in the picture naming task or preferred to be named in L2 in a free choice task), and poor accessibility which is reflected in slow RT across all sessions (more than 3000 ms). Moreover, each word category will be specified in terms of L2 acquisition, i.e. the information on how many words acquired their L2 labels is also included in the Table 2.8. It should be acknowledged that the distinction between low and high frequency words in the present study was arbitrarily based on the frequency range of 20, which brought about 27 low-frequency words (frequency range of 1-20), compared to 40 high-frequency words (frequency above 20, that was 20-610 in our case).

Table 2.8 Word frequency and word accessibility

<table>
<thead>
<tr>
<th>Word frequency</th>
<th>No recall in L1</th>
<th>Preferred to be named in L2</th>
<th>Poor word accessibility in L1 (RT longer than 3000 ms)</th>
<th>L2 label (not acquired)</th>
</tr>
</thead>
<tbody>
<tr>
<td>High-frequency (20 and above) - 40 words</td>
<td>11 words (28%)</td>
<td>21 words (53%)</td>
<td>12 words (30%)</td>
<td>1 word (3%)</td>
</tr>
<tr>
<td>Low frequency (1-20) - 27 words</td>
<td>5 words (19%)</td>
<td>9 words (33%)</td>
<td>8 (30%)</td>
<td>7 words (26%)</td>
</tr>
</tbody>
</table>

The analysis of the nouns in Table 2.8 indicates that high frequency words were more often lost in at least one session or preferentially named in L2 than low-frequency words, though the accessibility in terms of RT remained the same across both categories. On the other hand, if we look at the percentage of the words which were never learned in L2, we would see
that there were more low- than high-frequency words which were never acquired in L2. Thus it might suggest that inaccessibility of L1 words is affected by the acquisition of the equivalent L2 label.

The findings in other studies on first language loss (Leyen, 1984; Olshtein & Barzilay, 1991) revealed a higher likelihood for low-frequency lexicon be lost over time. There was no evidence reported in the literature that high frequency words may become more vulnerable to loss than low-frequency words.

It could be expected that low frequency words in L1 would be subject to a faster loss than high frequency words, based on the findings in the earlier studies (Leyen, 1984; Olshtain & Barzilay, 1991). On the contrary, S. demonstrated a very good retention of vocabulary which might be considered low frequency with respect to other items used in this study, words like “camel” (1), “owl” (2), “hammer” (9). In contrast, words like “flower” (23), “shirt” (27), “bread” (41), “cup” (45), “box” (70), “boat” (72), “money” (265), “door” (312), were either not recalled, at least, once or were extremely hard to access. A more careful analysis of the data concerning these words has shown that all words reported not recalled in L1 or those words which took long RT for retrieval were the words that acquired their L2 equivalent very early in this study. In contrast, the words retained better in L1 were those which either were never learned in L2 or were acquired at the very last session. That provides evidence for the
earlier made hypothesis that one of the reasons of L1 loss might be a semantic overlap between the equivalents in the two languages rather than word frequency per se.

But going back to the problem of low- vs. high-frequency words, the question is why the results of this study might differ from the findings in the previous studies? The explanation of the finding in this study which contradicts the earlier reported data in the literature can be found in the uniqueness of the subject of this research and unusual conditions of her language exposure. Loss of low-frequency words reported in other studies was found among the bilinguals who still had an L1 input, no matter how limited it was, who spoke two languages and whose vocabulary retention was tested after a few years of an extensive exposure to L2. In other words, they were exposed to both languages, though the extent of exposure was different. In such a situation low-frequency words may disappear faster than high-frequency words due to an infrequent use of these words in L1. The acquisition of those low-frequency words in L2 has never been tested in the previous studies. Thus it remains unclear whether the subjects knew those words in L2 or they simply lost access to the lexical label of an object in L1 without having learned a new name in L2.

The difference of the present study, as it has been emphasized earlier, is that (1) the subject’s exposure to L1 was terminated as soon as she came to the US, (2) the linguistic observation of the subject started at a very
early stage of L1 loss and L2 acquisition, and (3) both forgetting and acquisition of the same set of vocabulary items were tested over the period of one year. In such a unique situation, it would be surprising to expect that a certain category of words would be lost faster than another category due to their infrequent use or disuse. On the contrary, all categories were placed in an equal experimental setting and they were never used beyond the session time. Thus, an argument that low-frequency words in L1 might be lost faster than high-frequency words due to their low frequency use does not seem to be relevant to the present study. The only sound explanation of this result could be found in the hypothesis that longer retention of some vocabulary units in L1 at the early stage of L1 loss might be determined by a certain delay in acquisition of L2 equivalents for the low-frequency concepts.

2.7.7 Retrieval practice and forgetting

One of the concerns of the present study was to see whether the amount of exposure to a word, no matter how limited it might be in the circumstances of this unique linguistic situation, could affect L1 retention.

The analysis of the data has shown that 23% of the nouns were used in all seven sessions when the vocabulary tasks were offered and only 6% revealed good L1 retention, whereas 17% of the words repeatedly introduced in every session were eventually lost or caused a retrieval problem. Thus, the amount of retrieval practice did not seem to determine
the level of retention. For example, the word “flower” showed signs of loss very early in this study and was offered in every session to test the hypothesis that amount of retrieval practice might improve L1 retention. The gradual increase of RT from 2980 ms (session #2) to 7190 ms (session #8) in naming this concept in Russian proved that retrieval practice per se does not add to a better memory for words. The same applies to the word “money” which was offered across six session and demonstrated an increase in RT from 1280 ms (session #4) to 18150 ms (session #8).

2.7.8 Within category confusion

The observation of the subject’s responses in naming pictures has shown that semantic within category confusion affected not only cognates and non-distinguished categories discussed above but other vocabulary items. For example, a picture of a bench was correctly named in Russian only once, the third time it was offered (session #3). The Russian name “divan” (sofa) was used instead (sessions #2,3) until eventually it got inaccessible (session #8) in L1 and the picture was named only once in L2 (free choice task, session #7) as “couch”. The name “botinki” (boots) caused a retrieval problem (4250 ms) in session #4 after which it was replaced by a word “bosonozki” (sandals) in sessions #6 and #8. A picture of “deer” was named as “oslik” (donkey) in session #2, “olen’” (deer) in session #3, again as “oslik” (donkey) in session #5 and then was not retrieved at all (session #8). The same last session when it was not
retrieved in L1 it was named for the first time in L2 with an incorrect label "kangaroo". A picture of a queen revealed a retrieval problem in session (#7) when the RT in the blocking task was 6410 ms. and then it was incorrectly named as "director" (director) in L1 in the last session. A picture of a sink was labeled as "kran" (tap) in L1 in session #3 and remained unnamed in L2. Then it was chosen to be named in L2 as "tap" in the free choice task offered in sessions #5 and #6 and was reported unnamed in L1 in session #7. That time it was correctly named in L2. Next session #8 it was still correctly named in L2 and caused long RT (7130 ms.) to retrieve the same semantic relative "kran" (tap) in L1.

The analysis of these errors suggests that semantic within category confusion could be brought about by some pictures ambiguity, where S. might have a problem not to access the target word but to figure out the depicted concept. And if so, then the retrieval of a semantic relative, which actually affected both languages, has little to do with L1 forgetting.

2.7.9 Idiosyncratic findings

There were a few pictures in the study which have never been named in Russian and thus were later excluded from the experiment (e.g. "hose", "cage"). But there were also a few words which produced odd results that cannot be reasonably explained. One of them was the word "tzerkov" (church). Until the session (#5) the picture of a church remained unnamed in either of the two languages, which suggested that S. had not yet
learned the word in English and probably had never been exposed to this concept in Russian to be familiar with its name. In session (#5) the word was named in English for the first time and was still rejected in Russian. In session (#6) acquisition of the word was reported in L2 when the concept was offered in the free choice task. Then, quite surprisingly, in session (#7) it was named in both languages, though it took a long RT (7280 ms.) to be named in Russian. Next session (#8), the word was named again in both languages and this time RT in L1 was much shorter (2220 ms.). Taking into consideration the fact that S. did not have any L1 input beyond the session time and during the session the unnamed pictures were never prompted by an experimenter, it seems unlikely that the word was later cued by any L1 exposure. That means that S. knew the word but could not relate it to the picture until the L2 equivalent for the same picture was learned or probably until she was exposed to the concept of church beyond this experimental study.

Why did it happen? It can hardly be explained by any existing theories of language acquisition and forgetting. The only explanation which can be suggested is that a picture of a church illustrated a structure well known to any person of the western cultural background as a typical church and still it was rather atypical picture for the Russian concept of orthodox Christianity. Thus, there is a possibility that it took S. some time to figure
that the picture, no matter how architecturally it might differ from her idea of a church, represents the concept she knows in Russian.

However, another unnamed word, "chicken", was never recalled in Russian. It was used in different tasks across few sessions and still remained unnamed in L1. It is quite unlikely that S. did not know the word in L1. Coming from a small Russian town with lots of chickens and absolutely no camels which might have been walking along the streets, it was surprising to find that she well remembered the Russian word for "camel" and could not name a "chicken" at least once in L1. That was a very odd observation which cannot be easily explained. Yet we cannot claim any forgetting of those words which were never recalled in L1.

2.7.10 Level of language activation

Free choice task. One of the tasks employed in the present study was the so called ‘free choice’ task. Starting with session #4 through the last session #8, a set of 20 object pictures not used in any other task of the session were offered for naming in either of the two languages. S. was asked to name the pictures as fast as she could in whatever language comes to mind first. Preference in naming a picture in a particular language would indicate a better accessibility of that language. RT was measured as in the picture naming task. The aim of this task was (1) to test the level of accessibility, or activation of the two languages, (2) to see whether there is
any specific pattern in activation of the languages, and (3) to provide additional data for the across item analysis.

Fig. 2.7 Language activation (%)

Fig. 2.8 Language activation (RT)

The data obtained through this task was plotted on two separate graphs, i.e. one shows accessibility in terms of the percentage of words named in
each language (Fig. 2.7), another represents RT data from the free choice task (Fig 2.8).

As it is seen from Fig. 2.7, accessibility of both languages remained almost the same across 5 sessions, with Russian (L1) showing a little better activation than English (L2) until the very last session when there was a drop in Russian activation and an increase in activation of English. However, if we look at the RT chart (Fig. 2.8), it shows a much slower RT on naming the concepts in Russian in all but one session. The latter revealed the same RT for both languages. Yet the last session #8 showed that RT on Russian words slowed tremendously compared to English, which suggests that the activation of the Russian words was much harder than English, and there were more words named in L2 in that session.

This finding provides evidence of poorer L1 accessibility with more exposure to L2, that is the shift to a higher activation of English occurred in the 13th month after S. moved to the US.

Why was poor accessibility of L1 found only in the RT data and was not reflected in the amount of words named in each language? It can be interpreted from two different perspectives. If we look at it from the L2 acquisition point of view it is clear that about 50% of the words were preferred to be named in English, and at the last session the percentage was even higher. It can be indicative of a higher accessibility of L2 with time. On the other hand, only approximately 50% of the words were still
named in L1, which shows that the preference of which language to use was no longer with the native language; it was shared between the two languages.

There was no specific pattern of language activation found in the data. The first rough analysis suggested that there might be some pattern. That is, activation of one language store might have resulted in naming a few items in this language before switching to another language where the sequence would repeat again. However, in 21% of picture naming instances in this task a word would be recalled in a language that would be different from the language of both the preceding and succeeding words, that is, it could not result from activation of the same language store. A closer look at the data suggested that accessibility of each language was determined by the level of familiarity with the concept in L2 rather than by activation of the store per se. In other words, the better the word was learned in L2 the more likely it was to be recalled in L2. On the other hand, those words which had not yet acquired an L2 equivalent or this equivalent was not well established in memory were more likely to be named in L1. The data from the picture naming task provided support for this hypothesis.

Thus, reconsidering the data from this perspective, we might expect a much higher accessibility of L2 with a higher level of L2 proficiency when concepts become well learned in L2 and a decreased accessibility of L1
which might become a lexical retreat for those cases where searches in L2 store fail to provide lexical information.

One of the puzzling findings observed in the present task was a failure to retrieve a word in either language when a free choice was offered. The basic concepts familiar to a child of S.'s age, like “hammer”, “pencil”, etc. remained unnamed in this task, though the same words were retrieved in the picture-naming task given in the next session.

There could be two possible explanations of this finding. One comes from psycholinguistic research on bilinguals language processing (Grainger & Beuvillain, 1987) which suggested that some bilinguals cannot totally deactivate the other lexical system when they are operating in one language mode. In our case, an attempt to find a word in one lexical store could fail but the store remained activated while the search started in the other language store. That could produce a great interference and end up with a zero result.

Another hypothesis seems to be more relevant to the above finding and it comes from neurolinguistic studies on paraphasia. Luria (1972) suggested that “a flood of equally probable possibilities” prevents the discovery of the required word.

“According to Luria, anomic word blocks arise during the phase of equalization when all words in a matrix have equal likelihood of being evoked. The result is that nothing is produced” (Buckingham, 1977: 585).
If we apply this hypothesis to the above finding we can suggest that the free choice task placed S. in a situation when she tried to simultaneously access and activate both language stores and failed to retrieve a word, otherwise well known, in either of the two languages.

To summarize, the results of the free choice task employed in the present study revealed that the percentage of words which were chosen to be named in each language did not differ between the two languages, though it showed an increase in the number of English named words at the end of the monitoring period. However, the RT data shows a shift in language accessibility towards English resulting in a faster RT on naming the concepts in English. Moreover, the inspection of the data suggested that language preference might be affected by different factors, like better familiarity with the name in L1 or better acquisition of its equivalent in L2. But it remains unclear whether these factors can determine in the long run the RT taken to name the concepts.

2.7.11 Blocking effect

The purpose of the blocking task employed in this study was to see how the explicit L2 interference might decrease the L1 accessibility. Recall that S. was supposed to name the pictures in L1 ignoring the printed L2 names on them. In order to detect the blocking effect, the RT on the ‘blocked’ word was compared with the RT on the same word given in another session within two trials to the one where the word was blocked. It
is believed that the blocking effect could be claimed only in those instances where the RT on the 'blocked' word would exceed the RT on the same word in the "non-blocked" condition. The results on 12 words selected for the analysis are given in Table 2.9.

Table 2.9 Blocking effect

<table>
<thead>
<tr>
<th>Word</th>
<th>RT with 'block'</th>
<th>RT on same word w/o 'block'</th>
</tr>
</thead>
<tbody>
<tr>
<td>airplane</td>
<td>840</td>
<td>840</td>
</tr>
<tr>
<td>brush*</td>
<td>5780</td>
<td>880</td>
</tr>
<tr>
<td>camel*</td>
<td>970</td>
<td>880</td>
</tr>
<tr>
<td>children*</td>
<td>4720</td>
<td>1210</td>
</tr>
<tr>
<td>cup*</td>
<td>6410</td>
<td>4690</td>
</tr>
<tr>
<td>dress</td>
<td>1150</td>
<td>1530</td>
</tr>
<tr>
<td>elephant*</td>
<td>3600</td>
<td>2040</td>
</tr>
<tr>
<td>fork*</td>
<td>2970</td>
<td>860</td>
</tr>
<tr>
<td>hammer*</td>
<td>720</td>
<td>690</td>
</tr>
<tr>
<td>money*</td>
<td>11310</td>
<td>2600</td>
</tr>
<tr>
<td>pencil*</td>
<td>2790</td>
<td>1870</td>
</tr>
<tr>
<td>shirt*</td>
<td>3190</td>
<td>436</td>
</tr>
</tbody>
</table>

*words which showed blocking effect

Ten words out of twelve demonstrated an increase in RT in the 'blocking' condition, which suggests that L2 interference does aggravate L1 accessibility. However, there were two words (i.e. 'airplane' and 'dress') which did not show any blocking effect. The interpretation of this result was offered earlier in the paper. There is a possibility that S. could not yet read all the words in English which might make the access to these words unaffected by the provided L2 blocking. Since reading skills in either of the two languages were not tested in the present study, this rather speculative interpretation must suffice.
 Altogether, the analysis of the data on the blocking task provides some evidence that a greater L2 interference can provide a strong blocking effect on the access to the native language. The ability to read an L2 label might aggravate the retrieval of the L1 equivalent for the same concept.

2.8 General discussion

The present case study looked into L1 changes in three major linguistic fields: morphology, syntax, and vocabulary. However, the subject's reluctance to speak Russian at the later stage of the study resulted in the insufficient amount of data for the morphological and syntactic analysis. Thus the findings in these two fields provide restricted insight into the possible mechanisms of L1 forgetting rather than substantial evidence of any major L1 changes.

2.8.1 Findings in morphology

The analysis of L1 inflections showed a random confusion between nominative and accusative case markings, errors on plural markings, an error on a reflexive particle, and a generalization error on an irregular form of the verb. Although, inflectional morphemes were found to be still preserved and used correctly, the analysis of morphological changes suggested that L1 loss may be accompanied by a general confusion of a very complicated L1 category due to its disuse. The random occurrence of this type of error at a very early stage of L1 forgetting might become more abundant with time. Moreover, it was found that the occurrence of some

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
morphological errors might result from syntactic violations and as such they should be analyzed as a part of the whole syntactic structure rather than a separate linguistic entity. In addition, some morphological changes might indicate the presence of language transfer, where an L2 impact resulted in L1 changes reflecting the L2 grammatical pattern. Also, there was some evidence provided for the argument that morphological changes at the early stage of L1 forgetting leave semantics intact. In general, the analysis of morphological changes by L1 loss has shown that Russian inflections are a vulnerable category which can be confused or lost in the contact with a non-inflectional language, like English. However, insufficient amount of the data available for morphological analysis did not allow us to provide support for any the earlier proposed hypothesis on forgetting. Thus, we cannot say whether the general confusion with the Russian inflections was a result of the higher markedness of the Russian morphology compared to English, or the result of a tendency for processing simplicity, which itself may be the flip side of the first account.

2.8.2 Findings in syntax

The major findings in syntax concerned changes in verbal phrases, word order patterns, and complex object structures. The analysis of the errors with verbal phrases has shown that loss of some items in the first language could be caused by the tendency to transfer the rules of a second language to the first language rather than by inaccessibility of those items.
in L1. The syntactic violation in sentences with complex objects was suggested as an example of L2 transfer. The analysis of changes in word order by L1 loss provided further evidence of possible L2 interference into the L1 syntactic structure with restructuring of the first language according to grammatical principles found in the second.

However, new word order preference did not violate the acceptable word order pattern in Russian, rather it resulted in using more common word orders at the expense of abandoning less frequent orders. This suggested that word order change might move towards a consistent word order pattern in a language rather than reflect English interference into Russian syntax. If so, this might find support both in the theory of markedness and theory of processing simplicity.

2.8.3 Findings in vocabulary

The three major vocabulary tasks used in the study provided a substantial amount of data to examine the process of L1 retention and L2 acquisition. Both processes could be explored from the perspective of the actual amount of vocabulary items retained in L1 and learned in L2, as well as from the perspective of lexical accessibility reflected in the reaction time data.

The analysis of the L1 retention and L2 acquisition curves showed that the rate of L1 forgetting was slower than the rate of L2 acquisition and had a smoother pattern. However, the critical time periods remained the same.
both for forgetting and acquisition. The RT data pertained to the general
trends, i.e. decrease in the amount of language retention/acquisition was
accompanied by slower RT, whereas the increase in the amount of retention
/acquisition resulted in faster RT. The separate analysis on the two
grammatical categories, i.e. nouns and verbs, suggested that their trends of
loss and acquisition within a language might follow different patterns, with
a delay in verb acquisition/loss compared to nouns, but eventually both
trends fit the same general picture, where there is an increase of L2
acquisition and L1 loss with time. L1 loss is reflected, in turn, in a poorer
accessibility of the lexical items.

The across item analysis revealed a few vulnerable groups of words:
cognates, non-distinguished categories, and high-frequency words. The data
on cognates showed that the words semantically and phonologically related
in both languages became inaccessible in L1 and either got replaced by their
L2 equivalents or required extremely long time to be correctly named in L1,
or were admitted by the subject to be forgotten.

An unexpected finding of the present study was with the so-called non-
distinguished categories, or pairs of semantically related words
undistinguished in one language, while they are lexically distinguished in
another. It was suggested that a new notion of distinction acquired in L2
was transferred to the L1 non-distinguished categories and caused
inaccessibility of one of the members in L1 concept pairs, and the
inaccessible L1 item was the one which was the first to be acquired in L2 and the first to be falsely recognized as lexically different from its L1 counterpart.

Contrary to the findings in the previous studies on L1 loss, high-frequency words turned out to get less accessible than low-frequency words. The explanation of this finding was that poor accessibility of L1 words might be affected by the acquisition of the equivalent L2 label rather than by the word frequency per se. The acquisition of the L2 label in the present study happened to overlap with so-called word frequency. Longer retention of some vocabulary units in L1 at the early stage of L1 loss might be determined by a certain delay in acquisition of L2 equivalents for the low-frequency concepts.

One of the issues raised in the present study was whether the amount of retrieval practice might affect L1 forgetting. Provided the uniqueness of the study where there was no L1 input outside the experimental sessions, it was found that the amount of retrieval practice did not seem to determine the level of L1 retention.

There was also some semantic within category confusion registered in the vocabulary tasks. This was hypothesized to come from the possible ambiguity of the presented concepts.

The results of the two vocabulary tasks, i.e. free choice and blocking tasks, were aimed at testing language activation under different
The results of the free choice task revealed that the percentage of words which were chosen to be named in each language did not differ between the two languages, though it showed an increase in the number of English named words at the end of the monitoring period. However, the RT data showed a shift in language accessibility towards English, resulting in a faster RT on naming the concepts in English on the 13th month of the subject’s arrival to the US. Moreover, the inspection of the data suggested that language preference might be affected by different factors, like better familiarity with the name in L1 or better acquisition of its equivalent in L2.

On the other hand, the analysis of the data on the blocking task provided some evidence that a greater L2 interference can provide a strong blocking effect on the access to the native language. The better familiarity with the L2 label might aggravate the retrieval of the L1 equivalent for the same concept.

2.9 Summary

The general conclusion derived from the results of the present study is that in a pure attrition situation, where a child loses any contact with L1, (1) the process of L1 loss might be directly determined by L2 acquisition. The evidence came from the difference in the rate of acquisition/loss of nouns vs. verbs. (2) In addition, L1 changes indicative of language loss suggest the presence of L2 interference, which was confirmed by the some
morphological and syntactic errors reported in the study. (3) Moreover, accessibility of lexical items in L1 might be affected by the acquisition of the L2 equivalents for the same concepts. The support for this hypothesis was found in loss of certain vocabulary items, like cognates, high-frequency words, and non-distinguished categories. (4) Also, L1 forgetting was detected not only in the actual loss of the lexical information, but in the retrieval problems reflected in the reaction time data. The evidence of poor accessibility of some lexical information was found in the data obtained in all three vocabulary tasks. This provides an additional insight into the mechanisms by which L1 forgetting might occur.

