

Masked lexical priming between close and distant languages.

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Abstract

The masked priming effect from L2 to L1 (where L1 is a native language) was reported where meaning priming were strongest. In our experiment conducted in 2018 (“Form and meaning effects: cross-linguistic priming Norwegian Russian”) the findings demonstrated a different result: the form priming is stronger than meaning priming. In the present research, we examined the relation between meaning and form in a masked priming cross-linguistic experiment. The experiment was a lexical decision task. Twenty-two Russian-Ukrainian-Norwegian trilingual subjects participated where Russian is the mother tongue along with Ukrainian (balanced bilinguals) and Norwegian is a language learnt when moved to Norway. Word pairs having a relation between prime stimuli and target stimuli were from four groups: cognates (the same meaning and form), false friends (the same form with different meaning), translations (the same meaning with different form) and unrelated (different meaning and form). Each group consisted of 10 words pairs. One hypothesis was that there would be a stronger priming effect from Ukrainian (L2) primed words than from Norwegian (L3) primed words. Another hypothesis was that Norwegian words (L3) will have more significant priming effect on meaning related target words for Russian Native Speakers (L1) than Ukrainian words (L2).

The findings show meaning effect advantage over the form in both experiments. The results show more significant priming effect in Form for the L1 (Russian) words primed by L2 (Ukrainian) words than those primed by L3 (Norwegian) words. This supports the hypotheses.

Sammendrag

I den maskerte primingeffekt fra L2 til L1 (hvor L1 er morsmål) ble det rapportert at betydningspriming var sterkest. I vårt eksperiment som ble utført i 2018 (“Form og betydning effekter: tverrspråklig priming norsk-russisk”) viste funnene et annet resultat: formpriming er sterkere enn betydningspriming. I den nåværende forskningen undersøkte vi forholdet mellom betydning og form i maskert priming på tvers av språklig eksperiment. Det eksperimentet var leksikalsk avgjørelsesoppgave (lexical decision task). Tjueto russisk-ukrainsk-norsk trespråklige personer deltok, der russisk er morsmål sammen med ukrainsk (balanserte tospråklige) og norsk er språket som ble lært da de flyttet til Norge. Ordpar som har en sammenheng mellom primære stimuli og målstimuli besto av fire grupper: kognater (samme betydning og form), falske venner (samme form og annen betydning), oversettelser (samme betydning og forskjellig form) og ikke relatert (annen betydning og form). Hver gruppe besto av 10 ordpar. En hypotese var at det ville være en sterkere primingeffekt fra ukrainske (L2) primede ord enn fra norske (L3) primede ord. En annen hypotese var norske ord (L3) vil ha mer signifikant primingeffekt på betydningsrelaterte mål ord for russiske morsmål (L1) enn ukrainske ord (L2). Funnene viser betydningseffektfordelen fremfor formen i begge eksperimentene. Resultatene viser mer signifikant primingeffekt i form for L1 (russiske) ord primet av L2 (ukrainsk) ord enn de primet av L3 (norske) ord. Dette støtter hypotesene.

Table of contents

Acknowledgement	ii
Abstract	iii
Sammendrag	iv
1. Introduction	1
1.1 Bilingualism	2
1.1.1 Main characteristics of a bilingual	4
1.2 Multilingualism	5
1.3 Research hypothesis	6
1.4 Terms and definitions	7
1.5 Organization of the thesis	8
2. Theory	10
2.1 Linguacultural space of European languages	10
2.2 Lexical distances	11
2.3 Cyrillic	15
2.4 Latin	16
2.5 Comparing Cyril and Latin alphabets	17
2.6 Orthographic distances between Norwegian, Russian and Ukrainian	18
2.7 Lexical representation of languages in the mind of a bilingual individual	22
2.7.1 Interdependence Hypothesis	23
2.7.2 Independence Hypothesis	24
2.7.3 The Sub-set Hypothesis	25
2.7.4 The Sub-set Hypothesis	26
2.7.5 Asymmetry Hypothesis	28
2.8 Trilingual mental lexicon	30
3. Methodology	33
3.1 Priming in modern linguistic research	33
3.2 History of the priming study	34
3.3 Types of priming	36