However, it should be acknowledged that most longitudinal case studies on first language forgetting including the present research provide some data on the nature of language changes in different linguistic fields. But most of the longitudinal case studies with speculative approach to analyzing the nature of language forgetting are not aimed at explaining how the mechanism of forgetting works. We may see what happened to the language of a person as a result of his forgetting but we are not able to find out how it happened, based on those studies. It seems that only experimental investigation with robust tasks and carefully selected stimuli can answer the question of how the mechanism of forgetting operates.

Thus, based on the findings in the present case study, it would be interesting to further investigate the process and mechanisms of L1
forgetting in the experimental setting. In order to do that, we should explore the theoretical aspects of the two major mechanisms which might be responsible for L1 forgetting. First, we have to see how L2 interference might affect L1 forgetting. This type of interference is known as retroactive interference. Second, in order to test the hypothesis that L1 forgetting might be affected by the acquisition of the complete semantic relative in L2, we have to explore the so-called mutual exclusivity bias. The following two chapters will be devoted to the literature review on these two phenomena, after which the results of the experimental study conducted within this dissertation research will be discussed.
CHAPTER 3
RETROACTIVE INTERFERENCE. LITERATURE REVIEW

3.1 Introduction

As noted in the preceding case study, L1 forgetting may be caused by an extensive exposure to L2 environment, which interferes with the memories of the earlier learned L1 material. Thus it will be helpful to look at the problem of L1 forgetting from the perspective of retroactive interference. The literature review on RI revealed that interference per se can cause language forgetting, but there are other factors which are closely related to interference and should be considered when we do research on L1 forgetting.

The problem of language loss can be explored from different perspectives. The rate of language forgetting can be the function of the degree of original learning. If one person knew his or her mother tongue better than another person, does it mean that s/he will forget it slower? Or maybe s/he will forget it at the same rate as the person who did not know the language as well? If rates are same, a person who had a better knowledge of the language will always remember more of that language.

3.2 Language forgetting: rate and amount

Does forgetting depend on how well the material was learned or not? A number of psychological studies have tried to answer that question and there is still a disagreement in the literature as to the effect of original
learning on language forgetting. The answer to this question might elucidate one of the most important issues in first language forgetting, that is, the relationship between the rate of language forgetting and the age of the person. The higher the degree of learning, the less the forgetting. That postulate seems so obvious, that it was rather surprising to find an extensive dispute in the literature on the effects of the degree of original learning on the rate of forgetting. But before we turn to the reported studies, it would be appropriate to clarify the difference between rate and amount of forgetting. Concerning the rate of forgetting, we do not mean an absolute amount of forgetting, or the percentage of forgotten items. The percent of forgotten items may be different for two subject groups, while the rate will remain the same. In other words, the rate of forgetting, or speed, is graphically represented as a forgetting curve, and the slope will indicate the rate of forgetting.

3.3 Language forgetting and degree of original learning

3.3.1 Degree of original learning affects the rate forgetting

One of the very early studies on forgetting as a function of the degree of original learning was done by Briggs (1957). The classical retroactive inhibition paradigm with paired-associates was used. The paradigm will be explained later in this section and, for the time being, I would like to limit my discussion only to the obtained data. The number of trials in original learning conditions was varied, i.e. there were four degrees of learning for
original lists. It was found that as degree of original learning increased, recall functions became flatter in slope and the level of recall increased. In other words, the degree of original learning was found to affect the rate of forgetting, i.e. more learning yielded less forgetting.

These early findings were supported later by the data from other experiments. Wickelgren (1972) looked into the problem of memory decay as it is viewed by the theory of storage in LTM. If we disregard for a moment the sophisticated mathematical basis of his study and focus only on the experiment where retention of Russian-English word pairs was tested over different intervals, we can see that no systematic effect of degree of learning on the decay rate was found. But the other experiment reported in this study, with multiple learning trials and spaced practice, revealed that the degree of learning increased with the number of learning trials, while the decay rate decreased with increasing number of learning trials, that is, the degree of original learning did affect the rate of forgetting. Thus, the findings across these two studies were rather contradictory, thereby providing only partial support for the previously discussed conclusion in Briggs (1957) study.

3.3.2 Degree of original learning does not affect the rate of forgetting

The claim that initial level of learning affects rate of forgetting was challenged by Slamecka & McElree (1983). They criticized the previous studies on the effects of original learning on the rate of forgetting, and
suggested that an inappropriate method of analyzing the data, employed in those studies, might have led to the wrong conclusions. Their research examined the effect of degree of learning on the amount of normal forgetting of verbal lists. There were three experiments in which they varied learning of categorized lists, paired-associate lists, or sentence lists and tested retention at three intervals. They focused their attention on the place where the forgetting curve might be affected mostly, i.e. at intercepts or at slopes, and found that the slopes were unaffected by the degree of original learning, i.e. they remained parallel, no matter what the difference was in the amount of original learning. That finding enabled them to affirm the empirical conclusion that variations in the number of study trials have no effect on the slopes of retention curves. In other words, the overall interpretation was that the forgetting of verbal lists is independent of their degree of learning.

That extraordinary finding could not be explained by any existing theory of memory and it engendered an acrimonious dispute between Slamecka & McElree (1983), Slamecka (1985), on one side, and Loftus (1985), on the other side. Later Bogartz (1990) and Wixted (1990) joined the discussion with their empirical contribution to the resolution of the dispute. There were also a number of experimental studies which provided support for the previously reported findings (Bäuml, 1996; Grant & Logan,1993; Rose, 1992).
3.3.3 Empirical argument: Vertical or horizontal parallelism?

The main disagreement concerned the methods of analyzing experimental data. Slamecka (1985) was in favor of vertical parallelism, while Loftus (1985) supported horizontal parallelism. In vertical parallelism, the test establishes whether the slopes of the respective retention functions, as measured between the same delay intervals, differ from one another. These slopes represent the loss rates associated with each level of the independent variable, and if they do not reliably differ, then the forgetting is said to be comparable. The length of vertical lines connecting two points in slopes determine whether the rate of forgetting differs for two groups of subjects. In horizontal parallelism, in contrast, a horizontal line connecting two points of slopes at one interval is compared with a line connecting two points of slopes at a different interval. The main concern here is to see whether the retention interval difference at which performances are equal for both groups remains the same for all equal performance levels.

The dispute has not been resolved yet and the present research is not going to be aimed at resolving this empirical argument.

The empirical discussion on the effect of original learning on the rate of forgetting did not resolve the issue in the late 1980’s, and it seems that researchers have recently directed their efforts at providing some evidence for the earlier reported findings instead of getting involved in a sophisticated scientific dispute which brings them nowhere.
Rose (1992) conducted two experiments to test the effects of degree of learning, interpolated tests, and retention interval on the rate of forgetting of verbal lists. Though the main concern of that study was to find support for Slamecka and Katsaiti's (1988) data on the effects of prior testing on the rate of forgetting, another purpose was to compare rates of forgetting of the same list following near minimal learning for Group 1 with a high level of overlearning for Group 2. According to Rose (1992), there are two equivalent ways of determining rate of forgetting: the absolute number of words forgotten over equal retention intervals, or the slope of the forgetting function over those intervals. Each of these measures was used in this study. The experimental results extended that of Slamecka and McElree's (1983), that is, no significant interaction between the degree of original learning and the rate of forgetting was found.

Grant and Logan (1993) tried to investigate whether repetition priming and automaticity are lost over time as a function of degree of initial learning. The study was not conducted within a traditional paradigm used in other studies on forgetting and original learning, and its review will be limited only to the discussion of the findings which might be relevant to the issue of the effects of original learning on the forgetting rate. In general, it was found that the number of presentations did not affect the decline of priming over time. No matter how much an item was primed, the priming tended to decrease at the same rate. It enabled the researchers to conclude
that their findings were in keeping with Slamecka and McElree’s (1983) results, that forgetting was independent of the degree of initial learning. However, when the response prime data from Experiments 1 and 2 were combined and analyzed, it was found that items that had been repeated many times lost more priming than did items that had received fewer repetitions. That result did not occur when the experiments were analyzed separately, and it did not support Slamecka & McElree’s (1983) data. Yet Grant and Logan (1993) did not find much of a contradiction between their results and that of Slamecka and McElree’s (1983) and attributed the discrepancy in the obtained results to different measures used in both studies, i.e. the accuracy measure in Slamecka and McElree’s (1983) study and the speed measure in Grant and Logan’s (1993) study. Thus, the conclusion was made that when accuracy measures are examined, the results of Grant and Logan (1993) research are consistent and in agreement with Slamecka and McElree (1983).

Bauml’s (1996) study looked at the effect of the degree of both original learning and interpolated learning on the rate of forgetting. It will be discussed in more detail later in this section when we broach the issue of interpolated learning. Here I would like only to emphasize that this study was also consistent with Slamecka & McElree’s finding and revealed no interaction between the degree of original learning and the rate of forgetting.
The above are laboratory studies involving artificial materials as stimuli. What would happen if more naturalistic, linguistic material were used? There is very little evidence of language forgetting as a function of a degree of original learning which would come from the studies on first language forgetting. So it would be appropriate to refer to an interesting study on second language forgetting which might be relevant for the present research. The study was done by Bahrick (1984) and involved 733 subjects who learned Spanish as a second language in school. Retention was tested throughout the 50-year period. The level of original training was determined on the basis of different tests and a questionnaire. Multiple regression analysis showed that retention throughout the 50-year period is predictable on the basis of the level of original learning. It was found that memory curves decline exponentially for the first 3-6 years of the retention interval. After that retention remains unchanged for periods of up to 30 years before showing a final decline. The most interesting finding in that study was what Bahrick called a "permastore". Large portions of the originally acquired information remained accessible for over 50 years in spite of the fact that information was not used or rehearsed. This portion of information was believed to be in the "permastore" and it was found to depend on the degree of original learning. In other words, a higher level of original learning results in a greater amount of information retained in the "permastore". As to the rate of forgetting, which is the main concern of the present review, it
seems to follow the same pattern for all levels of learning, i.e. rapid decline during the first 3-6 years, then a steady retention phase up to 30 years, which is followed by a final decline. Examination of forgetting curves in Bahrick’s (1984) study shows that they remain parallel regardless the level of original proficiency in Spanish.

In summary, most studies revealed that the degree of original learning does not affect the rate of forgetting. In other words, the number of learning trials or years of exposure to the verbal material is independent of how fast the material is going to be forgotten. If we apply that conclusion to the problem of first language forgetting it can be hypothesized that the degree of proficiency in the first language will not determine how fast the language will be forgotten. However, those with better initial knowledge will have more of L1 retention than those with less initial knowledge.

Above studies looked into the issue of forgetting over time. But forgetting can occur due to different factors, like decay or interference. Below studies were concerned with forgetting as a function of interference.

3.4 Language forgetting and degree of interpolated learning

If the level of original learning supposedly does not affect the rate of forgetting, will the change in the level of interference, or interpolated learning, affect the rate of forgetting? If forgetting of the original learning is caused by the intrusion of some competing learning, how will the degree of that interpolated learning affect the rate of forgetting of the original
learning? In first language forgetting, any second language will be that kind of interpolated learning which might compete with the first language for the memory capacity.

3.4.1 Degree of original learning is affected by a degree of interpolated learning

One of the very early studies on the influence of degree of interpolated learning on retroactive inhibition (Melton & Irwin, 1940) would be particularly interesting for the present research. The experiment reported in the study involved the following procedure. The subjects learned a list of 18 nonsense syllables for 5 trials, rested for 30 min. or learned a second list for 5, 10, 20, or 40 trials, and then relearned the original list to a criterion of two successive errorless trials. The stimuli were always arranged in the same order and the participants were supposed to memorize not only the nonsense syllables but also their serial position. The anticipation method was used in the experiment, that is the subjects were supposed to spell out the syllable they were expecting to see next before they actually saw it. The general finding of the study was that the maximum inhibition of an original activity occurs when the interpolated activity is learned to a moderate degree (e.g. 10 and 20 trials). Very low or very high degrees of learning of the interpolated material (e.g. 5 and 40 trials) were reported to give the smallest amounts of RI. The interpretation of this outcome was found in the hypothesis that overlearning of the interpolated material tends
to reduce the interference with the recall and relearning of the original material.

Briggs's (1957) study which has been referred to earlier in this section provided indirect evidence of the decrease of the degree of original learning with the increase in the interpolated learning. In this study, both the number of original learning conditions and the number of interpolated learning conditions were varied. There were five degrees for interpolated lists and four degrees of learning for original lists. It was found that frequency of original learning recall decreased with increase of the degree of interpolated learning and slightly increased with high levels of interpolated learning. Moreover, it was found that RI was higher whenever the original learning and interpolated learning response systems were of near equal strength and consequently have low discriminability. This is known in literature as the concept of differentiation and had been earlier supported by Melton & Irwin's (1940) study.

3.4.2 Degree of original learning is not affected by a degree of interpolated learning

Another interesting study investigating the rate of forgetting as a function of the degree of original and interpolated learning has been already mentioned earlier in this section (Bäuml, 1996). The stimuli consisted of conceptually categorized pairs, or what is known as pair-associates. To avoid the problem of suppression of retrieval of the original material due to
the repeated retrieval of interpolated material in cued-recall task, a free recall task was introduced into the experimental design. There were three experimental conditions which varied the level of original and interpolated learning: the high-high, the low-high, and the high-low condition. For all levels of the high-high condition and low-high condition, the data suggested that both study time on the original list and interpolated list influenced recall performance, demonstrating the presence of different degrees of acquisition and of forgetting. The analysis of the forgetting graphs showed that the two forgetting functions looked fairly parallel, which indicated that the difference in recall performance caused by different study times on the original list remained about the same across interpolation levels.

However, the comparison of the forgetting functions of the high-high condition and the high-low condition revealed that the functions are different across conditions, i.e. the amount of forgetting did depend on the degree of interpolated learning: the higher level of interpolated learning caused greater degree of forgetting of original learning. Yet Bauml questioned the latter finding and conducted one more experiment to see whether the degree of interpolated learning was the sole factor responsible for a difference in forgetting rate. He predicted that differences in the amount of retrieval practice and of output interference could have caused the different amounts of forgetting. The procedure of this experiment was identical to that in the first experiment, but there were only two
experimental conditions: the high-high condition and the high-low condition. Plus the possible source of bias, like the amount of retrieval practice, was eliminated in this experiment by excluding the recall tests after each interpolated list and directing the subjects in the final recall tests to recall the original list first. The data showed that the degree of interpolated learning had no influence on retroactive interference. In other words, the importance of this study lies in the fact that it not only provided substantial evidence of absence of the effect of the degree of original learning on the amount of forgetting, but also suggested that the degree of interpolated learning has no influence on forgetting. This result contradicts those of Melton & Irwin, 1940 and Briggs (1957).

To summarize, there are three controversial claims made by the previous studies. One of the earliest studies referred to in this research (Melton & Irwin, 1940) reports that the maximum inhibition of an original material occurs when the interpolated material is learned to a moderate degree, while very low and very high degrees of interpolated learning produce the smallest amounts of retroactive interference (RI). Another (Briggs, 1957) predicts an increase in RI on the original learning with the increase in the degree of interpolated learning, and the highest degree of RI is expected to occur where the degree of original learning and interpolated learning have equal strength, which is partially consistent with Melton & Irwin's (1940) study. And finally, the latest study (Bäuml, 1996) states that the degree
of forgetting of the original learning is independent of the degree of interpolated learning. However, none of these studies involved meaning related stimuli, i.e. Melton & Irwin’s (1940) experiment was based on learning nonsense syllables, Brigg’s (1957) study used adjectives for pairs-associates, and Bäuml (1996) employed conceptually categorized associates. Thus, it has not yet been tested whether the presence of semantic relatives, or especially semantic equivalents, might produce a different effect.

3.5 Retroactive interference paradigm

The degree of original and interpolated learning and their effect on the rate of forgetting can throw some light on how fast the learned items are forgotten, but they do not answer the question why the items are forgotten.

One of the reasons for memory failure, or forgetting, is thought to be interference. There are two forms the interference can take - when prior learning acts forward in time to cause proactive interference (PI), or when newer information acts backward in time to cause retroactive interference (RI). First language forgetting, as new L2 (second language) interferes with old L1 (first language) lies in the realm of retroactive interference, and RI is going to be the main concern of the present review.

Traditionally, retroactive interference paradigm involves studying, learning and retention of two sets of paired-associates, the so-called A-B, A-C
paradigm. The first A-B set including paired-associates, like “dog-grape, lamp-cup”, is learned. Then the second A-C set is introduced and learned. In that set the first words from the A-B pairs remain the same and the second words are different, like “dog-map, lamp-cat”. The next step in that paradigm is to test the recall of the associates to the words (“dog, lamp”) from the first A-B list. Retroactive interference is found when the recall of A-B list is negatively affected by the presence of A-C list. In other words, when subjects learn different responses to the same cues the second-learned response (i.e. ‘C’) is believed to compete with successful recall of the first-learned response (i.e. ‘B’). The forgetting of A-B association is supposedly caused by the intrusion of A-C association. There have been a number of studies which altered or varied the classical RI paradigm to see whether the results would differ from those obtained with a traditional A-B, A-C paradigm.

Bower, Thompson-Schill, Tulving (1994) found that predictive relations that help stimuli retrieve unique responses greatly affect forgetting in RI paradigm. The major concern of this study was to compare the results of RI produced by standard lists of similar pairs with the results of RI created by modified incongruent lists in which each of the pairs was composed from very dissimilar materials. There were three experimental conditions used: all-same lists, congruent lists, and mispaired lists. The all-same lists were composed of six pairs drawn from one set of materials, e.g. in digit lists,
there were two-digit numbers, in letter lists - letters, in name lists - names of famous people, etc. Within each list, the stimulus constituted one element of the category and the two responses to that stimulus were two other elements of that category. For example, if it was a digit list the two responses to number “79” would be “56” (A-B list) and “18” (A-C list), if it was a name list the two responses to “Picasso” would be “Lincoln” (A-B list) and Marx (A-C list). The congruent lists were composed of one A-B; A-C pair from each of the six different all-same lists, e.g. “79-56; V-M; Picasso-Lincoln” in A-B set, and “79-18; V-R; Picasso-Marx” in A-C set.

The mispaired lists were composed so that the category of the correct response never matched the category of the stimulus term, e.g. “79-Picasso; V-18”, etc. In four experiments they varied the conditions by introducing more semantic categories, or changing the number of pairs within a given category. The results revealed practically no A-B forgetting in the congruent condition, whereas it was substantial in other two conditions. The conclusion was made that the difficulty of learning and later remembering a given paired associate depends greatly on the context of other materials that are being learned concurrently. When the category of the stimulus word predicted its response word category, and the response was relatively unique within its category, forgetting was negligible. Thus, modification of the traditional A-B, A-C paradigm proved that the stimuli
selection and the list construction can be decisive for the outcome of the experiment.

The results of Bower et al.'s (1994) study may have some implications for L1 forgetting. The context of L2 acquisition may determine which L1 items have higher susceptibility to forgetting. It can be hypothesized that those lexical items which are being acquired in L2 for the concepts shared by both languages will produce a higher level of interference in L1 than the items which specify the concept somewhat unique to L2. However, we cannot predict the extent of this possible effect.

Baddely & Dale (1966) extended the classical RI paradigm by introducing trials with semantically similar pairs and control trials comprising pairs with dissimilar stimuli. The purpose of that modification was to test the effect of semantic similarity on RI in long-term (LTM) and short-term memory (STM). Four lists of pairs were used, each two lists having similar stimuli, e.g. stimuli in “B” list were similar in meaning to those in “A” list, and stimuli in “Y” were similar to those in “X” list. The stimuli were adjectives, the similar stimuli were selected from pairs which rated high in similarity. There were two RI groups which learned lists with similar stimuli, and two control groups which learned the lists with unrelated stimuli. Both groups learned the first list, then were tested on retention of that list, then were given the second list. Immediately after the eighth trial on List 2, subjects were retested on List 1. The results of the experiment showed that RI effects

152
based on semantic similarity do occur in LTM. The finding of that study, conducted more than three decades ago, seems to be relevant to the present research. First language forgetting is supposedly caused by the interference of the semantic information in a new acquired language into the memory of the same semantic information encoded in a different language.

The retroactive interference paradigm can be used in a variety of settings. However, Clayton and Warren (1976) pointed out some methodological problems with the use of the retroactive interference design. It was emphasized that comparisons must be made between presentation conditions having the same interpolated activity. In addition, in order to eliminate possible confounding results, there should be no difference between the level of acquisition, both in terms of original and interpolated learning.

3.6 Summary

In summary, the review of literature on retroactive interference has demonstrated that RI is believed to cause forgetting of original learning. It is traditionally tested in so-called A-B, A-C paradigm, or pair-associates, where A-C is an interpolated, or interfering, learning which competes with the original learning, A-B, for the capacity in our memory. There are many factors which can affect the rate of retroactive interference, or forgetting, like the context of the concurrently learned material (Bower et al., 1994),

153
the semantic similarity between original and interpolated learning (Baddley & Dale, 1966), the degree of learning and testing, etc. For many years it was common knowledge and a well-accepted hypothesis that a higher degree of original learning brings about a slower rate of forgetting (Briggs, 1957; Wickelgren, 1972). This was challenged by Slamecka and McElree (1983) and later supported by a number of studies (Bauml, 1996; Grant & Logan, 1993; Rose, 1992) which showed that the rate of forgetting is independent of the degree of original learning. In the recent literature, no evidence has been found against that claim, though the problem of data analysis, which might account for discrepancy in the interpretation of experimental findings, remains yet unresolved. Moreover, the problem of interpolated learning and its effect on the rate of forgetting of original learning was investigated (Melton & Irwin, 1940; Briggs, 1957; Bauml, 1996). The degree of interpolated learning was found to affect the degree of original learning (Briggs, 1957), to affect the degree of original learning to a different extent depending on the number of trials in interpolated learning (Melton & Irwin, 1940), or be independent of the degree of interpolated learning (Bauml, 1996). The most consistent data indicating that there is no interaction between the degree of interpolated learning and rate of forgetting of original learning comes from Bauml’s (1996) study. However, no more evidence supporting that conclusion has been found in the literature.
Coming back to the problem of first language forgetting, it can be hypothesized that the level of proficiency in the mother tongue is not going to affect the rate of first language forgetting. The degree of first language learning will only affect the amount of retained verbal information (Bahrick, 1984), but not the rate of losing the information. In contrast, the amount of training in the L2 might produce different effects predicted by the three contradictory studies (Melton & Irwin, 1940; Briggs, 1957; Bäuml, 1996). Also, the amount of interference between the two languages might be determined by many factors, semantic similarity (Baddely & Dale, 1966) and the context of concurrently learned other material (Bower et al., 1994) being among them. In other words, semantic overlap between two interfering languages is most likely to cause language forgetting. But the context in which a new language is acquired may determine the extent of semantic overlap. The problem of semantic overlap which could result in memory failure has been also explored in studies on the mutual exclusivity constraint.
4.1 What is mutual exclusivity?

During acquisition of the second language, learners are exposed to new L2 vocabulary, that overlaps with previously acquired L1 vocabulary. There is a debate in the second language acquisition literature as to whether two synonymous monolingual terms are easily acquired. Applying this idea to the bilingual situation implies that it would be difficult for the bilingual (at least early on in L2 acquisition) to maintain synonymous L1 and L2 terms (Leopold, 1939). Thus, the acquisition of an L2 term may serve to dislodge the L1 term, which may cause L1 forgetting. The theoretical background of this phenomenon can be found in the mutual exclusivity hypothesis.