3.4	Lexical decision task	37
3.5	Participants	38
3.6	Experimental materials	39
3.6.1	False Friends	40
3.6.2	Cognates.....	40
3.6.3	Translations.....	41
3.6.4	Unrelated.....	41
3.6.5	Non-words.....	41
3.7	Experiment Procedure	42
3.8	Experiment Design	42
3.9	Performing the experiment	45
4.	Results	46
4.1	The first experiment set L3L1 (Nor-Russ)	46
4.1.1	Participants.....	46
4.1.2	Experiment.....	47
4.1.3	Results.....	47
4.2	The second experiment set L2L1 (Ukr-Russ)	51
4.2.1	Participants.....	51
4.2.2	Experiment.....	51
4.2.3	Results.....	52
4.3	Results for nonwords	56
5.	Conclusion	58
5.1	Discussion	58
5.2	Final Conclusion	59
5.3	Further Research	60
	Bibliography	61

Illustrations

Figures

Figure 2.1: Map of linguacultural space of European languages

Figure 2.2: Vocabulary differential distances of European languages proposed by Tischenko

Figure 2.3: Lexical Distance Among Languages of Europe by Steinbach

Figure 2.4: Calculations visualisation

Figure 2.5: Usage of the Cyrillic script around the world

Figure 2.6: Usage of the Latin script around the world

Figure 2.7: Letters in common

Figure 2.8: Heatmap visualizes matrix of distances

Figure 2.9: 3D-scale plot. Dissimilarities between Ukrainian, Russian, and Norwegian dictionaries

Figure 2.10: Concept-mediation

Figure 2.11: Word-association

Figure 2.12: Conceptual hypothesis

Figure 2.13: L1 and L2 stand for particular L1 and L2 words

Figure 2.14: The Revised Hierarchical Model

Figure 2.15: Model of trilingual mental lexicon

Figure 3.1: Cedrus response box RB-540

Figure 3.2: Priming sequence for experiment set #1 from L3 (Norwegian) to L1 (Russian)

Figure 3.3: Priming sequence for experiment set #2 from L2 (Ukrainian) to L1 (Russian)

Figure 4.1: Interaction of language and meaning for set 1 of the experiment

Figure 4.2: Interaction of language and form for set 1 of the experiment

Figure 4.3: Boxplot of RT across all categories for Nor-Rus set of the experiment

Figure 4.4: Interaction of language and meaning for set 2 of the experiment

Figure 4.5: Interaction of language and form for set 2 of the experiment

Figure 4.6: Boxplot of RT across all categories for Ukr-Rus set of the experiment

Figure 4.7: Boxplot of RT for nonwords

Figure 4.8: Mean reaction times for nonwords in four experiments

Tables

Table 2.1: Letters used both in the Latin and the Cyrillic alphabet

Table 2.2: Distance matrix

Table 2.3: Months of the year in Ukrainian, Russian and Norwegian

Table 3.1: Word pair relations

Table 4.1: Estimated RTs from regression Experiment 1

Table 4.2: ANOVA table for the regression analysis (Mixed Effects Model) Experiment 1

Table 4.3: Estimated RTs from regression Experiment 2

Table 4.4: ANOVA table for the regression analysis (Mixed Effects Model), Experiment 2

Table 4.5: Estimated RTs from regression (NONWORDS)

Chapter 1

1. Introduction

The globalization of the world economy leads to the formation of a global human population. In this regard, it is not surprising that special attention is being paid to the phenomenon of bilingualism and multilingualism. Those who speak more than one language are welcomed in the era of globalization because they facilitate integration processes between cultures of different countries of the world. On the other hand, one can sometimes hear doubts about the ability of bilinguals to equally fully function in both cultures and even about the negative impact of bilingualism on the cognitive development of children. The last statement, however, has been repeatedly refuted by numerous studies, according to which bilingual children are not behind their peers in development, but surpass them in tests for cognitive control (Jouravlev et al., 2014).

The study of mental lexicon is one of the actual linguistic problems associated with the explanation of the processes of perception and speech production. If the text is produced in a foreign language, there are problems of access to units of the bilingual/multilingual lexicon. Thus, mental lexicon is associated with the processes of recognition and understanding of the word (word recognition) and access to the word in the generation of speech (word activation lexical access) (Kornievskaya, 2012).