Mutual exclusivity is one of the hypotheses which provides some insight into the process of object labelling in early language acquisition. There are a few linguistic principles which are supposed to account for the process of language learning. Golinkoff, Mervis, and Hirsh-Pasek (1994) discuss the hierarchy of principles which might account for problems in language acquisition. The three of them present an interest for our discussion. First, Clark’s (1983) principle of contrast which states that if there is a difference in a language form, then there might be a difference in meaning. The child, hearing a new term, assumes that the speaker means something different.
from the previous term. Next, the novel name - nameless category principle (N3C) (Golinkoff et al., 1994) states that when presented with a novel label, a child will preferentially associate it with an object that does not yet have a name. And the last, though not the least for the present discussion, is the principle of mutual exclusivity offered by Markman (1989).

Mutual exclusivity claims that children are generally biased to assume that an object can have only a single name. If given a new word and an object with a known name, the child comes to apply the new term to a part of the object. This assignment violates another word learning principle, that of whole object which states that words refer to the whole object as opposed to its parts or attributes. If presented with a novel word referring in the context of one already labelled object and one new object, a child is more likely to link a novel word with an unnamed object rather than to give a named object a second label. The principle of mutual exclusivity makes a similar prediction to that of the N3C principle in this case.

I am not going to question the validity of the mutual exclusivity hypothesis. On the contrary, this review will be based on the assumption that mutual exclusivity does exist in early language learning, and it will be focused on those recent studies which have reported its presence. My particular interest will be to see how mutual exclusivity works in bilingual vs. monolingual settings, and the major part of the review will be devoted
to the discussion of those recent studies which were done with bilingual subjects.

Support for mutual exclusivity has been found in a number of studies (Merriman & Schuster, 1991; Liittschwager & Markman, 1994; Savage & Au, 1996; Merriman & Stevenson, 1997), though the findings differed in some respects. That has brought about an argument between two major researchers in this field, Merriman and Markman (Woodward & Markman, 1991; Merriman, 1991) and made it possible to hypothetically group the studies, which are being reviewed here, according to whether they belong to one or another “camp”.

4.2 Mutual exclusivity and age

The main disagreement in that argument concerned the age at which the principle of mutual exclusivity applies, with Merriman and colleagues maintaining that it is not present early on in acquisition, while Markman and colleagues maintain that even young children demonstrate this principle.

Merriman & Schuster (1991) experiment with 2-year-olds and 4-year-olds was designed at testing the disambiguation effect - a tendency to select unfamiliar rather than familiar things as the referents of new names. They found that the mutual exclusivity bias grows stronger during early childhood, and it was almost non-existent in 2-year-olds compared with 4-year-olds. The conclusion was made that mutual exclusivity is not available to very young children and therefore would be of little use in the early
stages of language acquisition. In young 2-year-old children attraction to novelty was found to be the sole cause of the effect which later will develop into mutual exclusivity bias.

Merriman (1991) presents an updated review of the earlier findings in the age-related phenomenon of mutual exclusivity and confirms his previous conclusion that very young children have a very weak, if any, mutual exclusivity bias.

In other words, a number of studies have provided an evidence that mutual exclusivity bias applies mostly to the children older than two years.

However, those studies were criticized by Woodward & Markman (1991), and there was found a support for the hypothesis that all children including very young ones, are subject to the bias.

For example, Liittschwager & Markman’s (1994) study with 16- and 24-month-olds provided evidence that mutual exclusivity is available to children as young as 16 months of age. They suggested that the absence of evidence supporting mutual exclusivity in young children could have been overlooked or misinterpreted in other studies. Their hypothesis was that

“in fact, mutual exclusivity and other word learning constraints might be especially beneficial for children in the early stages of language acquisition, when vocabularies are small, command of syntax is uncertain, and processing capacity is limited” (p.957).

The reason why other studies, including Merriman & Schuster (1991), failed to provide any reliable evidence supporting mutual exclusivity in very
young children, was thought to be in the way that name training assessment of 1- and 2-year-olds was done. For example, the tasks employed in Merriman & Schuster’s (1991) study were unsuitable for very young children in a number of ways; i.e. the amount of time children were allowed to play with novel versus familiar objects was not equal, the test sessions where children had to learn a great many novel words at once were too lengthy. Thus the procedural problems, according to Woodward & Markman (1991), might have been responsible for the 2-years-olds’ failure to demonstrate any mutual exclusivity bias.

Later, Savage & Au (1996) administered a new test in their study with 24- to 25-month-olds. In accordance with Liittschwager & Markman’s (1994) study, the results showed that at least some children under the age of two and a half years old tend to interpret novel words with the mutual exclusivity bias, although the tendency grows stronger with age.

Thus, the argument about the age and mutual exclusivity bias seems to have been eventually resolved, and it was found that children in all preschool ages are affected by that bias, though the disagreement still exists whether the extent of the effect remains the same for different ages.

4.3 Factors which can override mutual exclusivity

Another aspect of studies on mutual exclusivity concerns the flexible nature of this bias. In other words, at some point of language learning, mutual exclusivity bias is likely to be overridden by other factors, which
enable learning of synonyms and overlapping terms in the long run. Here the researchers agree on the term offered by Merriman & Bowman (1989) that mutual exclusivity is a default assumption, a probabilistic bias which can be overridden, rather than being an absolute innate constraint. Default option means that this principle is followed unless contradictory input is received or other beliefs or biases conflict with it.

4.3.1 Processing efficiency

One of the factors responsible for suspending the mutual exclusivity bias is believed to be processing efficiency. This issue has been addressed in the studies below.

Merriman & Stevenson (1997) offer a possible explanation for their claim of increasing mutual exclusivity effect with age. Age-related increases in processing efficiency might also account for the developmental trends in the disambiguation effect. In other words, an additional processing load in young children may reduce their ability to maintain the unfamiliar word in working memory while trying to decide how to map it. The problem of processing factors in suspending mutual exclusivity was addressed in two other studies, Liitschwager & Markman (1994) and Savage & Au (1996).

Liitschwager & Markman (1994) viewed mutual exclusivity as a beneficial indirect means of learning new object labels rather than a constraint in language learning. One of the advantages of the mutual exclusivity bias, according to the researchers, is that it helps children override the whole
object assumption and thereby enables them to learn labels for parts, substances, and other properties. The first experiment in Liitschwager & Markman (1994) brought up the question whether the children could override mutual exclusivity because the overall processing demands placed on them were fairly light. They explored the effect of processing load on word learning in a second experiment. The information-processing demands were increased by exposing each child to two new words instead of one. This increased the difficulty of the task and caused more troubles in overriding mutual exclusivity. The conclusion was made that though children can overcome the constraint, they can also fall back on the mutual exclusivity assumption when their memory ability was overburdened.

Savage & Au (1996) study extends the previous findings about the flexible nature of the mutual exclusivity bias. But in addition to two possible strategies used by children in interpreting novel labels, i.e. accepting both labels for one object, or rejecting a new one, they suggest that there may be the third possibility - to keep both labels in mind for a short while without committing to either.

The experimental procedure was the following. The children saw only the training object during the introduction of two novel labels. One was introduced by the teacher (e.g. "See - this is called a lemur"), another - by the experimenter (e.g. the experimenter might say: "Thank you for bringing the primate with you"). The first label was always introduced by a teacher,
and the second label by an experimenter, both were repeated the same number of times. Then the experimenter tested children’s production and comprehension of the novel labels immediately after the second label was introduced. Of the 32 children in this study, 25 offered a label when asked to name their training object, and they favored the label introduced by the experimenter. The authors suggested that probably children can keep track of who introduced which label, and they tend to use whichever label their addressee has used.

Additional experiments were designed to test the hypothesis. They modified the procedure a little bit by replacing the teacher by another experimenter, or by changing the testing order (comprehension and production tests) of the two labels. The results replicated those of the first experiment, and Savage & Au concluded that despite preschoolers’ limited memory and information-processing capacities, many children are able to keep in mind more than one plausible label for an object for a little while despite the mutual exclusivity assumption on which they often rely to induce word meanings. Moreover, it was found that in the presence of explicitly applied input children are quite good at using this input to override the mutual exclusivity principle appropriately.

4.3.2 Object typicality and word similarity

Merriman & Schuster (1991) investigated a few other factors which might affect the disambiguation effect, or mutual exclusivity bias. One was
object typicality and another was word similarity. It was found that a positive continuous relation exists between how much an item resembles the objects of its familiar category and children’s tendency to avoid selecting it as the referent of a new name. For example, children who hear someone call a teaspoon *jegger* will not be discouraged from calling it *spoon*; however those who hear *jegger* applied to an atypical spoon will refrain from using the familiar name for it.

There is also a continuous positive relation between how much a new word sounds like a familiar name and how likely children are to map it to a referent of that name rather than to some other object. For example, they have to figure out that the words *dog* and *doggie* refer to the same concept, that morphological change of the word (e.g. *cow* and *cows*) does not change the meaning. However, use of these factors, i.e. object typicality and word similarity, were found to be age-related, that is use of these types of information increased with age. Merriman & Schuster (1991) concluded that “ideally, when more reliable cues are present, children should completely abandon mutual exclusivity, and when such cues are absent, they should impose mutual exclusivity” (p. 1301).

### 4.3.3 Animacy

Another factor that may override the mutual exclusivity bias is animacy (Merriman & Stevenson, 1997). It is hypothesized that the mutual exclusivity bias may be greater for inanimate than for animate object
names. For example, the probability of animate objects to take proper names results in higher likelihood of animate objects to tolerate overlap between a new proper name and a familiar common name. However, this study revealed that when differences in novel name learning are taken into account, there is no difference between animate and inanimate sets effect on mutual exclusivity.

4.4 Summary on monolinguals

Before we turn to reviewing the literature on mutual exclusivity in bilinguals, let us summarize the main points in the recent studies on that constraint in monolinguals. First, the evidence for the mutual exclusivity bias was reported in all studies being reviewed here (Merriman & Schuster, 1991; Liittschwager & Markman's, 1994; Savage & Au, 1996; Merriman & Stevenson, 1997). Second, the issue whether it increases with age was addressed in a few studies (Merriman & Schuster’s, 1991; Liitschwager & Markman’s, 1994; Merriman & Stevenson, 1997). Third, there may be a connection between processing load and memory capacity, on the one hand, and mutual exclusivity, on the other (Liitschwager & Markman, 1994; Savage & Au, 1996; Merriman & Stevenson, 1997). Liitschwager & Markman (1994) emphasized children’s limited processing capacities which may prevent overcoming the constraint when the processing load is increased. However, Savage & Au (1996) suggested that children’s
memory, despite its limited capacity, can keep two labels until disambiguation is done.

Fourth, all researchers agree on the flexibility of the bias which enables it to be overridden in the presence of the sufficient contradictory input. Merriman & Schuster (1991) found typicality and similarity of novel words with familiar ones an important factor in affecting the disambiguation effect, or the tendency to give a novel name to unfamiliar object than to give a second label to already named object. The use of animacy in overriding mutual exclusivity was rejected by Merriman & Stevenson (1997).

4.5 Mutual exclusivity and its implications for second language acquisition

The problem of mutual exclusivity may have a special interest for second language acquisition, and as a result, for language forgetting. The theoretical background of second language learning indicates that, according to two different hypotheses, knowing the label for a category in one language may either help or hurt the acquisition of a corresponding label in the other language. On the one hand, acquisition of a label in a second language for an already familiar object named in the first language should be rather easy, since the child has already established a link between the first label and the corresponding conceptual category. On the other hand, if children are reluctant to giving two names to the same object due
to their mutual exclusivity assumption, it must be very hard for them to cope with name learning in two languages. If the bias exists in children, how can they overcome it when exposed to two different languages? How can children learn two labels in different languages for the same object unless they override the constraint? Or maybe the constraint does not apply to the bilingual setting, or it works in a different way? These and other relevant questions have been addressed in a few recent studies in the literature.

4.6 Mutual exclusivity in bilinguals

The number of bilingual studies on mutual exclusivity is so limited and they refer to each other’s findings so extensively, that it would be appropriate to review them in a chronological manner.

The first study investigating the difference in the mutual exclusivity bias between monolingual and bilingual subjects was done by Au & Glusman (1990). Three experiments in that study were aimed at exploring the mutual exclusivity constraint across languages. One involved Spanish-English bilingual children and adults. The subjects were first taught a novel word in English, then the experimenter asked to find a referent for a novel word in Spanish. The children subjects, age 3-7, were exposed to two experimenters, who spoke only one language in front of them. The adults were introduced to an English label and then a Spanish label by the same experimenter, who was bilingual in these two languages. The prediction of
the experiment was that bilingual speakers should not honor mutual exclusivity across languages. The data supported the prediction and suggested that bilingual children as well as bilingual adults readily accept two names for an object when the names clearly come from different languages. But it remained unclear whether bilingual adults will honor mutual exclusivity within a language.

The next experiment was designed to test mutual exclusivity bias in monolingual and bilingual adults when all subjects were exposed to only one language. The results of that experiment showed that no matter whether the subjects spoke one or two languages, or in what language the experiment was run, adults honored mutual exclusivity within a language.

The final experiment looked at the possibility that monolingual children can take advantage of the knowledge that a thing can take two names when they come from different languages and suspend the mutual exclusivity bias. The English monolingual children participating in that experiment were explicitly instructed that a novel name comes from Spanish. They were willing to accept it as a second label for an English-named object. The conclusion was made that the metalinguistic knowledge that an object can have different names in different languages helps monolingual as well as bilingual children suspend mutual exclusivity across languages.
Altogether, the three experiments of Au & Glusman’s (1990) study explored the disambiguation effect of mutual exclusivity (tendency to give a novel name to an unfamiliar object rather than to the one which has been already named), and made it clear that mutual exclusivity can be overridden when two names for an object distinctively come from different languages, both in bilingual and monolingual settings, and that both bilingual and monolingual speakers honor the bias within a language. Unfortunately, Au & Glusman’s (1990) study did not show whether there was a difference in the extent to which bilingual subjects vs. monolingual subjects suspended mutual exclusivity across languages or maintained it within a language. The next study tried to throw some light on that question.

Merriman & Kutlesic’s (1993) study explored two issues in bilingual and monolingual name learning. The first concerned children’s skills in using highlighted features to guide their extension of new names (e.g. a zebra has stripes but there are many striped things that are not zebras), second - preservation of mutual exclusivity. The authors made a number of predictions regarding the mutual exclusivity bias in bilinguals vs. monolinguals. Bilinguals’ frequent exposure to overlapping references which come from different languages but share the same conceptual representation might violate mutual exclusivity bias on a regular basis. These violations, in turn, might weaken the bias or prevent it from ever developing. Also, bilinguals’ greater flexibility might enable them to use the
mutual exclusivity principle more adaptively. That is, they are more likely to reserve it for same language labels in default situations, but not to extend it to different language labels.

The study compared monolingual and bilingual children with respect to two mutual exclusivity effects, correction and restriction. Children may preserve mutual exclusivity by either correcting or restricting their extension of a familiar name. In the correction effect, a child who believes that something is an exemplar of one name stops believing this after hearing it called by another name. In the restriction effect, children who have not previously committed a familiar name to a particular object refrain from doing so because they have heard another name used for the object.

The experiment involved bilingual Serbian-English children and monolingual English children who were between 5 and 8 years old and lived in the same neighborhood in the United States. There were two experimental conditions: same-language and different-language condition. In the same-language condition, children were taught a novel name for an unfamiliar object, and this training involved feature highlighting, i.e. a certain feature was specified and described. Then the children were asked to select other referents of the name from a set of seven objects and a second name was trained for the objects the child had selected as a referent of the first name. Then the children were asked to select the referents of the second name, and later from the same set - the referents of
the first name. In different-language condition, the design was similar to that in the same-language condition, but an additional task was introduced. Children were shown two dolls, one of which supposedly spoke only French and wanted to teach another doll some new names in French. It was found that monolinguals had a higher tendency than bilinguals to treat a referential feature that is highlighted during the presentation of a novel noun as a necessary condition for applying the noun to other things. It implies that bilinguals are less sensitive to physical differences between the two word-pairs as long as the words come from different languages.

As far as mutual exclusivity effects are concerned, it was reported that fewer bilinguals than monolinguals in the different language condition showed both correction and restriction effect, whereas they behaved similarly in the same language condition. In other words, bilinguals suspended mutual exclusivity across languages more often than monolinguals and maintained it within a language similar to monolinguals. Merriman & Kutlesic's (1993) study tried to explain a discrepancy between these findings and the results of the previously discussed study (Au & Glusman, 1990), in which both bilinguals and monolinguals suspended mutual exclusivity across languages. The age difference between the subjects in the two studies was claimed to account for the discrepancy of the data (in Au & Glusman's study, 1990, there were 3-7 years olds, and in Merriman & Kutlesic's study, 1993, there were 5-8 years olds). And we
remember from the earlier discussion in this section that Merriman & Schuster (1991) and Merriman (1991) have already brought up the question of the age factor in the development of the mutual exclusivity bias and stated that the bias increases with the age. Also, according to Merriman & Kutlesic (1993), the difference might have come from the fact that the studies examined different mutual exclusivity effects, i.e. disambiguation effect in Au & Glusman's (1990) study and restriction and correction effects in Merriman & Kutlesic's (1993) study. There was one more detail in the design of the experiment which was somehow omitted by Merriman & Kutlesic (1993) when they discussed the possible reasons for the discrepancy in the experimental data. This should be mentioned here. Despite the fact that the bilingual subjects in Merriman & Kutlesic (1993) study knew Serbian and English, French, as a foreign language, was introduced in the different language condition, whereas Spanish-English bilingual subjects in Au & Glusman (1990) study were exposed only to those two languages, i.e. Spanish and English, in the different language condition. It is not the concern of the present review to make the predictions as to what might have happened if the conditions had been the same. But that difference in the experimental procedure cannot be ruled out as a possible explanation of the resulting discrepancy.

There were two conclusions made in Merriman & Kutlesic's (1993) study. First, the tendency to maintain mutual exclusivity within a language
was found both in bilingual and monolingual groups, and it increased with age regardless whether the children knew one or two languages. Second, bilinguals were more likely to suspend mutual exclusivity across languages than monolinguals.

The most recent published study on mutual exclusivity in bilinguals and monolinguals was done by Davidson, Jergovic, Imami, and Theodos (1997). It was based on the same principles described in Au & Glusman's (1990) and Merriman & Kutlesic's (1993) studies, but here the researchers combined the methodologies from those studies, slightly modified them, and tried to examine the issues which were raised in previous works. First, the problem of the relationship between age and mutual exclusivity was given special attention. Second, three mutual exclusivity effects, i.e. disambiguation, restriction, and rejection, were tested. Two of them, disambiguation effect and restriction effect were tested in the first two studies (Au & Glusman, 1990 and Merriman & Kutlesic, 1993, respectively), the third one, the rejection effect had not been tested before in bilingual studies. Recall that in the disambiguation task, children are asked to find the referents of new names in sets that contain at least one thing they can name and at least one they cannot. They show the disambiguation effect if they select the unnamed things. In the restriction effect, children who have not previously committed a familiar name to a particular object refrain from doing so because they have heard another
name used for the object. And in the rejection effect, children reject a new word, when the new word is introduced for what the child believes to be the referent of a familiar word.

Finally, the main concern of the research was to examine monolingual and bilingual children's use of the mutual exclusivity constraint within a language and not across languages, that is, to see how likely bilingual children were to accept two names for an object if it was clear that the names came from the same language. Thus, the disambiguation, restriction and rejection tests for bilingual children were conducted in the child’s first language, Urdu or Greek, or in other words, in the same language condition.

The subjects of the experiment were 3- and 6-year-old children who were either monolingual in English or bilingual in English-Urdu or in English-Greek. The design of the experiment was similar to that employed in the other two studies (Au & Glusman, 1990 and Merriman & Kutlesic, 1993). First, the children were shown for several seconds each familiar and unfamiliar object in a random order. The children were asked to name the objects, and their responses, including "I don't know" for unfamiliar objects, were recorded. Then half the children were allowed to play with the familiar and unfamiliar objects for five minutes, while the remaining children were not. That was done to prevent the possible effect of novelty which might later determine the children's preference for picking up an object. Finally, in the disambiguation test, 12 pairs of objects were created, with one familiar and
one unfamiliar object in each pair. Half the time the familiar member of the pair was named, and the child was asked to point to it, and half the time an unfamiliar (artificial) name was given and the child was asked to point to it.

The results of the disambiguation test indicated that monolingual children maintain mutual exclusivity within a language more often than their same-age bilingual peers. This finding contradicts the conclusion made by Merriman & Kutlesic (1993) that monolinguals and bilinguals did not differ in their tendency to maintain mutual exclusivity within a language. It can be also indirectly compared with Au & Gulsman's (1990) relevant study which investigated the presence of the constraint in bilingual and monolingual adults. The results indicated that both groups maintained the constraint within a language. Again, these two studies cannot be directly compared due to two factors: first, Au & Glusman's (1990) study involved adults, and Davidson et al. (1997) study was done with children. Second, Au & Glusman (1990) did not look at the extent to which both groups maintained the constraint, that is, it was mainly concerned with establishing whether the effect was present or not rather than determining the difference in its strength across two groups. Davidson's et al. (1997) study, in contrast, not only explored the question whether monolinguals and bilinguals maintain the mutual exclusivity bias within a language, but also showed that bilingual children used the constraint to a lesser extent than monolingual children.
The methodology of the restriction test was modified in this study. Generally, the method involves showing children either hybrid pictures (pictures which possess the properties of two familiar basic-level categories from the same semantic category, e.g. a spoon and a fork), or to show children a picture of a typical referent (e.g. spoon). In this study, only hybrid pictures were used, and the hybrids were composed of either inanimate parts, or animate parts. That manipulation was aimed at assessing the restriction effect across inanimate and animate objects. There were two sets of pictures, set A were hybrid pictures composed of knife and fork parts and set B were composed of bird and fish parts. Half the children were shown set A first, the remaining children were shown set B first, then the other set was introduced. For example, in the knife and fork set, there were two sheets of pictures. The experimenter pointed to a target top picture on one of them and called it “knife”, the rest of the pictures were covered. Pointing to different hybrids on the respective sheet, the experimenter asked, in a counterbalanced order, if two of them were knives and two were forks. In terms of the mutual exclusivity bias, children should restrict the name of the hybrid to one category or label (i.e. knife). In other words, if children accepted the name “knife” for the hybrids, then the children should have rejected the name “fork” when it was used.

The results of that test revealed that monolingual children more readily restricted the names than bilingual children. Again, it contradicts the
conclusions made by Merriman & Kutlesic (1993) who found little difference in the extent to which monolingual and bilingual children corrected and restricted names within a language.

The rejection effect in monolingual and bilingual children has not been tested in two other studies mentioned above. The results of the rejection test in Davidson et al. (1997) study revealed that monolingual children more readily rejected an artificial name for a typical object than bilingual children. In other words, it was shown again that the mutual exclusivity constraint is more persistent in monolingual than in bilingual children within a language.

Davidson et al. (1997) concluded that bilingual children experience the mutual exclusivity constraint to a lesser extent than monolingual children within a language. It was suggested that the reason why they do so was because of their ability to suspend the bias between languages, which makes them, in turn, less willing or less likely to maintain the bias within a language. However, they admitted that bilingual children do have some mutual exclusivity bias within a language. It was also found that there were no developmental differences in bilinguals' performance, though a developmental increase in the disambiguation effect was found for monolingual children. This finding contradicts the data in Merriman & Kutlesic's (1993) study which reported that the tendency to maintain the mutual exclusivity constraint increased with age, no matter whether the children were bilingual or monolingual.
The general conclusion in Davidson et al. (1997) work was that additional studies examining bilingual children’s use of word-learning constraints are needed, and that it is necessary to examine how similarity and differences between languages may affect children’s use of the mutual exclusivity constraint.

4.7 Summary on bilinguals

To summarize, three studies examining bilingual and monolingual use of the mutual exclusivity constraint have been so far found in the literature. Au & Glusman (1990) reported that bilinguals and monolinguals maintain mutual exclusivity within a language and suspend it across languages. Merriman & Kutlesic (1993) extended that finding and showed that bilinguals were more likely to suspend mutual exclusivity across languages than monolinguals, whereas the tendency of both groups to maintain the bias within a language depended on their age rather than on the number of languages the children knew. Davidson et al. (1997), in contrast, found that the extent of the constraint within a language was determined by number of languages rather than by the age factor. Bilingual children in their study showed less mutual exclusivity within a language than monolingual children, while the age factor affected only the performance of monolingual children.

Thus, it is evident that there is a controversy in the literature as to whether monolingual and bilingual use of the mutual exclusivity constraint differs, and if it does, how it differs in across languages and within a
language conditions. Lack of sufficient data in bilingual research on mutual exclusivity leaves many issues unresolved and provides us with little support for further hypothesis.

If semantic overlap causes L1 forgetting in the environment of L2 acquisition it can be hypothesized that both mutual exclusivity and retroactive interference might be responsible for that. It would be possible to test both hypotheses, ME and RI, within one experimental design.
CHAPTER 5
EXPERIMENTAL STUDY

The possible affect of retroactive interference (RI) and the mutual exclusivity (ME) bias on language forgetting was the major concern of the present experimental research.

5.1 Introduction

Retroactive interference is believed to cause forgetting of original learning. The literature review has shown that the degree of original learning does not affect the rate of forgetting (Slamecka & McElree, 1983; Bäuml, 1996; Grant & Logan, 1993; Rose, 1992). However, there is not enough evidence found in the literature as to whether the degree of interpolated, or interfering, learning might affect the rate of forgetting (Melton & Irwin, 1940; Briggs, 1957; Bäuml, 1996). In addition, it was suggested that semantic similarity between the original and interpolated learning might determine the amount of retroactive interference (Baddley & Dale, 1966). Based on the above findings, it can be hypothesized that first language forgetting is independent of the initial level of proficiency and might be determined by the amount of exposure to the second language as well as by the semantic overlap in the lexicons of the two languages. The present experiment was based on the assumption that the rate of L1 forgetting does not depend on the degree of L1 learning, which remained the same across all experimental conditions. The amount of L2 exposure, on the
contrary, varied across the experimental conditions; i.e. the participants received 2, 5, 10, or 15 learning trials in the L2 phase. Moreover, to test the possible effect of semantic similarity, or 'semantic overlap', as it is called in this study, the experimental group learned the names for the same concepts in two languages while the control group learned the names for different, non-overlapping, concepts. In addition, the experiment was controlled for a word type (noun/verb) variable to see whether there might be any mechanisms of forgetting related to a grammatical category of the words learned. The latter was done to approximate the present experimental research with the earlier discussed case study. Recall, that there was a certain difference in the rate of noun/verb forgetting at the onset of the case study, although the ultimate retention of L1 nouns and verbs was almost the same. Also, to decrease the possible effect of the L1 nature on its consecutive forgetting, the two languages involved in the study were counterbalanced in terms of the first and the second language. In the light of the previous findings reported in the literature, the following predictions were made:

(1) Complete semantic overlap will produce greater interference and will result in a greater amount of lost L1 items, that is, the experimental groups must produce higher interference and L1 forgetting than the controls, which might be consistent with one of the findings in RI studies (Baddley & Dale, 1966).
(2) Based on the findings in the three controversial studies reported in the literature, three incompatible predictions can be made: (a) the rate of forgetting of original learning does not depend on the amount of interpolated learning, which would be consistent with Baumel’s (1996) study; (b) the rate of forgetting of original learning is affected by the degree of interpolated learning, that is an increase in the degree of interpolated learning will produce an increase in retroactive interference on the original learning (Briggs, 1957); (c) an inhibition effect might have different strength depending on the degree of interpolated learning, that is the maximum inhibition will occur with the moderate degrees of original learning, while a low and high degrees of interpolated learning will affect the degree of the original learning to the least extent (Melton & Irwin, 1940). The present study will hopefully contribute to resolving the existing controversy.

(3) If there is memory failure which might be responsible for retention of only one label for the concept in either of the two languages at the expense of losing another label in a different language, it must be found only in experimental groups, since only experimental groups will be learning names in two languages for the same concepts. It is expected that due to retroactive interference and mutual exclusivity bias the L1 name might be either replaced by the equivalent L2 name or become inaccessible. This might provide evidence for both theories. Rl theory would determine the
direction of interference, i.e. from L2 to L1, while ME bias would account for the memory failure to keep two labels for the same concept.

5.2 Method

5.2.1 Participants

Participants were undergraduate monolingual English-speaking students recruited from the Louisiana State University psychology department participant pool and given extra credits in psychology courses for participating in a one-hour session. The majority of the participants had taken foreign-language classes (mostly Spanish or French) before. The participants who had learned Russian or Hebrew, the two languages involved in the study, were excluded from the experiment. Altogether, there were 169 participants who took part in the study, and the results of 112 participants were selected for the analysis. 37 participants did not meet the learning criteria (i.e. they recalled less than 80% on the first L1 test) and their results were excluded from the analysis. Moreover, 20 participants were replaced by new ones after the preliminary results were received. These participants were in three conditions: (1) experimental group with Russian as L1 and 15 trials in Hebrew, (2) experimental group with Hebrew as L1 and 15 trials in Russian, (3) experimental group with Hebrew as L1 and 10 trials in Russian. The first two groups showed unexpected high performance on the first L1 test and insignificant forgetting on L1 retest. The superior performance of the first two groups might have been caused
by the original non-random assignment of participants to these most
difficult conditions involving the highest level of training in L2 (i.e. 15 trials).
At the very onset of the study, the participants showing excellent
performance on the L1 test were assigned to that condition in the attempt
to prevent high level of L1 forgetting after an extensive exposure to L2.
Although this policy was not applied later in the study, it might have
affected the overall results. Thus the two groups (15 trials) of participants
were completely replaced by new ones. Also, one of the groups of the
participants (10 trails) showed a much higher L1 loss and six out of seven
participants were randomly replaced by new ones to see whether there was
any artifact in participant selection which might have contributed to that
outcome. The results of the new analysis did not significantly differ from
the analysis based on the original participants prior to the replacement. The
latter can be found in the footnotes (p. 188).

5.2.2 Stimuli

For each condition, 8 black-and-white drawings depicting basic noun
concepts and 8 drawings depicting basic action (verb) concepts were
visually presented on the MAC computer monitor, while the names of the
concepts in two languages, Russian and Hebrew, were auditorily presented
through the earphones. The drawings were first given to an independent
group to ascertain they would elicit the depicted concept in English. Only
those pictures which were correctly named and identified in terms of
action/object were chosen for the experiment. To illustrate, the object concepts were presented by the words like “coat”, “fence”, “floor”, “bread”, “balloon”, etc., while the action concepts were the words like “knock”, “build”, “run”, “sleep”, etc. All action concepts were presented by a single agent which required a 3rd person singular verb in both languages. The object concepts represented singular nouns. The words in both languages were phonologically counterbalanced and did not have any specific sounds which might be difficult to English speakers. The words which sounded alike in the two languages, or were cognates in either two of the three languages (Russian, Hebrew, English) were excluded from the experiment. There were only one to two syllable words. Altogether, there were 48 pictures used in the study, with 16 pictures given to each group of participants. All experimental participants received the same 16 pictures for both language phases, while controls received the same 16 pictures as experimentals for L1 learning and different 16 pictures for L2 study phase. There were two sets of pictures for the control condition, since the first language varied between Russian and Hebrew and the stimuli used in one language was not always applicable to another due to the phonological language specificity. The list of the stimuli used in the study can be found in Appendix B (Table B.1).
5.2.3 Design

There was 2 (L1: Hebrew or Russian) x 2 (overlap condition: experimental vs. control) x 4 (number of trials in L2: 2, 5, 10, 15) x 2 (test: L1 test 1 vs. L1 retest, or L1 retest vs. L2 test ) x 2 (word type: nouns vs. verbs) factorial design used in the experiment. The first three factors were between participant, and the last two were within participant variables. The dependent variables were the accuracy in L1 response and the reaction time taken to provide a response.

The experiment consisted of two study phases and three retention tests. The L1 study phase included 10 trials for all groups and was followed by the L1 retention test, then an L2 study phase was offered. The L2 study phase involved a varying number of trials, 2, 5, 10, or 15, and was completed by the L2 retention test, which was immediately followed by the L1 retention retest. The participants were not informed about the tests in the instruction part of the experiment, thus all three tests, and particularly the L1 retest, were surprise tests.

The amount of retention was tested with a cued-recall task where pictures were cues and the name provided by a participant was a response. Reaction time to name the picture was precisely measured by the voice activated relay used in the experiment, while the correctness of responses was graded by the experimenter.
5.2.4 Procedure

All participants were run individually in this study, with the time of the session varying between 45 min. and 65 min. depending on the number of trials in L2. At the beginning of the experiment, the participant was asked whether s/he had any foreign language classes before, and in case of a positive answer, the foreign language learned before was specified. The participant was told that s/he would have a chance to learn words in two foreign languages, Russian and Hebrew during the experiment session. Then s/he was asked to read carefully instructions concerning the procedure of the experiment. This time the instructions were limited to the study phase of the first language. After the participant finished reading the instructions, the experimenter went over the procedure details with her/him to make sure that the participant clearly understood her/his task.

In order to maximally decrease possible English interference in this experiment, it has been decided to introduce each new block of trials with symbolic instructions as to how many times and when the participant was supposed to say a word. For example, the instruction 1***<> 2 introducing the second block of trials on the screen was supposed to be read as following: "when you see a picture(**) on the screen, try to recall the word and say it once (1) before you hear (<>) it in your earphones, then repeat it twice (2) after you hear the word". The participant was then asked to put the earphones on and the experiment started.
The experiment was programmed through the Super-Lab general purpose Macintosh software for human experimental psychology and psychological testing and did not require that the participant press any button during the experiment session. The first study phase consisted of 10 trials of studying the language offered as L1, it could be either Russian or Hebrew. The pictures were randomly arranged within each set, or block, of trials, so that nouns and verbs were in a mixed order with the restriction that the same semantic category words were not close to each other. For example, the words like “water” and “pour”, or “fork” and “eat” were not placed next to each other and had at least two other words in between. The idea behind that was that semantic closeness could both facilitate lexical retrieval of the target word and interfere with learning the semantic relative.

The first block consisted of 2 passes through 16 pictures, the second block consisted of 3 passes, and the third block had 5 passes in it. In the first block of trials, the picture appeared on the computer screen and 1000 ms after that the name was pronounced in the earphones. In this phase, the participant was supposed just to say a word once after s/he heard the word and try to memorize it. After the auditory stimulus for a picture was transmitted, there was a 2000 ms interval before a new picture was introduced, and the procedure repeated. The time interval (1000 ms) between the moment when the picture appeared on the screen and the moment when the auditory stimulus was transmitted through the
earphones was made relatively short. It was hoped that during this interval the participant would just access the conceptual store of the memory without retrieving the lexical label in English. Thus the likelihood of English interference would be decreased. The first two trials were run in this way. Then a new instruction on the screen announced the beginning of the new block.

The second block consisted of a different arrangement of the stimuli. This time, the picture remained on the screen for 3000 ms without anything being said in the earphones and another 4000 ms after the recorded word was said. The participant was supposed to say a word which s/he might remember from the previous study block before hearing the word (during the 3000 ms interval) and say it two times after hearing the word (during the 4000 ms interval). The three trials in the second block were run in this way and then a new instruction introduced the final block of 5 trials.

The final study block consisted of a new arrangement of the pictures. The time interval was increased to 4000 ms for the participant to say a word two times before s/he heard it, and to 4000 ms to say it twice after s/he heard it. Altogether, each word was supposed to be repeated 33 times during the L1 study phase. The combination of extensive repetition and retrieval practice was believed to produce sufficient recall on L1 test which was important for testing any consecutive forgetting. The L1 study phase lasted for about 20 minutes and then the first L1 test was offered. At this
time, the participant was asked to read carefully the instructions for the test. As it has been mentioned earlier, the participants were not informed that they would get any retention tests. In case at the beginning of the experiment, they asked about possible tests, the experimenter would give a vague response.

The arrangement of the words in the test phase were different from the various study orders and remained the same both for L1 test and L1 retest. Moreover, the same L1 tests were given to control and experimental groups. The participant was instructed to say the word in the learned language after s/he saw the picture. If s/he could not recall the word, s/he was asked to give her/his best guess. During the test phase, the picture remained on the screen as long as there was no auditory response picked up by the microphone. The microphone was located on the top of the monitor and its sensitivity was adjusted at such a level that an auditory response in a reasonably loud voice was picked up as a signal to change the picture. However, before a new picture appeared on the screen, the participant got a blank screen for 2000 ms. The purpose of this 2000 ms interval was (1) to help the participant suppress the previous concept s/he had just named, and (2) to give a short break before seeing a new picture. In some cases, the response was not loud enough for the microphone to pick it up as a signal, or on the contrary, some other non-verbal auditory
signal was taken as a response. The reaction time data for such responses was excluded from the analysis.

After the completion of the first L1 test, the participant was switched to L2 learning. The instructions and the procedure of the L2 study phase remained the same as in the L1 study phase. The only difference was in the number of L2 trials the participant received. The amount of exposure to L2 varied between 2 and 15 trials. In the L2 study phase, the control groups learned L2 words for new concepts, while the experimental groups learned L2 words for same concepts as L1. The L2 retention test, similar to the L1 test, was given at the end of L2 learning. The arrangement of words in L2 test for the experimental group remained the same as in the L1 test and L1 retest. The L1 retest immediately followed the L2 retention test and was always a surprise test to the participant. At the conclusion of the experiment, the participant was thanked for participation, given a credit slip, and dismissed. Most participants expressed their amazement that they could learn that many foreign words in one-hour session.

Before we turn to discussing the results of the experiment, we should clarify the classification of responses.

5.2.5 Categories of responses

There were 5 categories of responses: correct responses, related responses, within-language errors, across-language errors, and unrelated responses. The responses were assigned to a category by the experimenter
present throughout the experiment session. The experimenter was trilingual in Russian, English, and Hebrew, and had an academic background in linguistics.

Correct responses. The category of correct responses included: 1. The responses which were correct; 2. The responses which differed from the target one in terms of one phoneme provided that the incorrect phoneme belonged to the same phonemic pair and differed in terms of voice/voiceless aspect. Example, “dovek” instead of “dofek” (“knock” in Hebrew), or “mozek” instead of “mozeg” (“pour” in Hebrew); 3. The responses which differed from the target word due to the fact that the word was incorrectly learned and consistently repeated in this incorrect form during the study phase. The experimenter usually took note of those words which were said incorrectly each time after the auditory stimulus was presented. If the word was incorrectly retrieved during the learning phase but then correctly repeated after the auditory stimulus was presented, such response was not classified as the correct response of this category. For example, there were a few typical words incorrectly learned and recalled by some participants like “tratz” instead of “ratz” (“run” in Hebrew), “vilkan” instead of “vilka” (“fork” in Russian), or “boner” instead of “bone” (“build” in Hebrew), or “tol” instead of “pol” (“floor” in Russian), or “garder” instead of “gader” (“fence” in Hebrew). They remained in the same slightly incorrect form even after the correct word was heard through the earphones. If the word
appeared in a form slightly different from the target one and was accepted as a correct response in the first L1 test, it had to remain in the same form in the L1 retest to be accepted as correct. Any further deviation from the norm in the L1 retest would place the response in one of the other response categories.

Related category. Those responses which were phonologically related to the target word were taken as a related response. In this category, there were: 1) responses which slightly differed from the target word in terms of one phoneme other than the phoneme from the same voice/voiceless phonemic pair: e.g. “shoreks” instead of “shorek” (“whistle” in Hebrew), or “dopek” instead of “dofek” (“knock” in Hebrew), and 2) responses which differed in terms of more than one phoneme, maintaining though the phonological pattern of the target word: e.g. “pito” instead of “paljto” (“coat” in Russian), or “shet” instead of “shjet”. It should be noted, however, that the words had to maintain the same word-initial phoneme and the same number of syllables to be considered a related response.

Within-language errors. If the word was a correct or related name of another concept learned in the study phase and was just incorrectly applied to the target word in the test phase, it was accepted as a within-language error: e.g. “kos” (“glass” in Hebrew) instead of “shorek” (“whistle” in Hebrew), or “zabor” (“fence” in Russian) instead of “voda” (“water” in Russian). However, it should be acknowledged that there is a possibility
that some participants produced within-language errors in the attempt to follow the instructions which encouraged the participants to give the best guess if they cannot come up with the correct response. Thus, some within-language errors might have been intentionally made by the participant rather than caused by some within language confusion. That should be taken into consideration when interpreting the experimental data.

Across-language errors. Those words which were the names learned in one of the study phases but came from the wrong language were considered across-language errors. Needless to say that these errors could be found only in the L2 test or L1 retest after the exposure to the second language. Among across-language errors were 1. responses which were direct equivalents in the two languages, like "lehem" in Hebrew and "hleb" in Russian ("bread"), and 2. responses which referred to different concepts, like "hleb" ("bread" in Russian) instead of "ma'im" ("water" in Hebrew). Again, only the correct or related responses in one language applied in the other language test were considered across-language errors. If the participant used an English word as a response, which happened quite rarely, the response was considered unrelated rather than across-language error.

Unrelated responses. All other responses, not found in the above mentioned categories, were considered unrelated. In this category, there were 1. responses which could not be related to any other words learned in
both languages during the study phases, 2. responses in English, 3. silence responses which indicated failures to produce whatever word after reasonable time (20-30 sec.) elapsed.

It should be mentioned, however, that in case the participant self-corrected his/her response, the new response was accepted as the final one and the reaction time taken for this response was excluded from the analysis.

5.3 Results

Results of the experiment will be organized and discussed in three sections as follows:

Amount of retention. This section will include between group analyses of variance for the participants performance in two tests measuring L1 recall (L1 test 1 and L1 retest) for two major groups of participants, i.e. experimental and control. Each response category, i.e. correct, related, unrelated, within-language errors, and across-language errors, will be analyzed separately. These serve to determine how L1 forgetting was reflected across different between-participant variables, like the overlap condition, number of trials in L2 learning, and the L1 factor.

RT data analysis. This section will include the results of between participant analysis of variance for the reaction time data on correct responses. It is believed that L1 forgetting is reflected not only in the actual loss of L1 linguistic information but in the retrieval problem caused by
inaccessibility of L1 lexical items. Lexical accessibility is, in turn, measured by the time taken to retrieve a target word. Thus the analysis of the RT data obtained in this study will be of interest. However, only RT data on correct responses will be used. If it takes a long time for the participant to correctly name the picture, this response, no matter how perfectly correct it might be, can be already indicative of language loss. On the other hand, if s/he does not remember the word, or makes an error, the problem with L1 accessibility is reflected in error rate rather than in RT. Reaction time taken to produce any incorrect response would not illustrate the retrieval mechanism of our memory.

The RT analysis in this study will be based on comparing the participants performance in L1 test 1 and L1 retest. The results of the RT analysis is expected to contribute to the above mentioned section on the amount of actual L1 retention.

**L1 forgetting vs. L2 acquisition.** This section will look into the general trends observed on L1 retest and L2 test to see whether there is any correlation between L1 forgetting and L2 acquisition in our experimental study. The analysis will be based on the participants performance in L1 retest and L2 test. After a general analysis, a more specific analysis by individual item will be presented.
5.3.1 Amount of retention

ANOVA's were run on the five response types, i.e. correct, related, within-language errors, across-language errors, unrelated, and each response type analysis will be separately discussed. The major concern of the analyses was to find main effects and possible interactions on five factors, that is the factor of test, trials, overlap condition, first language (L1), and word type.

ANOVA: correct responses

An ANOVA on the amount of correct responses yielded a significant main effect of test, $F(1, 96) = 63.3$, $p < 0.0001$, which indicated that the performance on the first L1 test ($M = 13$) was far better than the performance on the L1 retest ($M = 11.8$). There was also a significant main effect of word type, $F(1, 96) = 29.5$, $p < 0.0001$, which showed that nouns ($M = 6.5$) were significantly better learned as well as retained than verbs ($M = 5.7$).

The main effect of test was qualified by a few significant two-way interactions: test x overlap condition, $F(1, 96) = 19.3$, $p < 0.0001$, test x trials, $F(3, 96) = 7.7$, $p < 0.0001$; and high level interaction, i.e. test x overlap condition x trials, $F(3, 96) = 3.1$, $p < 0.03$.

Table 5.1 presents the relevant cell means as well as difference scores between the two tests. Note that the largest amount of L1 loss appears to be in E10 and E15. To elucidate the source of the interaction, the post hoc
multiple-range analysis using the Student-Neuman-Keul’s (SNK) test at 0.05 level of confidence was performed on the difference between the two tests scores. Post hoc tests in this study were run so that they treated the 2x4 variables (i.e. condition -2, trials - 4) as one independent variable with 8 levels.

The results of the post hoc showed no significant difference between all control groups and two experimental groups with the low degree of training in L2, i.e. groups with 2 and 5 trials. There was also no difference between two experimental groups with the highest degree of training in L2, i.e. groups with 10 and 15 trials in L2, which means that their degree of L1 loss was statistically the same.