The main questions in studying the mental lexicon of a bilingual individual are whether it represents two separate systems of lexical representations for each language or a single internal vocabulary and whether mastering a second language imply the formation of a second system of concepts or do both languages have a single conceptual unit.

Weinreich identifies three possible types of representations in the bilingual mental lexicon: general conceptual representations (compounds), two separate conceptual representations (coordinate) and subordinate, when access to the meaning of a word of a foreign language is carried out only using the meaning of the word of the native language (subordinate) (Weinreich, 1972).

Along with bilinguals, multilinguals draw the attention of researchers too. The study of multilingualism is performed from different points of view and using different methods.

Depending on the scientific direction, various methods are used to solve this issue, from the analysis of experimental data and observations, to studying the areas of activity of the cerebral cortex and building information models.

Tolmacheva (2012) studied the interaction of languages in the mind of a multilingual individual. Her subject was the interaction of languages with different scripts in the minds of a multilingual individual in a mixed multilingualism (when people constantly move from one language to another and use one or the other language, without noticing which language they use in each given case). Her research was based on term-words of three languages - Burmese, English and Russian. The results showed that connection between words of all three languages depend on the cultural and political situation of individuals: Burmese is a native language, English is a language used all over the country due to historical fact (Burma was a colony of Great Britain) and Russian was taught in school due to relations with Soviet Union. Thus, the support in identifying the Russian word term was the word in English in which it was learned, not Burmese (Tolmacheva, 2012).

Current research also is based on three languages: Ukrainian, Russian and Norwegian where Ukrainian is a mother tongue while Russian is a second native language due to the political and cultural situation for individuals who are born in Ukraine 20 years ago or before. This study presents Russian as L1 and Ukrainian as L2, these share the same script. Norwegian is presented as L3 and has different script. This research will look into how the form and meaning similarities affect the response time. This will be done using masked priming lexical decision tasks across three languages.

1.1 Bilingualism

In the modern world, bilingualism is a widespread phenomenon. Researchers of the phenomenon state that at least half of the world's population is bilingual. Bilingualism is found in all age groups, from infants to the elderly, in all walks of life, it cannot be attributed only to the rich and educated. The phenomenon of bilingualism can be found in most countries of the world (Hoffmann, 2014).

Canada and the USA are two countries with many millions of inhabitants who are bilingual: about 35% of Canada's population is bilingual, in the United States this percentage is lower, from 18 to 20%. The number of bilinguals is much higher in other parts of the world. Asia and Africa, where the use of several languages in everyday life is not considered something extraordinary (Grosjean & Li, 2013).

There are several reasons why bilingualism has become a popular area for the researchers. The fact that there are many more languages in the world than countries tells it all. There are more than 200 countries and more than 7000 languages. Due to global immigration and the large number of peoples living in the same territory, in some countries they speak a huge number of languages. Their continuous contact contributes to the appearance of bilingualism. In Nigeria there are 250 languages, 120 in Tanzania and 100 Cameroon. In India one can hear over 150 languages and New Guinea accounts more than 700. In China there are dozens of languages and the American native Indians speak almost 1000 different languages. Therefore, in most countries there are one or two languages of communication that people use along with the local language(s). All this implies the emergence of bilingualism or multilingualism (Katzner, & Miller, 2002).

The other fact is that people have been visiting other countries to conduct trade, business, job search, and for religious reasons throughout history. The current population of many countries is the result of immigration, as an example, the United States of America, Canada, Australia, and many countries of South America. A stream of immigrants has also recently surged into Europe. In most cases, immigrants adopt the language of the host country and therefore become bilinguals. In addition, there are many cases where indigenous people adopt a new language, for example, American Indians in North America or residents of the former Soviet republics in Russia (Levin & Bukin, 2010).

Another important reason for the emergence and spread of bilingualism is bilingual education. Around the world, a large number of students study in foreign countries in a foreign language and become functional bilinguals. According to the requirements of bilingual educational programs, upon completion of training, such students should form a balanced bilingualism which begins when the degree of knowledge of the second language approaches close to the degree of knowledge of the mother tongue (Serova, 2010).