Table 5.1 ANOVA: Means on test x overlap condition x trials

<table>
<thead>
<tr>
<th>Group</th>
<th>L1 test 1</th>
<th>L1 retest</th>
<th>Difference*</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>12.6</td>
<td>12.7</td>
<td>-0.07c</td>
</tr>
<tr>
<td>C5</td>
<td>13.1</td>
<td>12.7</td>
<td>0.36c</td>
</tr>
<tr>
<td>C10</td>
<td>12.4</td>
<td>12.0</td>
<td>0.42c</td>
</tr>
<tr>
<td>C15</td>
<td>12.6</td>
<td>11.4</td>
<td>1.29bc</td>
</tr>
<tr>
<td>E2</td>
<td>13.4</td>
<td>12.6</td>
<td>0.79c</td>
</tr>
<tr>
<td>E5</td>
<td>12.6</td>
<td>11.9</td>
<td>0.71c</td>
</tr>
<tr>
<td>E10</td>
<td>12.6</td>
<td>9.5</td>
<td>3.07a</td>
</tr>
<tr>
<td>E15</td>
<td>13.1</td>
<td>10.8</td>
<td>2.35ab</td>
</tr>
</tbody>
</table>

*C - control group; E - experimental group; 2, 5, 10, 15 - number of trials in L2; *Means with the same letter (superscript) are not significantly different
groups with 10 and 15 trials in L2, which means that their degree of L1 loss was the same. The experimental group with 10 trials was also found significantly different from all control groups and two experimental groups with a low degree of L1 learning (groups with 2 and 5 trials), which is important for our discussion. However, there was also no significant difference between the experimental and control groups having the highest number of trials in L2, i.e. groups with 15 trials, though the control group with 15 trials was not different from the rest of the control groups and two low trial experimental groups. Thus, our prediction about semantic overlap as a cause of language forgetting was supported, since the experimental group with the equal degree of training in both languages (10 trials) did significantly differ from all control groups and two experimental groups with a lower number of trials in L2.\(^1\) Although the experimental group with 15 trials was not found to be statistically different from the experimental group with 10 trials, the absolute value of L1 loss for this group is lower than for the group with 10 trials. This might be explained by the differentiation hypothesis mentioned earlier in the paper (Melton & Irwin, 1940).

\(^1\) The same trend was shown prior to the replacement of the three experimental groups and it indicates a consistent pattern rather than an accidental occurrence of such effect.

<table>
<thead>
<tr>
<th>group/test</th>
<th>Preliminary results</th>
<th>Final results</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>L1 test 1</td>
<td>L1 retest</td>
</tr>
<tr>
<td>E15 (H)</td>
<td>14.4</td>
<td>12.6</td>
</tr>
<tr>
<td>E15 (R)</td>
<td>13.6</td>
<td>10.8</td>
</tr>
<tr>
<td>E10 (H)</td>
<td>13.8</td>
<td>8.8</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
The main effect of test was also qualified by another significant two-way interaction: test x L1, $F(1,96) = 7.5$, $p < 0.01$, which was additionally qualified by a high level interaction between test x L1 x trials $F(3, 96) = 5.6$, $p < 0.001$. The cell means for this interaction are given in Table 5.2.

Table 5.2. ANOVA: Means on test x L1 x trials

<table>
<thead>
<tr>
<th>group/trial</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 test 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>12.6</td>
<td>12.6</td>
<td>11.6</td>
<td>12.4</td>
</tr>
<tr>
<td>H</td>
<td>13.3</td>
<td>13.1</td>
<td>13.4</td>
<td>13.4</td>
</tr>
<tr>
<td>L1 retest</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>R</td>
<td>11.9</td>
<td>12.1</td>
<td>10.6</td>
<td>11.7</td>
</tr>
<tr>
<td>H</td>
<td>13.4</td>
<td>12.6</td>
<td>10.9</td>
<td>10.4</td>
</tr>
</tbody>
</table>

' R' - groups with Russian as L1, ' H' - groups with Hebrew as L1

As it is clear from the above table, the performance on L1 test is better for the groups with Hebrew as L1. However, the two high trial groups (10 and 15) with Hebrew as L1 show the largest decrease in performance on L1 retest. This might be a source of the above significant interaction. We can speculate that a higher loss with the groups having Hebrew as L1 might come from the fact that Russian was found to be harder to learn than Hebrew in this study. There is a possibility that the participants had to put in much cognitive effort to learn Russian (L2) which, in turn, might aggravate their memory of Hebrew (L1). The effect of L1 factor will be discussed later in the paper.

To summarize, the analysis of the ANOVA results for correct responses revealed a superior performance of the control participants in the L1 retest which provides evidence of semantic overlap as a possible explanation of
Moreover, the degree of correct responses decreased with the number of trials in L2 for experimental groups with 10 trials, which were different from all control and two lower experimental groups (2 and 5 trials), and for the experimental groups with 15 trials, which differed from three control groups (2, 5, 10 trials) and two lower experimental groups (2 and 5 trials). This provides evidence that (1) semantic overlap aggravates memory for L1 words; (2) the degree of training in L2 for groups with semantic overlap affects the degree of L1 forgetting, and semantic overlap might cause more forgetting for groups having an equal amount of exposure to both languages. The results of the ANOVA also suggested that Russian posed more learning problems than Hebrew, though the level of performance in both languages decreased with more trials in L2.

**ANOVA: related responses**

The next category of responses which will be discussed in this section is a category of related responses.

An identical ANOVA was performed on this category of responses. No main effect emerged for the test factor, though there was a reliable effect of the word type $F(1, 96)=7.8, p<0.01$. It indicates that more verbs ($M=0.9$) than nouns ($M=0.6$) were retained in the phonologically related form. Remember, the earlier discussed ANOVA for correct responses demonstrated a better retention of nouns in the correct form. That suggests that the overall problem in retaining the correct form of the L1 verbs could...
result in the increase of the amount of the related responses on that category. The problem with remembering an exact phonological form of the word might produce more phonologically related forms.

ANOVA: within-language responses

The ANOVA on within-language errors yielded no reliable main effect of test, which means that within language errors were randomly produced in both tests. However, the main effect of L1 reached significance on this category of responses, $F(1, 96) = 5.2$, $p < 0.03$ indicating that there were more within-language errors in Russian ($M = 0.4$) than in Hebrew ($M = 0.2$) which adds to the above discussion on the overall difficulties posed by Russian in the present study.

The main effect of the word type also showed significance on this category of responses, $F(1, 96) = 18.9$, $p < 0.0001$, indicating that within-language confusion was much higher on verbs ($M = 0.3$) than on nouns ($M = 0.1$) which converges with the above findings on correct and related responses. No significant interactions were found.

ANOVA: across-language errors

As could be expected, an ANOVA for across-language errors revealed the significant main effect of test, $F(1, 96) = 15.9$, $p < 0.0001$, indicating that across-language errors caused by language interference did occur in L1 retest ($M = 0.18$) and were not found in the first L1 test ($M = 0$).
The main effect of trials also emerged on this category of responses, $F(3, 96) = 4.4, p < 0.001$. In addition, the factor of test and trials interacted, $F(3, 96) = 4.4, p < 0.0062$. The means on this interaction are given in Table 5.3.

Table 5.3. ANOVA: Means on test x trials

<table>
<thead>
<tr>
<th>test/trials</th>
<th>2</th>
<th>5</th>
<th>10</th>
<th>15</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 test1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>L1 retest</td>
<td>0.14</td>
<td>0.4</td>
<td>0.14</td>
<td></td>
</tr>
</tbody>
</table>

The SNK post hoc test showed that the group with 10 trials in L2 was statistically different from the rest, which might be the source of the above interaction. Recall that previous studies (Melton & Irwin, 1940; Briggs, 1957) reported the highest amount of retroactive intrusions in the group with the moderate degree of original learning (Melton & Irwin, 1940), or with the degree of original learning equal to that of interpolated learning (Briggs, 1957).

Within the main effect of test, there was a marginally significant interaction between test and overlap condition, $F(1, 96) = 2.9, p < 0.09$, indicating a higher rate of across-language errors on the experimental ($M = 0.2$) than on the control group ($M = 0.1$) in the L1 retest.

ANOVA: unrelated responses

The between participant analysis of variance for unrelated responses revealed the results that mirrored those on correct responses. The main effect of test reached significance, $F(1, 96) = 47.9, p < 0.0001$, showing that the amount of unrelated responses was higher in the L1 retest.
(M = 2.4) than in the L1 test (M = 1.4). The main effect of word type was also statistically reliable, F(1, 96) = 13.9, p < 0.0003, indicating a higher amount of unrelated responses on verbs (M = 1.2) than on nouns (M = 0.7). The latter effect was not qualified by any interaction, which showed again that nouns were simply retained better than verbs regardless of the language or the overlap condition. As to the first main effect, the effect of test, it was qualified by two two-way reliable interactions: test x overlap condition, F(1, 96) = 12.2, p < 0.001, indicating more forgetting in the experimental condition; and test x trials, F(3, 96) = 5.8, p < 0.001, indicating more forgetting with more trials.

In addition, the ANOVA on unrelated responses revealed a high-level marginal interaction which might be relevant to our discussion. This interaction involved three independent variables, i.e. test x overlap condition x trials, F(3, 96) = 2.6, p < 0.06. The results illustrating this interaction are given in Table 5.4.

Table 5.4. ANOVA: Means on test x overlap condition x trials

<table>
<thead>
<tr>
<th>Group</th>
<th>L1 test 1</th>
<th>L1 retest</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td>C2</td>
<td>1.71</td>
<td>1.64</td>
<td>0.07</td>
</tr>
<tr>
<td>C5</td>
<td>1.21</td>
<td>1.71</td>
<td>-0.5</td>
</tr>
<tr>
<td>C10</td>
<td>1.71</td>
<td>1.85</td>
<td>-0.14</td>
</tr>
<tr>
<td>C15</td>
<td>1.21</td>
<td>2.64</td>
<td>-1.4</td>
</tr>
<tr>
<td>E2</td>
<td>0.93</td>
<td>1.85</td>
<td>-0.9</td>
</tr>
<tr>
<td>E5</td>
<td>1.71</td>
<td>2.14</td>
<td>-0.42</td>
</tr>
<tr>
<td>E10</td>
<td>1.57</td>
<td>3.92</td>
<td>-2.35</td>
</tr>
<tr>
<td>E15</td>
<td>1.35</td>
<td>3.35</td>
<td>-2.00</td>
</tr>
</tbody>
</table>

*C - control group; E - experimental group; 2, 5, 10, 15 - number of trials in L2; *Means with the same letter (superscript) are not significantly different
The results of the SNK post hoc test collapsed across language variable revealed no significant difference between all control and two low trial (2 and 5) experimental groups. The two experimental groups with a high number of trials in L2 (10 and 15 trials) did not differ significantly and showed the highest degree of L1 loss. This provides evidence for our prediction that the experimental groups would have a higher L1 loss than control groups. These two groups were found, in turn, significantly different from all but two groups. The control group with 15 trials and the experimental group with 2 trials, though not different from the rest of the control groups and from the experimental group with 5 trials, were also found not to differ statistically from the above two experimental groups (10 and 15 trials). The two 15 trial groups, again, were found not significantly different in the post hoc on correct responses. Thus, we can suggest that there is a trend to produce forgetting even in the non-overlap condition when the degree of training in L2 exceeds that in L1, but this trend was not significant in the present study. However, the interpretation of the idiosyncratic results with the experimental 2 trial group seems problematic. The replication of the experiment might hopefully reveal a more consistent outcome. We cannot completely rule out the possible problem with the participants selection in this study.

Also, the main effect of test was qualified by a significant three-way interaction, test x L1 x trials; F(3, 96) = 3.7, p < 0.02, which merged into a
marginally significant high level interaction, test x L1 x overlap condition x trials, F(3, 96) = 2.7, p < 0.06. The means illustrating this high-level interaction are given in Table 5.5.

To elucidate the source of the above interaction, a post hoc SNK test was run separately on the difference on test performance for each language group. The results revealed no significant difference among the groups with Russian as L1.

Table 5.5. ANOVA: Means on test x L1 x overlap condition x trials

<table>
<thead>
<tr>
<th>group/trial</th>
<th>L1 test 1</th>
<th>L1 retest</th>
<th>Difference</th>
<th>L1 test 1</th>
<th>L1 retest</th>
<th>Difference</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Russian</td>
<td>Russian</td>
<td>Russian</td>
<td>Hebrew</td>
<td>Hebrew</td>
<td>Hebrew</td>
</tr>
<tr>
<td>C2</td>
<td>1.57</td>
<td>1.7</td>
<td>-0.14 A</td>
<td>1.85</td>
<td>1.57</td>
<td>0.28 A</td>
</tr>
<tr>
<td>C5</td>
<td>1.85</td>
<td>2.14</td>
<td>-0.28 A</td>
<td>0.57</td>
<td>1.29</td>
<td>-0.71 A</td>
</tr>
<tr>
<td>C10</td>
<td>2</td>
<td>1.71</td>
<td>0.28 A</td>
<td>1.39</td>
<td>2</td>
<td>-0.57 A</td>
</tr>
<tr>
<td>C15</td>
<td>1.29</td>
<td>2.7</td>
<td>-1.43 A</td>
<td>1.07</td>
<td>2.57</td>
<td>-1.44 B</td>
</tr>
<tr>
<td>E2</td>
<td>1.14</td>
<td>2.86</td>
<td>-1.71 A</td>
<td>0.9</td>
<td>0.86</td>
<td>-0.14 A</td>
</tr>
<tr>
<td>E5</td>
<td>1.57</td>
<td>2.71</td>
<td>-1.14 A</td>
<td>1.77</td>
<td>1.57</td>
<td>0.29 A</td>
</tr>
<tr>
<td>E10</td>
<td>2.14</td>
<td>3.85</td>
<td>-1.71 A</td>
<td>1.41</td>
<td>4</td>
<td>-3.63 C</td>
</tr>
<tr>
<td>E15</td>
<td>1.14</td>
<td>2.85</td>
<td>-1.14 A</td>
<td>1.06</td>
<td>4.3</td>
<td>-3.57 C</td>
</tr>
</tbody>
</table>

C - control participants, E - experimental participants; 2, 5, 10, 15 - number of trials in L2
*Means with the same letter (superscript) within the same column are not significantly different

The absence of any significant difference between the Russian groups might be attributed to the same L1 factor, i.e. Hebrew offered as L2 did not aggravate memory for Russian as much as in the opposite case due to Hebrew’s less cognitive demanding nature. As to the groups with Hebrew as L1, all control and two low trial (2 and 5) experimental groups were found not to be different from each other. Also, the two high trial experimental groups (10 and 15) were not different from each other and
significantly different from all control and two low trial experimental groups. In addition, the experimental group with 10 trials did not significantly differ from the control group with 15 trials. This might be the source of the above interaction. We can offer the same interpretation of this finding as suggested earlier in the paper, that a higher loss with the groups having Hebrew as L1 might come from the fact that supposedly Russian (L2) took more cognitive effort to learn, which, in turn, might aggravate memory for Hebrew (L1).

To summarize, the inspection of the data on unrelated responses provides evidence of (1) the higher degree of L1 loss with experimental groups rather than with control groups; (2) L1 loss with more trials in L2 for the groups with semantic overlap; (3) the effect of L2 nature on L1 forgetting. The first two findings mirror those reported on correct responses.

5.3.2 ANOVA: RT data on correct responses

Before we discuss the results of the ANOVA on the reaction time, it should be acknowledged that in some instances the correct responses were produced with a long latency. Since retrieval problems caused by forgetting can be characterized by long reaction times, it was decided not to cut off the large outliers from the data. In addition, the ANOVA results on RT data obtained on the category of correct responses will be compared with the results of the above discussed ANOVA on the rate of correct responses.
This will serve to illustrate how the rate of producing a correct response might be reflected in the RT taken to retrieve a correct word.

An identical ANOVA on the mean reaction times for the category of correct responses was performed. The results revealed a significant main effect of test, $F(1, 96) = 12.3$, $p < 0.001$, which means that the reaction time for the same words on the second L1 test ($M = 2133$) was longer than on the first L1 test ($M = 1872$). This general finding replicates the one for the rate of retention of correct responses. The main effect of word type, $F(1, 96) = 29.8$, $p < 0.0001$, emerged in this analysis as well, and it is consistent with the above finding on the rate of correct responses that verbs ($M = 2200$) in general turned out to be more difficult to recall than nouns ($M = 1804$). The main effect of overlap condition which failed to reach significance in the above ANOVA on the rate of correct responses did reach significance in this ANOVA on RT, $F(1, 96) = 5.9$, $p < 0.02$, indicating longer reaction times to produce a correct response among experimental participants ($M = 2143$) compared to control participants ($M = 1862$). The overlap factor interacted with the factor of trials, $F(3, 96) = 5.5$, $p < 0.002$ signifying a RT increase for the experimental groups with a higher degree of L2 learning. The post hoc results will be given later in this section.

Within the main effect of test, the test factor interacted with the factor of overlap condition, $F(1.96) = 22.8$, $p < 0.0001$, and there was a significant
test x trials interaction, \( F(3, 96) = 8.3, p < 0.0001 \). Recall that two similar interactions were found in the ANOVA on rate of correct responses.

These interactions were qualified by two marginally significant high level interactions that might be interesting for our discussion. First, three factors, i.e. test, overlap condition, and trials, interacted at \( F(3, 96) = 2.3, p < 0.09 \), and the similar interaction reached significance on the rate of correct responses. Fig. 5.1 illustrates this interaction.

![Fig. 5.1 RT on correct responses](image)

The above chart (Fig 5.1.) demonstrates the reaction time data collapsed across the L1 factor. As the above chart shows, there is a large increase in the RT for the experimental participants with 10 and 15 trials in L2 on the L1 retest, while the RT for the control participants insignificantly changes across the test and group conditions. The trial factor seems not to affect the control groups, yet it is quite noticeable among the experimental
participants, i.e. these participants seem to have more problems with lexical retrieval of L1 items with bigger number of trials in L2.

The SNK post hoc test (Table 5.6) performed on the RT difference between the results on L1 test 1 and L1 retest by a trial confirms what is seen in the visual inspection of the graphs.

All control and two low trial (2 and 5) experimental groups were found not different, while two high trial experimental groups (10 and 15) were found not different from each other and statistically different from all control and two low trial experimental groups.

Table 5.6 ANOVA: post hoc (SNK)

<table>
<thead>
<tr>
<th>group</th>
<th>C2</th>
<th>C5</th>
<th>C10</th>
<th>C15</th>
<th>E2</th>
<th>E5</th>
<th>E10</th>
<th>E15</th>
</tr>
</thead>
<tbody>
<tr>
<td>post hoc results</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>A</td>
<td>B</td>
<td>B</td>
</tr>
</tbody>
</table>

*C - control group; E - experimental group; 2, 5, 10, 15 - number of trials in L2;
*Means with the same letter (superscript) are not significantly different

Second, all four variables, i.e. test, L1, overlap condition, and trials marginally interacted at \( F(3, 96) = 2.3, p < 0.09 \), which was not found in the ANOVA on the rate of correct responses. The means illustrating the above high level interaction are given in the following two graphs, Fig. 5.2 and Fig. 5.3, on groups with Russian or Hebrew as L1.

Both L1 groups show the trend for slower reaction times on the L1 retest for the experimental groups with high number of trials in L2. This trend may emerge earlier for the groups with Russian as L1, which showed slower RT also for the control 10 trial condition. In addition, the 2 trial experimental
group with Russian as L1 shows a significantly faster RT on L1 retest than its Hebrew counterpart. The inconsistency in RT for control groups across two languages and odd results produced by the 2 trial experimental groups with Russian as L1 might account for the above interaction. Remember, that the same odd results with 2 trial experimental group were reported in the earlier post hoc test on unrelated responses (see Table 5.5). To further elucidate the interaction post hoc tests were run separately on each language group (Table 5.7. and 5.8.). For Hebrew as L1, the two high trial (10, 15) experimental groups were significantly different from all control and two low trial experimental groups. As to the condition with Russian as

![Graph showing RT on groups with Russian as L1](image)

**Fig. 5.2 RT on groups with Russian as L1**

<table>
<thead>
<tr>
<th>group</th>
<th>C2</th>
<th>C5</th>
<th>C10</th>
<th>C15</th>
<th>E2</th>
<th>E5</th>
<th>E10</th>
<th>E15</th>
</tr>
</thead>
<tbody>
<tr>
<td>post hoc result</td>
<td>A</td>
<td>AB</td>
<td>ABC</td>
<td>ABC</td>
<td>AB</td>
<td>BCD</td>
<td>CD</td>
<td>D</td>
</tr>
</tbody>
</table>

*Groups with the same letter are not significantly different*
L1, there were four overlapping significantly different groups. Clearly, E15 is different from all control conditions, while E5 and E10 are not different from E15, and they are also not different from the control high trial groups (C10 and C15). In general, the difference between Russian and Hebrew groups does not falsify our finding that experimental groups with a high number of trials in L2 have more retrieval problems than the control groups regardless of the languages they learned in this study.

The ANOVA on RT revealed one more significant interaction within the main effect of the word type. The four independent variables, i.e. word
type, L1, overlap condition, and trials, interacted at $F(3, 96) = 3.6, p < 0.02$.

Table 5.9 illustrates the results on this interaction.

Table 5.9 ANOVA: Means on word type x L1 x overlap condition x trials (RT)

<table>
<thead>
<tr>
<th>Group</th>
<th>Nouns</th>
<th>Verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Russian</td>
<td>Hebrew</td>
</tr>
<tr>
<td>C2</td>
<td>1885</td>
<td>1653</td>
</tr>
<tr>
<td>C5</td>
<td>1644</td>
<td>1823</td>
</tr>
<tr>
<td>C10</td>
<td>1507</td>
<td>1811</td>
</tr>
<tr>
<td>C15</td>
<td>1739</td>
<td>1570</td>
</tr>
<tr>
<td>E2</td>
<td>1378</td>
<td>1532</td>
</tr>
<tr>
<td>E5</td>
<td>1883</td>
<td>1550</td>
</tr>
<tr>
<td>E10</td>
<td>1850</td>
<td>2323</td>
</tr>
<tr>
<td>E15</td>
<td>2268</td>
<td>2453</td>
</tr>
</tbody>
</table>

*C - control group; E - experimental group; 2, 5, 10, 15 - number of trials in L2

With the general trend to have an equal or faster RT on nouns than on verbs, two groups with Hebrew as L1 (C5, E2) demonstrated an opposite effect, i.e. their RT on verbs was faster than on nouns. Moreover, two groups with Russian as L1 (C15, E5) showed approximately the same RT on both word categories. Since these groups come from different overlap conditions (i.e. experimental and control), different language conditions (Russian and Hebrew), and have a different number of trials in L2 (i.e. 2, 5, 15), this might account for the above high-level interaction.

Altogether, the results of the overall ANOVA on the rate of correct responses and the reaction time data converge on the same finding that (1) the experimental groups have poorer performance on the L1 retest than the control groups, and (2) the decrease in the performance is determined by
the amount of exposure to L2 that the experimental groups received in this study.

However, the above analyses did not look into the relationship between L1 forgetting and L2 acquisition. So far, the degree of L1 loss has been found to depend on the degree of L2 learning. But we do not know yet whether there is a linear relationship between the two processes, or how the amount of exposure to L2 affects L1 forgetting and L2 acquisition. Thus now we will turn to the ANOVA performed on the response data obtained in the L1 retest and L2 test.

5.3.3 L1 forgetting vs. L2 acquisition

In order to compare the within participant performance on two different language tests, i.e. L1 retest and L2 test, an ANOVA identical in structure to those discussed above was run. The means on the performance in these two tests were calculated. The main effect of test reached significance, F(1, 96) = 7.2, p < 0.01, indicating a better performance on L1 retest (M = 11.8) than on the L2 test (M = 11.2). Another main effect emerged on word type, F(1, 96) = 49.3, p < 0.0001. The source of this effect lies in a better performance on nouns (M = 6.1) than verbs (M = 5.3). There was also a significant main effect of overlap condition, F(1, 96) = 5.9, p < 0.02, showing a better performance on the control (M = 11.8) than the experimental groups (M = 11). The reliable effect of trials, F(3, 96) = 27.1, p < 0.0001 also emerged in this analysis, indicating better L2 learning with
more trials. The two main effects, the effect of test and effect of trials interacted, $F(3, 96) = 156.8, p < 0.0001$. The means on the latter interaction are given in Fig. 5.4.

![Graph showing L1 retention vs. L2 acquisition](image)

**Fig. 5.4** L1 retention vs. L2 acquisition

The means in the above chart clearly demonstrate two opposite effects, i.e. the acquisition of L2 significantly increases, while L1 retention slightly decreases with higher trials in L2. However, the relationship between the two processes is far from linear, suggesting that as in a natural setting, the process of L1 forgetting might involve mechanisms more complicated than just the physical amount of exposure to L2. With more trials in L2 we would probably get a clearer picture of how these two trends might develop.

The main effect of category was qualified by three statistically reliable interactions, i.e. word type x L1, $F(1, 96) = 5.5, p < 0.02$; word type x L1 x
overlap condition, \( F(1,96) = 7.2, p < 0.01 \); word type \( \times \) L1 \( \times \) overlap condition \( \times \) trials, \( F(3, 96) = 3.2, p < 0.03 \). The means of the latter high level interaction are summarized in Table 5.10. It should be mentioned that the results of Table 5.10 are collapsed over test factor, that is the cell values reflect the retention of words in both languages the participant learned, e.g. the means given in subgroup of ‘Russian nouns’ actually reflect retention of both Russian (L1) and Hebrew (L2) nouns by a particular group.

Table 5.10 ANOVA: Means on word type \( \times \) L1 \( \times \) overlap condition \( \times \) trials

<table>
<thead>
<tr>
<th>Group/trial</th>
<th>nouns</th>
<th>Hebrew</th>
<th>verbs</th>
<th>Hebrew</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Russian</td>
<td></td>
<td>Russian</td>
<td></td>
</tr>
<tr>
<td>C2</td>
<td>4.8</td>
<td>5.2</td>
<td>4.7</td>
<td>3.4</td>
</tr>
<tr>
<td>C5</td>
<td>6.1</td>
<td>5.6</td>
<td>6.1</td>
<td>5.1</td>
</tr>
<tr>
<td>C10</td>
<td>6.9</td>
<td>6.8</td>
<td>6.5</td>
<td>6.1</td>
</tr>
<tr>
<td>C15</td>
<td>7.0</td>
<td>6.8</td>
<td>6.7</td>
<td>5.9</td>
</tr>
<tr>
<td>E2</td>
<td>4.4</td>
<td>4.6</td>
<td>2.9</td>
<td>4.4</td>
</tr>
<tr>
<td>E5</td>
<td>6.1</td>
<td>6.2</td>
<td>5.1</td>
<td>5.1</td>
</tr>
<tr>
<td>E10</td>
<td>5.5</td>
<td>6.1</td>
<td>5.5</td>
<td>5.5</td>
</tr>
<tr>
<td>E15</td>
<td>6.9</td>
<td>6.8</td>
<td>6.4</td>
<td>6.1</td>
</tr>
</tbody>
</table>

C - control participants, E - experimental participants; 2, 5, 10, 15 - number of trials in L2, Russian, Hebrew - L1

Although not consistent across all trials, in general, the Hebrew experimental groups don’t show much worse performance than control groups, while Russian groups with certain number of trials in L2 do perform worse in the experimental condition than in control, especially for verbs. This might explain the source of the above interaction.

However, it should be noted that the language factor per se did not affect language retention on both tests. When calculating means only over the L1 factor, the overall number of retained words in each language group
is about the same (group with Russian as L1: M = 11.4; group with Hebrew as L1: M = 11.2).

The interaction between two major effects, test x category, was marginally significant but was qualified by a significant four-way interaction, test x word type x L1 x overlap condition, F(1, 96) = 7.4, p < 0.01. To see the source of the latter interaction, the results are summarized in Table 5.11.

Table 5.11 ANOVA: Means on test x word type x L1 x overlap condition

<table>
<thead>
<tr>
<th>group/test</th>
<th>nouns</th>
<th>verbs</th>
</tr>
</thead>
<tbody>
<tr>
<td>L1 retest</td>
<td>Russian</td>
<td>Hebrew</td>
</tr>
<tr>
<td>C</td>
<td>6.5</td>
<td>6.6</td>
</tr>
<tr>
<td>E</td>
<td>5.8</td>
<td>6.2</td>
</tr>
<tr>
<td>L2 test</td>
<td>Hebrew</td>
<td>Russian</td>
</tr>
<tr>
<td>C</td>
<td>5.9</td>
<td>6.0</td>
</tr>
<tr>
<td>E</td>
<td>5.7</td>
<td>5.6</td>
</tr>
</tbody>
</table>

C - control participants, E - experimental participants

With a trend to produce more correct responses on the L1 retest than on L2 test, there were two odd results which might be a source of the above interaction. The control groups with Russian as L1 had a much more superior performance on verbs in Hebrew (L2) test than the rest of the groups in L2 test. Again, we can suggest that the easier language (Hebrew) offered after a harder language (Russian) might produce a facilitation effect in learning of the material requiring less cognitive effort. The same interpretation can be offered for the results with the reverse case, i.e. the control group with Hebrew as L1 produced the least number of correct responses on the same word category in L2 (Russian) test. Russian, in
general, was found harder to learn in this study, which might result in a poor performance of this particular group.

To summarize, the results of the ANOVA on L1 retest and L2 test reveal (1) two opposite trends observed in L1 forgetting and L2 learning. The retention of the original learning (L1) exhibited a slight decrease with a number of trials in L2, while the learning of a new material (L2) significantly increased with a number of trials in L2. This finding can be related to a difference in the trial condition, which might affect L2 acquisition more than L1 retention. (2) The overall amount of correct responses is higher on L1 retest than on L2 test, which again might be attributed to the trial factor. (3) Both L1 forgetting and L2 acquisition were found to be affected by the overlap condition. In other words, the participants learning words for non-overlapping concepts tend to retain L1 words and learn L2 words better than the experimental participants. This suggests that our hypothesis about semantic overlap as a cause of L1 forgetting might be related to and have implications for the studies on second language acquisition. Since this effect was not predicted at the onset of the study, it is interesting, not crucial though, for the present discussion. (4) The significance of word type factor showed that in both language tests the participants did better on nouns than on verbs, which supports findings in the above ANOVA on L1 tests. (5) The interpretation of the L1 factor is not as simple as it was in the above analyses where comparison was made between same language
tests. In addition to the above reported finding on the higher difficulty in learning Russian than Hebrew, we can suggest that the performance on L2 test might be affected to a certain extent by what language was learned as L1. If L1 learning is more cognitive demanding, then L2 acquisition might be facilitated. However, the above empirical observation is not relevant to language acquisition in a natural setting.

Another concern of our research was to see whether L1 forgetting occurs by the mechanism which fails to maintain two labels for the same concept. The latter would find support in the mutual exclusivity bias. So far the results of the study have shown that the experimental participants did forget more L1 items than the control participants but it is not clear yet whether the forgetting of particular L1 items resulted in their replacement with the L2 equivalents. The next section will look into the results of the item replacement analysis.

5.3.4 Item replacement: within participant analysis

The item replacement, if any, could be found only in the condition of a complete semantic overlap. Thus the control participants were excluded from the following analysis. An ANOVA was run on the data obtained from the L1 retest and L2 test with the experimental participants. A new variable, replacement, was created. If the word was correctly recalled on L1 test 1, its equivalent was learned in L2 test, and it was not retrieved on L1 retest, it was considered as a replacement. If the word was correctly
recalled on L1 test 1, its equivalent was learned in L2, and it was successfully retrieved on L1 retest, it was considered as a non-replacement.

Then the ratio (replacement ratio) of all replacement cases to the sum of the number of replacement and non-replacement cases was calculated.

Moreover, the same two-way ANOVA calculated the means on another ratio, the so-called chance ratio. It was the ratio of all cases where the L1 word was correctly named in L1 test 1, the L2 equivalent was not learned, and it was not recalled on L1 retest over all cases where the L1 word was correctly named in L1 test 1, and the equivalent was never acquired in L2, whether or not there was recall on the L1 retest. This ratio gives an idea of L1 loss not caused by L2 replacement. The means for the loss (replacement) ratio for cases where an L2 word was learned and for the loss (chance) ratio where an L2 word was not learned are presented in Table 5.12.

### Table 5.12 ANOVA: Means for the loss and chance ratio

<table>
<thead>
<tr>
<th>Trials</th>
<th>Replacement ratio where L2 word was learned</th>
<th>Chance ratio where L2 word was not learned</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>0.10&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.08&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>5</td>
<td>0.14&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.04&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>10</td>
<td>0.29&lt;sup&gt;a&lt;/sup&gt;</td>
<td>0.16&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
<tr>
<td>15</td>
<td>0.19&lt;sup&gt;ab&lt;/sup&gt;</td>
<td>0.07&lt;sup&gt;a&lt;/sup&gt;</td>
</tr>
</tbody>
</table>

*Means with the same letter (superscript) in the same column are not significantly different

The results of this ANOVA yielded a significant main effect on the type of ratio with $F(1, 52) = 9.5$, $p < 0.003$ indicating more chances of L1 loss where L2 equivalent is learned. No matter how small the numbers on the
replacement ratio are, they are significantly bigger than those for the chance ratio. It indicates a trend for a lexical replacement to occur when an L2 equivalent is learned for the same concept. This, in turn, finds support for mutual exclusivity hypothesis. However, we should not overestimate this finding, noticing how often two labels for the same concept are retained in both languages: e.g. 71% of times the participants in the experimental group with 10 trials in L2 had both labels. Therefore, mutual exclusivity bias cannot account for majority of what is going on here, although it accounts for a quite noticeable trend of rejecting an L1 label as soon as its L2 equivalent is learned.

5.4 General discussion

5.4.1 Semantic overlap and retroactive language interference

The overall ANOVA analyses on the results of the present study converge on the conclusion that the experimental participants learning the names in two languages for the same concepts showed a higher degree of L1 loss than the control participants who learned the words for non-overlapping concepts. The evidence comes from the ANOVA on the rate of correct responses, unrelated responses, RT data on correct responses, and ANOVA on L1 retest and L2 test. This confirms our hypothesis that semantic overlap between the equivalents in two languages causes the forgetting of the originally learned language. The present finding can contribute to
studies on retroactive interference as a cause of forgetting of the original learning.

5.4.2 Semantic overlap and proactive language interference

In addition, the performance of the control group was higher than the experimental group on L2 test, indicating a negative effect of semantic interference on L2 acquisition. The latter can have implications for studies on second language acquisition. The possible effect of semantic overlap on proactive interference was not in the realm of the present study. Thus our finding should be left as a suggestion for future research.

5.4.3 Semantic overlap and mutual exclusivity bias

The memory failure to maintain two labels for the same concept was found to affect experimental participants and can be offered as a partial explanation of L1 loss, at least, in the realm of vocabulary. The evidence of the possible ME effect was found in the ANOVA on item replacement which showed a trend for a lexical replacement to occur when an L2 equivalent is learned for the same concept. This trend was found statistically significant compared to those cases where an L1 word was lost and its L2 equivalent was never acquired. This can suggest that mutual exclusivity bias affects not only the process of language acquisition so far reported in the literature but also the process of language forgetting. If so, this can provide support for our hypothesis that our memory constraints fail to keep two labels for
the same concept and result in losing the originally learned label at the expense of the newly acquired equivalent.

However, we should not overestimate this finding. With a clear trend to increase the replacement ratio with higher trials in L2, the actual percent of the cases where replacement occurred is much lower than the percent of the cases where no replacement was reported. We can only hypothesize that increasing the degree of L2 learning above 15 trials would increase the replacement ratio. Thus, future studies on L1 loss are encouraged to investigate to what extent the present pattern of results might generalize to the ME constraint.

5.4.4 Degree of L1 loss

The forgetting of the first language in the experimental groups was found to depend on the degree of training in the second language. The results of the present study revealed that the participants with higher level of training in L2 with semantic overlap tend to forget more lexical information in L1. The effect of trials determining the degree of L2 learning in our study was found significant almost in all ANOVA analyses. The experimental groups with a higher number of trials, i.e. 10 and/15, were found significantly different from other groups. The effect of trials tend to interact with the effect of overlap condition, being statistically reliable only for experimental participants. In summary, the finding in our study contradicts the recently reported findings (Bäuml, 1996) that the degree of interpolated learning
does not affect the degree of forgetting of the original learning and provides support for the much earlier studies (Melton & Irwin, 1940; Briggs, 1957). However, it should be acknowledged that the present study was not aimed at replicating the design of Bäuml’s (1996) experiment. Thus there was a difference in the test procedure. Recall, that Bäuml’s first experiment was designed similar to the present study, that is the interpolated learning was tested right after the study phase and only then the retest on the original learning was offered. There was a difference in forgetting rate which was ascribed to retrieval practice in the interpolated learning. Thus, in the second experiment, the retest of the original learning was offered before the test on the interpolated learning in order to reduce the interference effect. The findings of the second experiment confirmed Bäuml’s hypothesis that the degree of interpolated learning does not affect the degree of forgetting of the original learning. In the present study, the L1 retest followed L2 test, which might have produced an additional interference affecting the degree of L1 retention for different trial groups. The question is to what extent could it have affected the participants performance on L1 retest and whether the L2 test is such a crucial factor for L1 forgetting. This was not tested in our study. Reconsidering our findings from the perspective of the experimental design, we can suggest that they are partially consistent with Bäuml’s findings, although they contradict the major claim made by the author.
In any event, the results of our study showed that the degree of L1 loss increased with higher number of trials in L2 and was significantly higher with the experimental groups having 10 or 15 trials in L2. That was confirmed by the results of the three ANOVA (on correct responses, unrelated responses, and RT). But even with no significant difference between the two groups, the absolute value of L1 loss seemed to be higher with the 10 trial group. It should be reminded that three groups of participants were rerun in this experiment, since the experimental group with 10 trials showed much higher loss than the two experimental groups with 15 trials. That was thought to have come from the possible artifact in participant selection. However, the results of the replacement showed the same effect, that is the L1 loss with the 10 trial group was higher than with the 15 trial groups. In addition, the results of the ANOVA on across-language errors found that the experimental group with the 10 trials was significantly different from all other groups. If we remember that the 10 trial group had equal amount of training in both languages, this might provide indirect support for the discriminability hypothesis reported in the earlier studies (Melton & Irwin, 1940; Briggs, 1957), that the maximum strength of retroactive interference is experienced by the condition with the equal degree of original and interpolated learning. This effect needs further investigation and support.
5.4.5 Language factor

The present study revealed a few significant interactions with L1. Most of these did not yield any consistent trend. The language per se was found not to affect the degree of L1 forgetting, which implies that the degree of L1 forgetting is not determined by the specificity of the L1 nature. However, the degree of learning was lower with Russian than with Hebrew, whether Russian was offered as L1 or L2. The evidence of a poorer performance on Russian was found in almost all ANOVA's. The difficulties posed by Russian in this study were confirmed by the participants of the experiment who were asked at the end of the session which language was harder to learn.

5.4.6 Nouns vs. verbs

The present study revealed a better performance on nouns than verbs indicating that nouns might be easier to learn than verbs. However, we should not overestimate this finding. We have to remember that the process of language acquisition was experimentally simulated in this study and did not incorporate all the complexity of those mechanisms which govern language acquisition in a natural setting. The verbs used as stimuli in our study could be more difficult to learn due to the conjugation-induced form similarity absent among nouns. In other words, the action concepts used as stimuli in the present study depicted a 3rd person agent which required in both languages a 3rd person singular verb which, in turn, resulted in a phonological similarity in the verb endings. And this similarity was much
higher in Russian than in Hebrew. On the contrary, nouns were highly
distinguishable and phonologically distinct which might have facilitated their
better acquisition and higher level of retention.

5.4.7 L1 forgetting vs. L2 acquisition

The results of the ANOVA on comparing the performance on L1 retest
and L2 test showed that the decrease in the level of L1 retention was
accompanied by an increase in acquisition of L2. The non-linear relationship
between the two processes pertains to the situation found in a natural
setting, where L1 forgetting is generally smoother than L2 acquisition. Both
processes were affected by the degree of training in L2, the trial effect
being stronger for L2 learning due to the fact that the amount of exposure
to the second language deliberately varied across groups in the present
study.

To conclude, the results of our research confirmed our major prediction
made at the onset of the study, that semantic overlap between the
equivalents in two languages results in L1 loss. Moreover, the degree of L1
loss was found to depend on the degree of exposure to L2. And finally,
there was some evidence provided for the argument that mutual exclusivity
bias might constrain the retention of the L1 label for the same concept after
its equivalent is learned in L2. However, the latter needs further
investigation. The findings of the present research can provide implications
both for the studies on L1 loss and L2 acquisition. Further research might
contribute to our findings and elucidate some issues which either remained unclear in the present study or were not addressed.
CHAPTER 6
CONCLUSIONS

6.1 Major issues

The major concern of the present research was to gain insight into the mechanisms of first language forgetting. The combination of the two studies presented here was aimed at bringing together the evidence on L1 loss received in a naturalistic setting and in a controlled experimental condition. These two studies were conducted successively (i.e. after a year-long monitoring of the case subject was completed, the experimental study was designed), which allowed us to test certain hypotheses suggested by the case study in the later experimental research. Thus, the two studies differed in their structural and methodological approach, but served the same goal. The case study which involved a real life situation was more descriptive and empirical, while the experimental study was conducted in a laboratory setting and involved robust tasks and analyses.

Also, the case study explored linguistic changes in three major linguistic fields, i.e. morphology, syntax, and vocabulary, with the main emphasis on the latter, while the experimental study simulated the process of acquisition/forgetting of only one linguistic aspect, that of vocabulary. Thus, not all findings in the first study could be further tested experimentally. In the long run, the combination of a purely linguistic study...
and a psychological study might give a psycholinguistic perspective on first language forgetting and the mechanisms by which it occurs.

The major principles extracted across both studies are discussed in the next sections.

6.2 Semantic overlap as a major mechanism of L1 forgetting

The results of the case study suggested that L1 loss occurs faster and more often with those words whose equivalents are learned in L2. The evidence came from the loss of cognates, confusion with so-called non-distinguished categories, and a higher vulnerability of high-frequency words. All these categories of words acquired L2 equivalents and later were either lost from memory, or replaced by those equivalents, or became difficult to access. On the contrary, the majority of the well-retained words were not yet learned in L2 at the end of the study. Thus it was suggested that it might be problematic to retain L1 linguistic information due to its semantic similarity with L2 information. A literature review of both the retroactive interference (RI) and mutual exclusivity bias (ME) supports the semantic overlap hypothesis.

The hypothesis was further tested in the experimental study. The results of the experimental research confirmed our prediction that a complete semantic overlap between two equivalents representing the same concept in two different languages does produce more L1 forgetting than learning of non-overlapping concepts. The performance of experimental groups learning
the words in two different languages for the same concepts was significantly worse than the performance of the control groups learning the words for non-overlapping concepts. Thus both studies converged on the conclusion that a major mechanism of first language forgetting concerns semantic similarity between the lexical equivalents representing overlapping concepts, thereby confirming our hypothesis.

Moreover, the experimental study provided some additional evidence for the argument that the nature of this mechanism might relate to the mutual exclusivity bias, i.e. there might be some failure to retain two labels for the same concept, which would result in rejection of one of them. Although this evidence was not strong, we suggest further studies investigating this issue.

6.3 L1 forgetting due to L2 interference

Also, the results of the two studies converged on the conclusion that, in general, L1 forgetting is affected by L2 acquisition, i.e. first language forgetting is determined by retroactive interference from a newly acquired language. The evidence of L2 interference came from both studies. The case study reported a trend that L1 changes might be caused by L2 transfer in all three linguistic fields. A non-linear relationship between the two processes, i.e. L1 retention and L2 acquisition, was reported in both studies: the process of L1 forgetting is slower and is characterized by a smoother pattern than the process of L2 acquisition. The remarkable
similarity between the forgetting/acquisition patterns obtained in the two studies can be seen by comparing the curves in Fig. 2.1 and Fig. 5.4. It shows that the laboratory simulation of the forgetting/acquisition processes employed in the experimental study resembled those processes which were registered in the real-life naturalistic setting used in the case study.

In addition, the results of the case study suggested that the degree of L1 loss is determined by the amount of exposure to L2. There was a critical period in the process of L1 forgetting, which occurred during the seventh month of the subject’s exposure to L2 (i.e. the midterm in the observation period), after which the L1 retention curve suggested some stabilization.

The experimental study provided further evidence of L2 interference in the process of the L1 vocabulary retention. There is a controversy in the literature as to whether the degree of L2 learning affects the degree of L1 retention, therefore the testing of this issue was one of the major concerns of the experimental study. The results of the experimental study did confirm the results of the case study, i.e. the degree of L2 learning affected the degree of L1 retention. The experimental groups with the amount of exposure to L2 equal to or higher than their exposure to L1 demonstrated a higher L1 loss. However, since the two studies differed in methodological approach, we cannot relate these findings to each other and make a general conclusion as to what period in L2 acquisition might be crucial to L1 forgetting. Various factors, like the age of a speaker, the initial L1
competence, the amount of L1 input, as well as the amount of L2 exposure for the semantic overlap condition might affect the process of L1 forgetting and result in different critical periods.

In addition, L1 forgetting is believed to be reflected in the actual amount of linguistic loss as well as in the retrieval problems, which are, in turn, reflected in the reaction time taken to access the target linguistic information. A comparison of the reaction time data obtained in both studies showed a similar pattern, i.e. access to L1 became harder with time and this was reflected in slower RT on the correct recall of the target items.

Reaction time data obtained in the two studies provided evidence of poorer accessibility of L1 words. This might indicate language loss. Thus we suggest that reaction time factor should be considered in the future research on L1 loss to enhance our understanding of how the control over first language might be aggravated with time.

6.4 Nouns vs. verbs

At the onset of the case study, it was noticed that verbs were better retained in L1 and more poorly acquired in L2 than nouns. Thus it was decided to continue to control for the word type factor during the observation period to see whether there might be any differences in the loss of the two grammatical categories. Further inspection of the data obtained in the case study did not reveal big discrepancies in the forgetting trends. Verbs remained better retained than nouns in L1 at the end of the
monitoring period, although the L2 acquisition level of verbs paralleled that of nouns at the end of the study. In general, both word categories showed similar trends, with a drop in an L1 retention and an increase in L2 acquisition at certain periods of time.

The results of the experimental study showed a significantly better acquisition and retention of nouns than verbs. However, this finding does not falsify the absence of the similar effect in the case study. It was suggested that the poorer performance on verbs in the experimental study came from a high phonological conjugation-induced similarity among verbs which is not relevant to language acquisition in a natural setting. If this is the case, then we can suggest that both studies converge on the conclusion that the degree of L1 loss is not different between the two grammatical categories.