Current research involves individuals who match all these situations discussed above. They are born in the country (Ukraine) which adopted a new language (language) to such an extent that it became a mother tongue for the majority of the population. Therefore, they are born bilingual. Later, they immigrated to another country (Norway) where they learned a new language, thus becoming multilingual.

In modern science, there are many interpretations and of the definition of “bilingualism”. We call a bilingual an individual who is the fluent in two languages at the same time. Thus, all scholars underline in the main thing: bilingualism is fluency in two languages simultaneously. However, none of these definitions indicates the degree of language proficiency.

Before we look at how the mental lexicon of a bilingual or multilingual individual is presented in his brain, we need to look at the main characteristics of a bilingual person.

1.1.1 Main characteristics of a bilingual

Thierry (1978) in his research was arguing that a real bilingual is a person who is accepted by both language communities meaning that he is at the same social and cultural level. He described individuals who had learned L1 and L2 in their early age, before they turned 14. They spoke both languages at home and at work or school. They didn't have an accent in any language. They equally well possessed all the skills in both languages and never mixed languages when communicating with monolinguals (Thiery, 1978). These people are a unique example of a balanced bilinguals. They are not many in the world because most people do not fit these criteria. Many people communicate in two languages every day, but do not speak them equally well and fluently. Very often bilinguals speak with an accent or constantly switch from one to the other.

It is very rare to meet a person who is equally competent in two languages in all communication situations. Most bilinguals usually use two languages for different purposes, in different contexts and with different people. In addition, a balance can exist with a low level of competence in both languages. The idea of balanced bilingualism is unrealistic and yet there is an example of a child who can study all subjects at school in both languages and take part in the work of the class in any language. They are called a real balanced bilingual (Fishman, 1967)

In presented work the individuals who participated in the experiment are very close to balanced bilinguals. Their first language (L1) does not interfere with the second (L2), and this second language is developed to a high degree, close to language proficiency in a native speaker. But the experiment included the third language and therefore the participants no longer are bilinguals but multilinguals.

1.2 Multilingualism

Interest in multilingualism grows rapidly. In Europe it is such an important topic that it is even discussed on a high political level.

Union (EU) presents multilingualism as one of its founding principles. Having 24 official languages the EU is proud to be the territory where more than 60 minority languages are spoken. The Union puts a lot of effort and investment into promote multilingualism among nations. Its goal is each citizen would be able to speak in two languages additionally to the mother tongues (https://europa.eu/european-union/about-eu/eu-languages_en) .

Modern linguistics considers trilingualism as one of the varieties of multilingualism defining it as the ability of an individual to communicate in three languages (Aronin & Singleton, 2012). Trilinguals are people who, to one degree or another, speak three languages and are able to use them for various purposes (Cenoz & Valencia, 1994).

Jarvis and Pavlenko argue that multilingualism is not just the sum of two, three or more languages represented in the human mind, but a system, the characteristics of which are determined, first of all, by interlanguage interactions. In the most general form, interlanguage interactions are defined as the interaction of different societies / ethnic groups and their languages, as well as an individual manifestation of language contacts in the minds of speakers in their mental lexicon (Jarvis & Pavlenko, 2008).

When it comes a trilingual lexicon, the interlanguage interactions have varying characteristics, the specificity of which is largely determined by one or another type of

trilingualism formed by an individual. The typologies of trilingualism that exist today are mostly based on traditional classifications developed for a bilingual:

- a natural type – spontaneous mastering of three languages
- an artificial type - mastering of two foreign languages by a monolingual in an educational setting.

However, as practice shows, in the modern world, trilingualism of a combined type is much more common, which is a combination of natural and artificial methods of mastering of different languages by the same individual. This type of trilingualism arises in cases where natural bilingualism (usually a native speaker of the ethnic language and the state language of the country of residence) studies one more foreign language (Dotsenko et al., 2015). In the present thesis it is the third language - L3.

Combined trilingualism is a combination of three languages learned in different ways, characterized by different levels of proficiency and different areas of use. Therefore, at the forefront in modern studies of trilingualism is the need to study various kinds of relationships between specific languages represented in the mental lexicon of an individual with certain types of trilingualism.