6.5 Summary

In general, the results of the present research showed that in L1 loss situation, (1) semantic overlap between the equivalents in two languages might be a major cause of first language forgetting, (2) L1 changes and L1 retention are influenced by L2 interference, and that (3) the strength of this interference determines the degree of L1 forgetting. The results of the present research might have some implications for studies on first language forgetting, second language acquisition, as well as psychological studies on retroactive interference.
REFERENCES


APPENDIX A. CASE STUDY DATA

1. Free talk task

(session # 1)

C 1: A это кто будет говорить?
L 2: Это ты будешь говорить. Вот вначале ты мне расскажи о себе.
    Что хочешь рассказать о себе. Я ведь тебя совсем не знаю.
    Сколько тебе лет?
C: Мне девять.
L: Когда ты родилась?
C: Я родилась двадцатого апреля.
L: В каком году?
C: Я не знаю.
L: А теперь расскажи мне о своих друзьях в России. У тебя ведь
    были друзья в России?
C: У меня там были двое.... Даже трое.
L: Ну и как их звали?
C: Мая, Таня, Лена.
L: Им тоже было 9 лет?
C: Нет, я не знаю, сколько им было. Мае семь, а Тане, наверно,
    пять.
L: Вы были в разных классах?
C: Нет, Мая еще не ходила.
L: Не ходила еще в школу?
C: Нет.
L: А вы жили в одной комнате?
C: Нет, я в третий, а Таня с Мая в первой.
L: А сколько человек вас было в комнате?
C: Нас было по двенадцать.
L: По двенадцать человек?
C: Да.
L: И не шумно было?
C: Ну в третьей группе я жила. Там были шумные дети.
L: И кто тебе больше нравился из этих трех девочек?
C: Мая.
L: Она самая маленькая была?
C: Н-е-е-е-т, она немного побольше.
L: Она немного побольше, постарше тебя была?
C: Н-е-е-е-т.
L: Больше других?
C: Н-е-е-т (смеется). Ну я не могу...
L: А как называется город, где ты жила?

1 C - subject's name initial
2 L - researcher's name initial
С: Плецкое.
Л: А ты мне можешь рассказывать, какой это город? Я там никогда не была.
С: (молчит)
Л: Ну расскажи мне, какой это город, что в нем есть интересного. Много ли лесов там.
С: Ну, там нету лесов. Там участки у нас.
Л: Участки, и люди вот так же живут в своих домах?
С: Да.
Л: А улицы большие?
С: Да.
Л: Какой там транспорт есть, какие автобусы ходят?
С: Ну, там у нас не ходят автобусы. У нас там только машина наша ходит.
Л: Машина ваша?
С: Да, и автобус наш.
Л: А куда вы гулять ходили?
С: Ну мы ходили зимой на лыжную базу.
Л: На лыжах ты хорошо катаешься?
С: Ну, на лыжах мы там не катались. На досочках.
Л: С горки, да?
С: Да.
Л: Ты любишь так кататься?
С: Да, я еще когда-нибудь так хочу.
Л: Скажи, а была у вас там речка или озеро?
С: У нас там э..... озеро есть.
Л: И вы там купались?
С: Нет, ни разу. Мы только в Дворец ездили. Но меня не брали.
Л: Потому что у меня сердце больное.
С: Да?
Л: Ты оставалась? Но теперь зато ты будешь заниматься спортом и все пройдет.
С: Да?
Л: А что тебе нравится в "кэмпе"?
С: В "крэмпе"?
Л: В "кэмпе", в лагере, куда ты сейчас ходишь.
С: Мне только нравится на экскурсии ездить. И на "скейтах" ездить.
Л: Ты имеешь ввиду, на роликов коньках?
С: Да, но я все время падала.
Л: Ну ты скоро научишься. А что вы еще там делаете?
С: Где?
Л: В "кэмпе".
С: В "кэмпе"? Мы там гуляем. Там у какого-то участок. Карусели там нету, ничего нету.
Л: Вы там играете?
С: Да.
Л: А какие-нибудь поездки у вас есть? Куда-нибудь вас возят?
C: Нет, нас не возят.
Л: Никуда не возят?
C: Нет, только на экскурсии, а на поездки - нет.

(session #7)
Л: С., расскажи мне, пожалуйста о своей школе, как у тебя прошел год.
C: I don't know that.
Л: Ну, пожалуйста, расскажи мне что-нибудь. Я тебя прошу.
C: I don't know anything.
Л: Ты мне можешь это же сказать по-русски?
C: No
(продолжения после русской части picture naming task)
Л: Ты перешла в новую школу, расскажи мне о ней.
C: I don't know what to say
Л: Сколько детей у вас в классе
C: Я не знаю ничего
Л: Как зовут вашу учительницу
C: Mrs. Johnes
Л: А какой предмет ты любишь больше всего?
C: Math
Л: А уроков вам много задают?
C: Нет, они задают только ...... на Fridays.
Л: А что ты делаешь в переменку?
C: У нас там нету переменки, там recess we have. Мы играем на улице.
Л: А что у вас там есть, качели или еще что-то?
C: Tree house .... I don't know what it is called in Russian......(After a long pause) машина, basketball player.
Л: А как ты ездишь в школу, на автобусе?
C: Нет, на машины.
Л: А у вас только девочки, или девочки и мальчики?
C: Девочки и мальчики

2. Picture description task

(session #1)
Л: Вот картинка, очень похожая на то, что у тебя было в России.
Расскажи, что ты здесь видишь.
C: Я вижу дом.
Л: Дом большой?
C: Да.
Л: А еще что ты здесь видишь?
C: Там сидит девочка.
Л: Где она сидит?
C: .... На крыльце.
А это кто, собака?
Л: Собака, наверно, стоит рядом с девочкой.
С: ... и мышка.
Л: Собака похожа на мышку.
С: Нет, мышка похожа на мышку.
Л: Ну а еще что ты видишь?
С: Я вижу девочку. Она бежит. Нет, она падает. Я вижу дерево, а на дереве висит мальчик. Мальчик лежит и загорает.
Л: А это что?
С: Дерево. А на дереве - качеля.
Л: А вот это что ты думаешь?
С: Дом.
Л: Ты думаешь это дом? Там люди живут?
С: может быть, гараж?
Л: Может, и гараж. А может, это место, где звери живут? И тогда, что это будет?
С: Зверинец?
Л: А это что такое?
С: Теплица.
Л: А что за теплицей?
С: Забор. У нас тоже такой был.
Л: А это что такое?
С: Дорога.
Л: А такая маленькая дорога, как называется?
С: Тропинка.
Л: Правильно. А вот это как называется? (показываю на печную трубу)
С: Я не знаю, как это называется.
Л: Не знаешь, как это называется? Откуда дым идет?
С: Из бани.
Л: Из трубы, наверное.
С: Да, но надо баню включать.
Л: А как ты думаешь, это зима, лето?
С: Лето.
Л: Почему ты так думаешь?
С: Потому что ребенок загорает.
Л: ... и трава.
С: ...и солнышко.

(session #2)
С: Я вижу э.... Девочка с мальчиком ругаются.
Л: И один мальчик... Он сидит и ревет.
С: Заячка. Собака и кот. Мальчик пинает.
Л: ...э.... смотрит на мышку. Я не знаю, как это называется.
С: Кто, собака?
C: Ну, да, я не знаю, у нее какая … это, ну…
Л: Морда у нее смешная, да?
C: Да (смеется).
Л: А это кто?
C: Мышка.

(session #5)
Л: Что ты видишь?
C: Я вижу девочку и … the мышка сидит на балконе. I don't know what is this. Я вижу … собаку … бежит. Я вижу девочку … Кто это, мальчик?
Л: Мальчик.
C: Мальчик висит на дереве. Я вижу гараж open. No, I see…
Л: Ну а если по-русски?
C: Я вижу кот сидит. Я вижу мальчик лежит.
Л: Где мальчик лежит?
C: На траве. Я вижу девочка падает. Я вижу … зайчик бежит. Я вижу … качель.
Л: А где качель висит?
C: Качель висит на дереве.
Л: А какое это время года, как ты думаешь?
C: Лето
Л: Почему ты так думаешь?
C: Потому что …. Я не знаю.
Л: Ну почему ты думаешь, что это лето?
C: Потому что жарко, потому что…..
Л: Какого цвета деревья?
C: Потому что деревья …. I don't know……
Л: Какого цвета?
C: Зеленого. Потому что птички летают.
Л: А дом какого цвета?
C: Желтый
Л: А сколько в нем этажей?
C: А******* Пять (в доме пять окон)
Л: Пять этажей? Это же окна, а этажи вот…
C: No! Два.

(session #6)
Л: Что ты видишь?
C: In English?
Л: In Russian.
C: Я вижу …. Мальчика … плачет. Я вижу … собака … I don't know.
Л: Ну расскажи, какие звери здесь.
C: Кошка … собака … зайчик … девочка … два мальчика.
Л: Что они делают, эти дети.
C: I don't know what it is called.
Л: Дерутся они, да?
С: Да. Птичка ... укусила с... в... хвост... Кошка ... сердитая... That's all what I can tell.

(session #8)
Л: Расскажи, что ты здесь видишь?
С: Я вижу .... Мальчик играет с .... кот. И девочка катается ... I don't know what it is called. И мальчик с собакой ... играют.
Л: И мальчик убегает, от кого?
С: Собаки. Ребята...они сидят на качели.
Л: А кто еще здесь есть?
С: Кот, собака .... заяц.
С: Я вижу собачка нюхает .... Цветок.
Собака ... она сидит I don't know how it is called in Russian.
Л: Дерево
С: Дерев...ве?
Маленькая собачка несет подарок большой собачею
Собака дает ей соску ("соска" была подсказана).
I don't know what he is doing... Pulling... Собака хватает ...I don't know what it is called...
Л: Волосы
С: Волосы
The man .... I mean ..... мальчик .....дает мячик....
Л: Кому?
С: Собаке.
Is that a clown? Clown несет цветочки....
Л: Кому?
С: Слону.
Мальчик сидит на телевизоре.

3. Story telling task

(session #1)
С: Жила девочка. И бабушка ей подарила на день рождения красную шапочку.
Л: куда она пошла в своей красной шапочке?
С: Она пошла к бабушке, проводать ее.
Л: Что у нее в корзинке?
С: Горшочек масла и ... пироги.
Л: И вот идет она по лесу...
С: ... идет она по лесу, а в навстречу ей волк.
Л: И что он ей сказал? Они, по-моему, поговорили?
С: Они... Здравствуй Красная Шапочка! Куда ты идешь? - Я иду к бабушке...проводать ее.

249

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
Л: И что хитрый волк сказал?
С: Я съем тебя.
Л: Нет, помнишь, что он сказал? - Я пойду по этой дорожке, ты по другой. И посмотрим, кто...
С: ...быстрее дойдет. И он быстрее дошел.
Л: Что он сделал?
Л: И что он сделал с бедной бабушкой?
С: Он ....
Л: Он съел ее.
С: Ну, он съел ее. Одел очки, ее одежду всю и лег в кровать.
Л: А дальше?
Л: И тут на шум прибежали...
С: ...ребята.
Л: Какие ребята? Что у них в руках? Дровосеки. И что они сделали с волком?
С: Они его зарубили. И вытащили Красную Шапочку и бабушку.

(session #5)
С: Красная Шапочка собиралась ... идти к бабушке. И она пошла и ... собирала .... Собирала ... цветы. И навстречу она увидела волка. And волк спросил: Как тебя зовут? И Маша, она сказала: Машенька. И...
Л: И что еще он у нее спросил?
С: Он ее спросил... Я тебя съем.
Л: Нет, по-моему, он ее спросил куда она идет.
С: "Куда ты идешь?" And Машенька сказала...........
Л: Она сказала: Я иду к бабушке.
С: Я иду к бабушке. И потом волк ей сказал: Кто придет быстрее: я или ты? И он быстрее... И он звенит. And ..." Бабушка, здрасте", and бабушка сказала: Кто там? And ....волк тонким голосом говорит : Это я, Машенька. And ... I forgot...
Л: Что он с бабушкой сделал?
С: Он ее убил
Л: Он скушал ее.
С: And он скушал ee and он... and он одел на себя ее одежду and он....
Л: Лег в постель
С: And лег в постель. And Маша приходит ... And...I don't know. And говорит....

250
Л: Бабушка, почему у тебя такие большие уши? А что говорит волк?
С: Потому чтобы хорошо слышать тебя - Почему у тебя такие большие глаза? - Потому чтобы хорошо видеть тебя. - Почему у тебя большой....
Л: Большие зубы
Л: И что произошло? На шум прибежали охотники и...
С: Убили волка
4. Vocabulary data

Note: The data is pulled out of the picture naming task if not specified otherwise.

Table A.1 Across item analysis (nouns) Russian

<table>
<thead>
<tr>
<th>Name/ RT</th>
<th>#2</th>
<th>#3</th>
<th>#4</th>
<th>#5</th>
<th>#6</th>
<th>#7</th>
<th>#8</th>
</tr>
</thead>
<tbody>
<tr>
<td>1. airplane</td>
<td>free - L2 (910)</td>
<td>910</td>
<td>840</td>
<td>990</td>
<td>1560</td>
<td>2160</td>
<td>940</td>
</tr>
<tr>
<td>2. balloon</td>
<td>1530</td>
<td>1340</td>
<td>1370</td>
<td>1600</td>
<td>free - L1 (980)</td>
<td>990</td>
<td>3220</td>
</tr>
<tr>
<td>3. belt</td>
<td>3310</td>
<td>1870</td>
<td>2620</td>
<td>lost</td>
<td>free - L1 (7720)</td>
<td>750</td>
<td></td>
</tr>
<tr>
<td>4. bench</td>
<td>1060</td>
<td>2800</td>
<td>1410</td>
<td>3220</td>
<td>free - L1 (10340): couch</td>
<td>lost</td>
<td></td>
</tr>
<tr>
<td>5. bike</td>
<td>1280</td>
<td>940</td>
<td>2160</td>
<td>1130</td>
<td>free - L1 (840)</td>
<td>free - L2 (3850)</td>
<td></td>
</tr>
<tr>
<td>6. boat</td>
<td>910</td>
<td>930</td>
<td>1690</td>
<td>1780</td>
<td>free - L2 (1560)</td>
<td>free - L2 (2160)</td>
<td></td>
</tr>
<tr>
<td>7. boots</td>
<td>4690</td>
<td></td>
<td></td>
<td>block - 4250: bosonozki</td>
<td>940</td>
<td>free - L1 (8940): bosonozki</td>
<td></td>
</tr>
<tr>
<td>8. box</td>
<td>free - L2 (2120)</td>
<td>block - 9230</td>
<td>lost</td>
<td>block - 10780</td>
<td>5910</td>
<td></td>
<td></td>
</tr>
<tr>
<td>9. bread</td>
<td>1000</td>
<td>1060</td>
<td>1530</td>
<td>1160</td>
<td>free - L1 (940)</td>
<td>lost</td>
<td>1970</td>
</tr>
<tr>
<td>10. broom</td>
<td>free - L1 (2780)</td>
<td>free - L2 (2250)</td>
<td>1870</td>
<td>free - L1 (1690)</td>
<td>free - L2 (3370)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>11. brush</td>
<td>free - L1 (1800)</td>
<td>free - L1 (1430)</td>
<td>block - 5780</td>
<td>880</td>
<td>free - L2 (5030)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>12. cage</td>
<td>free - L1 (2400)</td>
<td></td>
<td>lost</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>13. camel</td>
<td>free - L1 (890)</td>
<td>free - L1 (2380)</td>
<td>880</td>
<td>block - 970</td>
<td>1020</td>
<td></td>
<td></td>
</tr>
<tr>
<td>14. carrot</td>
<td>1000</td>
<td>1000</td>
<td>680</td>
<td>1930</td>
<td>680</td>
<td>2960</td>
<td></td>
</tr>
<tr>
<td>15. cat</td>
<td>1150</td>
<td>1400</td>
<td>1250</td>
<td>3030</td>
<td>free - L1 (4480)</td>
<td>free - L2 (1840)</td>
<td>1530</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
</tr>
<tr>
<td>16. chicken</td>
<td>free-lost</td>
<td>block-980</td>
<td>lost</td>
<td>free-L2</td>
<td>lost</td>
<td></td>
<td></td>
</tr>
<tr>
<td>17. children</td>
<td>free-L2</td>
<td>block-4720</td>
<td>1090</td>
<td>free-L2</td>
<td>1220</td>
<td></td>
<td></td>
</tr>
<tr>
<td>18. chest</td>
<td>1340</td>
<td>lost</td>
<td>free-L2</td>
<td>7280</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>19. church</td>
<td>1160</td>
<td>980</td>
<td>5220-L2</td>
<td>7680</td>
<td>free-L1</td>
<td>lost</td>
<td></td>
</tr>
<tr>
<td>20. clock</td>
<td>3470</td>
<td>free-L2</td>
<td>free-L2</td>
<td>free-L2</td>
<td>4380</td>
<td></td>
<td></td>
</tr>
<tr>
<td>21. coat</td>
<td>1310</td>
<td>1910</td>
<td>1190</td>
<td>3780</td>
<td>4690</td>
<td>block-6410</td>
<td></td>
</tr>
<tr>
<td>22. cup</td>
<td>1900 (oslik)</td>
<td>1030 (olen')</td>
<td>free-L1</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>23. deer</td>
<td>24. desk</td>
<td>free-L2</td>
<td>870</td>
<td>8750</td>
<td>2470</td>
<td></td>
<td></td>
</tr>
<tr>
<td>25. dishes</td>
<td>free-L1</td>
<td>free-L1</td>
<td>free-L1</td>
<td>free-L2</td>
<td>1840</td>
<td>1440</td>
<td></td>
</tr>
<tr>
<td>26. door</td>
<td>2160</td>
<td>750</td>
<td>1030</td>
<td>lost</td>
<td>760</td>
<td>free-L2</td>
<td></td>
</tr>
<tr>
<td>27. dress</td>
<td>28. duck</td>
<td>8410-L2</td>
<td>890-L2</td>
<td>lost</td>
<td>block-2870</td>
<td>lost</td>
<td></td>
</tr>
<tr>
<td>(goose)</td>
<td>(jacket)</td>
<td>(gus')</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>29. eight</td>
<td>30. elephant</td>
<td>860</td>
<td>1810</td>
<td>2580</td>
<td>1500</td>
<td>block-3600</td>
<td>6470</td>
</tr>
<tr>
<td>31. eleven</td>
<td>free-L2</td>
<td>block-9910</td>
<td>3530-L2</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>32. fence</td>
<td>free-L1</td>
<td>block-1150</td>
<td>1910</td>
<td>1150</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>33. fire</td>
<td>1400</td>
<td>820</td>
<td>910</td>
<td>670</td>
<td>free-lost</td>
<td>980</td>
<td></td>
</tr>
<tr>
<td>34. flag</td>
<td>3880</td>
<td>1970</td>
<td>lost</td>
<td>7720</td>
<td>lost</td>
<td>lost</td>
<td></td>
</tr>
<tr>
<td>35. floor</td>
<td>2980</td>
<td>3200</td>
<td>2080</td>
<td>6900</td>
<td>6000</td>
<td>6870</td>
<td>7130</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>---</td>
<td>---</td>
<td>---</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>37. four</td>
<td>free - L1 (3480)</td>
<td>free - L1 (2910)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>38. fork</td>
<td>630</td>
<td>9000</td>
<td>840</td>
<td>2060</td>
<td>block - 2070</td>
<td>block - 780</td>
<td></td>
</tr>
<tr>
<td>39. frog</td>
<td>870</td>
<td>940</td>
<td>2000</td>
<td>980</td>
<td>7510</td>
<td>free - L1 (1220)</td>
<td>lost</td>
</tr>
<tr>
<td>40. grape</td>
<td>2560</td>
<td>6350</td>
<td>1800</td>
<td>2560</td>
<td>free - L2 (1500)</td>
<td>690</td>
<td>block - 720</td>
</tr>
<tr>
<td>41. hammer</td>
<td>780</td>
<td>free choice-</td>
<td>lost</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>42. hive</td>
<td>lost</td>
<td>free - lost</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>43. hose</td>
<td>free - L1 (910)</td>
<td>free - L1 (1160)</td>
<td>980</td>
<td>free - L1 (690)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>44. king</td>
<td>1620</td>
<td>free - L2 (3530):stairs</td>
<td>lost</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>45. knife</td>
<td>810</td>
<td>2440</td>
<td>970</td>
<td>5470</td>
<td>1000</td>
<td>980</td>
<td>free - L1 (1030)</td>
</tr>
<tr>
<td>46. ladder</td>
<td>910</td>
<td>1310</td>
<td>free - L2 (3530):stairs</td>
<td>lost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>47. leaf</td>
<td>free - L2 (232)</td>
<td>91</td>
<td>187 (L2)</td>
<td>750</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>48. letter</td>
<td>2970</td>
<td>78</td>
<td>free - L2 (1720):tigr</td>
<td>lost</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>49. lion</td>
<td>1590</td>
<td>2600 (L2)</td>
<td>2400 (tigr)</td>
<td>1970 (L2)</td>
<td>free - L1 (1720):tigr</td>
<td>3150 (L2)</td>
<td>free - L2 (3440)</td>
</tr>
<tr>
<td>50. mask</td>
<td>6750 (ambig.)</td>
<td>3840</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>51. money</td>
<td>amb.</td>
<td>1280</td>
<td>2850</td>
<td>block - 11310</td>
<td>free - L1 (2380)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>52. mouse</td>
<td>700</td>
<td>940</td>
<td>1100</td>
<td>1340</td>
<td>free - L1 (8370)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>53. nest</td>
<td></td>
<td></td>
<td></td>
<td>free - L1 (3700)</td>
<td>free - L1 (3780)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>54. owl</td>
<td>1470</td>
<td>980</td>
<td>1580</td>
<td>680</td>
<td>8170</td>
<td>free - L2 (1060):jeans</td>
<td></td>
</tr>
<tr>
<td>55. pants</td>
<td>free - L1 (3700)</td>
<td>free - L1 (3780)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56. pear</td>
<td>820</td>
<td>910</td>
<td>880</td>
<td>3310</td>
<td>free - L2 (4180)</td>
<td>2190</td>
<td>free - L1 (2310)</td>
</tr>
<tr>
<td>57. pen</td>
<td>1870</td>
<td>3710</td>
<td>1870</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>58. pencil</td>
<td>940</td>
<td>1240</td>
<td>1250</td>
<td></td>
<td>block - 2790</td>
<td>free - L1</td>
<td></td>
</tr>
<tr>
<td>Item</td>
<td>Code 1</td>
<td>Code 2</td>
<td>Code 3</td>
<td>Code 4</td>
<td>Code 5</td>
<td>Code 6</td>
<td>Code 7</td>
</tr>
<tr>
<td>---------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
<td>--------</td>
</tr>
<tr>
<td>plant</td>
<td>L2</td>
<td>free</td>
<td>-59</td>
<td>L2</td>
<td>free</td>
<td>-4980</td>
<td>453</td>
</tr>
<tr>
<td>plate</td>
<td>660</td>
<td>840</td>
<td>-60</td>
<td>3000</td>
<td>-930</td>
<td>1090</td>
<td>-641</td>
</tr>
<tr>
<td>queen</td>
<td>L1</td>
<td>free</td>
<td>-61</td>
<td>5030</td>
<td>-2880</td>
<td>1590</td>
<td>1520</td>
</tr>
<tr>
<td>rocket</td>
<td>1800</td>
<td></td>
<td>-62</td>
<td>3680</td>
<td>-1090</td>
<td>5030</td>
<td>-2880</td>
</tr>
<tr>
<td>shirt</td>
<td>2820</td>
<td>lost</td>
<td>-63</td>
<td>2880</td>
<td>-3250</td>
<td>3340</td>
<td>1800</td>
</tr>
<tr>
<td>shoe</td>
<td></td>
<td></td>
<td>-64</td>
<td>2800</td>
<td>-1590</td>
<td>1520</td>
<td>block</td>
</tr>
<tr>
<td>sink</td>
<td>4970</td>
<td>9470</td>
<td>2900</td>
<td>3190</td>
<td>5030</td>
<td>2880</td>
<td></td>
</tr>
<tr>
<td>six</td>
<td></td>
<td></td>
<td>-67</td>
<td>940</td>
<td>free</td>
<td>L1</td>
<td>(3220)</td>
</tr>
<tr>
<td>skirt</td>
<td>870</td>
<td>1190</td>
<td>1080</td>
<td>890</td>
<td>free</td>
<td>L2</td>
<td>(3030)</td>
</tr>
<tr>
<td>slide</td>
<td>810</td>
<td>810</td>
<td>990</td>
<td>1720</td>
<td>1340</td>
<td>3150</td>
<td>1590</td>
</tr>
<tr>
<td>sock</td>
<td>5430</td>
<td>9470</td>
<td>950</td>
<td>6750</td>
<td>1340</td>
<td>3150</td>
<td>1590</td>
</tr>
<tr>
<td>spoon</td>
<td>1790</td>
<td>760</td>
<td>1200</td>
<td>1220</td>
<td>910</td>
<td>free</td>
<td>L1</td>
</tr>
<tr>
<td>stairs</td>
<td>970</td>
<td>960</td>
<td>1530</td>
<td>940</td>
<td>free</td>
<td>L1</td>
<td>(3220)</td>
</tr>
<tr>
<td>stove</td>
<td>1180</td>
<td>4060</td>
<td>1760</td>
<td>3870</td>
<td>1340</td>
<td>free</td>
<td>L2</td>
</tr>
<tr>
<td>swing</td>
<td>720</td>
<td>1560</td>
<td>980</td>
<td>2130</td>
<td>free</td>
<td>L1</td>
<td>(680)</td>
</tr>
<tr>
<td>telephone</td>
<td>free</td>
<td>L2</td>
<td>(880)</td>
<td>690</td>
<td>1250</td>
<td>3780</td>
<td></td>
</tr>
<tr>
<td>tiger</td>
<td>1500</td>
<td>free</td>
<td>L1</td>
<td>3150</td>
<td>free</td>
<td>L2</td>
<td>(1280)</td>
</tr>
<tr>
<td>three</td>
<td>1340</td>
<td>1840</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Name</td>
<td>RT</td>
<td>#2</td>
<td>#3</td>
<td>#4</td>
<td>#5</td>
<td>#6</td>
<td>#7</td>
</tr>
<tr>
<td>---------------</td>
<td>----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>-----</td>
<td>----------------</td>
<td>-----</td>
</tr>
<tr>
<td>77. turtle</td>
<td>940</td>
<td>1150</td>
<td>2050</td>
<td></td>
<td>630</td>
<td>free - L1 (1660)</td>
<td>870</td>
</tr>
<tr>
<td>78. twelve</td>
<td>780</td>
<td>760</td>
<td>3130</td>
<td></td>
<td></td>
<td>free - L1 (5030)</td>
<td>1120</td>
</tr>
<tr>
<td>79. watch</td>
<td>1080</td>
<td>2320</td>
<td>1980</td>
<td></td>
<td>5600</td>
<td>960 free - L1 (9560) block - (5440) free - L1 (1660)</td>
<td></td>
</tr>
<tr>
<td>80. water</td>
<td>2370</td>
<td>760</td>
<td></td>
<td></td>
<td></td>
<td>free - L1 block - (710) free - L1 block - 1290 (delfin)</td>
<td>2060 (delfin) 6750 (delfin) 870 (delfin)</td>
</tr>
<tr>
<td>81. wheel</td>
<td>1600</td>
<td></td>
<td></td>
<td>free - L2 (1720): dolphin</td>
<td>780 (L2)</td>
<td></td>
<td>780 (L2)</td>
</tr>
<tr>
<td>82. whale</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1290 (delfin)</td>
<td></td>
</tr>
<tr>
<td>83. zebra</td>
<td>2680 (L2)</td>
<td>lost</td>
<td></td>
<td>lost</td>
<td>780 (L2)</td>
<td></td>
<td>free - L2 (2130)</td>
</tr>
</tbody>
</table>

*Note: The data is pulled out of the picture naming task if not specified otherwise.*

**Table A.2 Across item analysis (nouns) English**
<p>| | | | | | | | | | | | | | | | | | | | |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |
| 1560 | 1720 | 780 | 600 | 810 | 750 | 2090 | 810 | 600 | 2370 | 1030 | 1340 | 2570 | 1060 | 2970 | 1620 | 900 | 1060 | 790 | 460 | 2030 | 1320 | 1310 | 1590 | 1060 | 1500 | 2970 | 1500 | 1820 | 910 | 810 | 2970 | 1500 | 1820 | 910 | 810 | 2970 | 1500 | 1820 | 910 | 810 |
|   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |   |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>52. mouse</td>
<td>750</td>
<td>1690</td>
<td>970</td>
<td>820</td>
<td>1470</td>
<td></td>
</tr>
<tr>
<td>53. nest</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>54. owl</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>55. pants</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>56. pear</td>
<td></td>
<td></td>
<td></td>
<td>1900</td>
<td></td>
<td></td>
</tr>
<tr>
<td>57. pen</td>
<td></td>
<td>1380</td>
<td>860</td>
<td>650</td>
<td>1560</td>
<td></td>
</tr>
<tr>
<td>58. pencil</td>
<td>1060</td>
<td>720</td>
<td>750</td>
<td>760</td>
<td></td>
<td></td>
</tr>
<tr>
<td>59. plant</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td>1810 (flower)</td>
<td></td>
</tr>
<tr>
<td>60. plate</td>
<td>1200</td>
<td>720</td>
<td></td>
<td></td>
<td>1690</td>
<td></td>
</tr>
<tr>
<td>61. queen</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>62. rocket</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>63. shirt</td>
<td>1600</td>
<td>3100</td>
<td></td>
<td>2060 (jacket)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>64. shoe</td>
<td>910</td>
<td>3160</td>
<td>1160</td>
<td>1190</td>
<td>1250</td>
<td></td>
</tr>
<tr>
<td>65. sink</td>
<td></td>
<td></td>
<td></td>
<td>91</td>
<td>138</td>
<td></td>
</tr>
<tr>
<td>66. six</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>67. skirt</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>68. slide</td>
<td></td>
<td>980</td>
<td>1280</td>
<td>770</td>
<td></td>
<td></td>
</tr>
<tr>
<td>69. sock</td>
<td></td>
<td>1000</td>
<td>880</td>
<td>850</td>
<td>690</td>
<td></td>
</tr>
<tr>
<td>70. spoon</td>
<td>800</td>
<td>2590</td>
<td>1290</td>
<td>1160</td>
<td></td>
<td></td>
</tr>
<tr>
<td>71. stairs</td>
<td>2500</td>
<td>3000</td>
<td></td>
<td>720</td>
<td>3940</td>
<td></td>
</tr>
<tr>
<td>72. stove</td>
<td></td>
<td></td>
<td></td>
<td>122</td>
<td></td>
<td></td>
</tr>
<tr>
<td>73. swing</td>
<td>1220</td>
<td>840</td>
<td>900</td>
<td>1220</td>
<td>620</td>
<td></td>
</tr>
<tr>
<td>74. telephone</td>
<td></td>
<td></td>
<td></td>
<td>720</td>
<td>680</td>
<td></td>
</tr>
<tr>
<td>75. tiger</td>
<td>810</td>
<td>1280</td>
<td>1100 (L1)</td>
<td>1580</td>
<td>720</td>
<td></td>
</tr>
<tr>
<td>76. three</td>
<td>1720</td>
<td>980</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>77. turtle</td>
<td>880</td>
<td>5850</td>
<td>5690</td>
<td>850</td>
<td></td>
<td></td>
</tr>
<tr>
<td>78. twelve</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>79. watch</td>
<td>3200 (clock)</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>80. water</td>
<td>1100</td>
<td>1380</td>
<td>1060</td>
<td>840</td>
<td></td>
<td></td>
</tr>
<tr>
<td>81. wheel</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>82. whale</td>
<td></td>
<td></td>
<td></td>
<td>4750 (dolphin)</td>
<td>880 (dolphin)</td>
<td>630 (dolphin)</td>
</tr>
<tr>
<td>83. zebra</td>
<td>630</td>
<td>780</td>
<td>680</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Note: The data is pulled out of the picture naming task if not specified otherwise.
Table A.3 Word frequency

<table>
<thead>
<tr>
<th>Name</th>
<th>Frequency</th>
<th>Rank</th>
</tr>
</thead>
<tbody>
<tr>
<td>camel</td>
<td>1</td>
<td>50406</td>
</tr>
<tr>
<td>carrot</td>
<td>1</td>
<td>50406</td>
</tr>
<tr>
<td>frog</td>
<td>1</td>
<td>50406</td>
</tr>
<tr>
<td>whale</td>
<td>1</td>
<td>50406</td>
</tr>
<tr>
<td>zebra</td>
<td>1</td>
<td>50406</td>
</tr>
<tr>
<td>broom</td>
<td>2</td>
<td>27863</td>
</tr>
<tr>
<td>hive</td>
<td>2</td>
<td>27863</td>
</tr>
<tr>
<td>owl</td>
<td>2</td>
<td>27863</td>
</tr>
<tr>
<td>grape</td>
<td>3</td>
<td>20630</td>
</tr>
<tr>
<td>sock</td>
<td>4</td>
<td>16683</td>
</tr>
<tr>
<td>bike</td>
<td>5</td>
<td>14218</td>
</tr>
<tr>
<td>pear</td>
<td>6</td>
<td>12398</td>
</tr>
<tr>
<td>spoon</td>
<td>6</td>
<td>12398</td>
</tr>
<tr>
<td>elephant</td>
<td>7</td>
<td>11119</td>
</tr>
<tr>
<td>rocket</td>
<td>7</td>
<td>11119</td>
</tr>
<tr>
<td>tiger</td>
<td>7</td>
<td>11119</td>
</tr>
<tr>
<td>turtle</td>
<td>8</td>
<td>9998</td>
</tr>
<tr>
<td>cage</td>
<td>9</td>
<td>9173</td>
</tr>
<tr>
<td>duck</td>
<td>9</td>
<td>9173</td>
</tr>
<tr>
<td>(goose)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>hammer</td>
<td>9</td>
<td>9173</td>
</tr>
<tr>
<td>hose</td>
<td>9</td>
<td>9173</td>
</tr>
<tr>
<td>mask</td>
<td>9</td>
<td>9173</td>
</tr>
<tr>
<td>pants</td>
<td>9</td>
<td>9173</td>
</tr>
<tr>
<td>balloon</td>
<td>10</td>
<td>8478</td>
</tr>
<tr>
<td>mouse</td>
<td>10</td>
<td>8478</td>
</tr>
<tr>
<td>airplane</td>
<td>11</td>
<td>7919</td>
</tr>
<tr>
<td>leaf</td>
<td>12</td>
<td>7421</td>
</tr>
<tr>
<td>deer</td>
<td>13</td>
<td>6987</td>
</tr>
<tr>
<td>fork</td>
<td>14</td>
<td>6597</td>
</tr>
<tr>
<td>shoe</td>
<td>14</td>
<td>6597</td>
</tr>
<tr>
<td>stove</td>
<td>15</td>
<td>6273</td>
</tr>
<tr>
<td>flag</td>
<td>16</td>
<td>5972</td>
</tr>
<tr>
<td>lion</td>
<td>17</td>
<td>5658</td>
</tr>
<tr>
<td>pen</td>
<td>18</td>
<td>5403</td>
</tr>
<tr>
<td>ladder</td>
<td>19</td>
<td>5182</td>
</tr>
<tr>
<td>boots</td>
<td>20</td>
<td>4984</td>
</tr>
<tr>
<td>clock</td>
<td>20</td>
<td>4984</td>
</tr>
<tr>
<td>nest</td>
<td>20</td>
<td>4984</td>
</tr>
<tr>
<td>slide</td>
<td>20</td>
<td>4984</td>
</tr>
<tr>
<td>dishes</td>
<td>21</td>
<td>4777</td>
</tr>
<tr>
<td>skirt</td>
<td>21</td>
<td>4777</td>
</tr>
<tr>
<td>plate</td>
<td>22</td>
<td>4584</td>
</tr>
<tr>
<td>cat</td>
<td>23</td>
<td>4426</td>
</tr>
<tr>
<td>flower</td>
<td>23</td>
<td>4426</td>
</tr>
<tr>
<td>sink</td>
<td>23</td>
<td>4426</td>
</tr>
<tr>
<td>swing</td>
<td>24</td>
<td>4270</td>
</tr>
<tr>
<td>shirt</td>
<td>27</td>
<td>3906</td>
</tr>
<tr>
<td>belt</td>
<td>29</td>
<td>3691</td>
</tr>
<tr>
<td>fence</td>
<td>30</td>
<td>3593</td>
</tr>
<tr>
<td>pencil</td>
<td>34</td>
<td>3244</td>
</tr>
<tr>
<td>bench</td>
<td>35</td>
<td>3157</td>
</tr>
</tbody>
</table>

Reproduced with permission of the copyright owner. Further reproduction prohibited without permission.
<p>| | | | |</p>
<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>52.</td>
<td>chicken</td>
<td>37</td>
<td>3005</td>
</tr>
<tr>
<td>53.</td>
<td>eleven</td>
<td>40</td>
<td>2796</td>
</tr>
<tr>
<td>54.</td>
<td>bread</td>
<td>41</td>
<td>2719</td>
</tr>
<tr>
<td>55.</td>
<td>queen</td>
<td>41</td>
<td>2719</td>
</tr>
<tr>
<td>56.</td>
<td>coat</td>
<td>43</td>
<td>2604</td>
</tr>
<tr>
<td>57.</td>
<td>brush</td>
<td>44</td>
<td>2545</td>
</tr>
<tr>
<td>58.</td>
<td>cup</td>
<td>45</td>
<td>2485</td>
</tr>
<tr>
<td>59.</td>
<td>stairs</td>
<td>47</td>
<td>2376</td>
</tr>
<tr>
<td>60.</td>
<td>twelve</td>
<td>48</td>
<td>2316</td>
</tr>
<tr>
<td>61.</td>
<td>chest</td>
<td>53</td>
<td>2126</td>
</tr>
<tr>
<td>62.</td>
<td>wheel</td>
<td>56</td>
<td>2006</td>
</tr>
<tr>
<td>63.</td>
<td>desk</td>
<td>65</td>
<td>1704</td>
</tr>
<tr>
<td>64.</td>
<td>dress</td>
<td>67</td>
<td>1644</td>
</tr>
<tr>
<td>65.</td>
<td>box</td>
<td>70</td>
<td>1561</td>
</tr>
<tr>
<td>66.</td>
<td>boat</td>
<td>72</td>
<td>1513</td>
</tr>
<tr>
<td>67.</td>
<td>knife</td>
<td>76</td>
<td>1418</td>
</tr>
<tr>
<td>68.</td>
<td>telephone</td>
<td>76</td>
<td>1418</td>
</tr>
<tr>
<td>69.</td>
<td>watch</td>
<td>81</td>
<td>1348</td>
</tr>
<tr>
<td>70.</td>
<td>king</td>
<td>88</td>
<td>1223</td>
</tr>
<tr>
<td>71.</td>
<td>eight</td>
<td>104</td>
<td>1025</td>
</tr>
<tr>
<td>72.</td>
<td>plant</td>
<td>125</td>
<td>842</td>
</tr>
<tr>
<td>73.</td>
<td>letter</td>
<td>145</td>
<td>693</td>
</tr>
<tr>
<td>74.</td>
<td>floor</td>
<td>158</td>
<td>631</td>
</tr>
<tr>
<td>75.</td>
<td>fire</td>
<td>187</td>
<td>516</td>
</tr>
<tr>
<td>76.</td>
<td>six</td>
<td>220</td>
<td>426</td>
</tr>
<tr>
<td>77.</td>
<td>money</td>
<td>265</td>
<td>356</td>
</tr>
<tr>
<td>78.</td>
<td>door</td>
<td>312</td>
<td>299</td>
</tr>
<tr>
<td>79.</td>
<td>church</td>
<td>348</td>
<td>271</td>
</tr>
<tr>
<td>80.</td>
<td>children</td>
<td>355</td>
<td>268</td>
</tr>
<tr>
<td>81.</td>
<td>four</td>
<td>359</td>
<td>265</td>
</tr>
<tr>
<td>82.</td>
<td>water</td>
<td>442</td>
<td>195</td>
</tr>
<tr>
<td>83.</td>
<td>three</td>
<td>610</td>
<td>152</td>
</tr>
</tbody>
</table>
# APPENDIX B. EXPERIMENTAL STUDY STIMULI

Table B.1 List of stimuli used in the experimental study

<table>
<thead>
<tr>
<th>Group</th>
<th>Russian</th>
<th>Hebrew</th>
<th>English translation</th>
</tr>
</thead>
<tbody>
<tr>
<td>experimental</td>
<td>palto</td>
<td>me’il</td>
<td>coat</td>
</tr>
<tr>
<td></td>
<td>zabor</td>
<td>gader</td>
<td>fence</td>
</tr>
<tr>
<td></td>
<td>vilka</td>
<td>mazieg</td>
<td>fork</td>
</tr>
<tr>
<td></td>
<td>pol</td>
<td>ritzpa</td>
<td>floor</td>
</tr>
<tr>
<td></td>
<td>voda</td>
<td>ma’im</td>
<td>water</td>
</tr>
<tr>
<td></td>
<td>stakan</td>
<td>kos</td>
<td>glass</td>
</tr>
<tr>
<td></td>
<td>hleb</td>
<td>lehem</td>
<td>bread</td>
</tr>
<tr>
<td></td>
<td>shar</td>
<td>kadur</td>
<td>balloon</td>
</tr>
<tr>
<td>verbs</td>
<td>vidit</td>
<td>ro’eh</td>
<td>see</td>
</tr>
<tr>
<td></td>
<td>sh’et</td>
<td>tofer</td>
<td>sew</td>
</tr>
<tr>
<td></td>
<td>spit</td>
<td>jashen</td>
<td>sleep</td>
</tr>
<tr>
<td></td>
<td>svistit</td>
<td>shorek</td>
<td>whistle</td>
</tr>
<tr>
<td></td>
<td>stroit</td>
<td>boneh</td>
<td>build</td>
</tr>
<tr>
<td></td>
<td>stuchit</td>
<td>dofek</td>
<td>knock</td>
</tr>
<tr>
<td></td>
<td>l’jet</td>
<td>mozeg</td>
<td>pour</td>
</tr>
<tr>
<td></td>
<td>bezit</td>
<td>ratz</td>
<td>run</td>
</tr>
<tr>
<td>control with</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Russian as L1</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>(Hebrew words)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>nouns</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>motsos</td>
<td>airplane</td>
<td></td>
</tr>
<tr>
<td></td>
<td>kufsa</td>
<td>box</td>
<td></td>
</tr>
<tr>
<td></td>
<td>kluv</td>
<td>cage</td>
<td></td>
</tr>
<tr>
<td></td>
<td>hatul</td>
<td>cat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>pil</td>
<td>elephant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>sakin</td>
<td>knife</td>
<td></td>
</tr>
<tr>
<td></td>
<td>ele</td>
<td>leaf</td>
<td></td>
</tr>
<tr>
<td></td>
<td>kesef</td>
<td>money</td>
<td></td>
</tr>
<tr>
<td>verbs</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>ohel</td>
<td>eat</td>
<td></td>
</tr>
<tr>
<td></td>
<td>nose</td>
<td>carry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>tofes</td>
<td>catch</td>
<td></td>
</tr>
<tr>
<td></td>
<td>bohe</td>
<td>cry</td>
<td></td>
</tr>
<tr>
<td></td>
<td>roked</td>
<td>dance</td>
<td></td>
</tr>
<tr>
<td></td>
<td>af</td>
<td>fly</td>
<td></td>
</tr>
<tr>
<td></td>
<td>shotel</td>
<td>plant</td>
<td></td>
</tr>
<tr>
<td></td>
<td>kore</td>
<td>read</td>
<td></td>
</tr>
</tbody>
</table>
control with Hebrew
as L1 (Russian words)

<table>
<thead>
<tr>
<th>Nouns</th>
<th>Hebrew</th>
</tr>
</thead>
<tbody>
<tr>
<td>gorka</td>
<td>slide</td>
</tr>
<tr>
<td>metla</td>
<td>broom</td>
</tr>
<tr>
<td>korol</td>
<td>king</td>
</tr>
<tr>
<td>list</td>
<td>leaf</td>
</tr>
<tr>
<td>lev</td>
<td>lion</td>
</tr>
<tr>
<td>sova</td>
<td>owl</td>
</tr>
<tr>
<td>grusha</td>
<td>pear</td>
</tr>
<tr>
<td>kit</td>
<td>whale</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Verbs</th>
<th>Hebrew</th>
</tr>
</thead>
<tbody>
<tr>
<td>est</td>
<td>eat</td>
</tr>
<tr>
<td>du'jet</td>
<td>blow</td>
</tr>
<tr>
<td>neset</td>
<td>carry</td>
</tr>
<tr>
<td>plachet</td>
<td>cry</td>
</tr>
<tr>
<td>letit</td>
<td>fly</td>
</tr>
<tr>
<td>gladit</td>
<td>iron</td>
</tr>
<tr>
<td>pilit</td>
<td>saw</td>
</tr>
<tr>
<td>mo'jet</td>
<td>wash</td>
</tr>
</tbody>
</table>
VITA

Ludmila Isurin, a former Soviet citizen, was born in St. Petersburg, Russia. In 1981 she graduated from St. Petersburg State University with a master’s degree in English language and American literature. She emigrated with her husband and a baby daughter to Israel in 1990. In 1996 she was admitted to the doctorate program at Louisiana State University and moved to the United States. She is trilingual in Russian, English, and Hebrew. Ludmila has acquired a broad cultural and academic experience of teaching undergraduate students in three countries for the last 17 years. The topic of her dissertation research has been on her mind since she left Russia. She will receive the degree of Doctor of Philosophy in August, 1999.
DOCTORAL EXAMINATION AND DISSERTATION REPORT

Candidate:  Ludmila Isurin

Major Field:  Linguistics

Title of Dissertation:  Mechanisms of First Language Forgetting

Approved:

[Signature]
Major Professor and Chairman

[Signature]
Dean of the Graduate School

EXAMINING COMMITTEE:

[Signatures]

Date of Examination:  May 7, 1999