1.3 Research hypothesis

While taking an Experimental psycholinguistics course in 2018 that was a part of the curriculum for the master program in linguistics at the University of Bergen, the term paper related to a cross-linguistic masked primed lexical decision task was presented. The paper was based on the experiment conducted on 20 Russian native speakers (L1) mastering Norwegian (L2) in their adulthood. The findings demonstrate the form priming is stronger than meaning priming. Most surprising is that False Friends are primed, and this is different from earlier experiments.

Two years earlier, native speakers in Spanish and German who had learned Norwegian were tested in a cross-linguistic primed lexical decision task. The aim of the study was to measure the priming effect of Norwegian prime words on L1 target words and to check the connections

between L1 and L2 in the mental lexicon of beginner learners- It was tested how L1 might influence L2 learning. The results presented that "...the German L1 beginner learners had already made a connection between the meanings of the words in their L1 and L2 in their mental lexicon, and that the German L1 speakers have an advantage over Spanish L1 speakers in learning Norwegian" (Sverreson, 2016, p.V).

The aim of this thesis is to test trilingual individuals who are very close to balanced bilinguals in L1 (Russian) and L2 (Ukrainian) and who learned L3 (Norwegian) when they relocated to Norway.

The hypothesis of the study is:

- 1) Russian (L1) will experience a stronger priming effect from Ukrainian (L2) prime words than from Norwegian (L3) primed words. Ukrainian is very closely related to Russian and they were mastered on the same level by participants in their childhood, these two languages share the same script (Cyrillic) while Norwegian was learnt in adulthood and it has quite a different script (Latin).
- 2) Norwegian words (L3) will have more significant priming effect on meaning related target words for Russian Native Speakers (L1) than Ukrainian words (L2).

1.4 Terms and definitions

Before going into detailed theory it is necessary to explain some descriptions. In 1.2 and 1.3 bilinguals and trilinguals are defined. In addition to that, it is best to explain a definition to L1, L2 and L3. The most common definition of L1 is a native speaker. L2 is referred to as second language, L3 to a third acquired language. The logical chain goes on as a person acquires a new language. This is true in many cases and in many studies, but not exactly true for the current one. As it was mentioned above the participants were born in a country that has its national language – Ukrainian. In addition to this, the population also historically speak Russian due to the fact that the country was a part of Soviet Union for longer than 70 years where Russian was the

main language. With gaining independence many changes happened but not much changed in terms of the language. Although Ukrainian was proclaimed as a state language, people continued to speak Russian with family, in schools and at work. Ukrainian has become more popular too and therefore people speak it with family, in schools and at work too. It never bothered anyone until 2015 when the political situation in the county worsened. Despite all the political issues, people continue to use two languages and it is very hard to identify which one is L1 and which one is L2 for each single person. There are people that can state this clearly, but the majority speak both on more or less the same level. Therefore, in the current studies L1 is Russian language as it has been dominant for years, L2 refers to Ukrainian and L3 is Norwegian. Further, Norwegian is L3 for many participants but not all. Some participants spoke fluent English when they moved to Norway, some lived in countries other than Ukraine as a transit point before they moved to Norway and can communicate in the language of the county they resided. Hence, Norwegian is L4 for some participants. As the current research is based on 3 languages, Norwegian is presented as L3 here.

The official language in Norway is Norwegian. Despite the ethnic homogeneity of Norway, two forms of the Norwegian language are clearly distinguished: bokmål and nynorsk. Norwegian courses for foreigners offer bokmål only, therefore all participants who studied Norwegian in Norway were exposed to bokmål. Some of them learned to speak Bergen's dialect too. To avoid any confusion in this study Norwegian is referring to bokmål and all Norwegian words chosen for the experiment are in bokmål.

1.5 Organization of the thesis

The current chapter has presented a background for the research and previous research on the topic. It also highlighted the definitions. The hypothesis was formulated, and the outline of the paper is presented.

Chapter 2 will present lexical and linguacultural distances between three languages used in the experiment together with the attempt to calculate orthographical distances using the Levenshtein matrix. The theoretical background will be presented in the same chapter. It will

discuss several hypotheses of lexical representation of languages in the mind of a bilingual and trilingual individual.

Methodology is outlined in chapter 3 together with experimental design, stimuli and methods.

The results will be presented in Chapter 4 followed by chapter 5 where the results will be discussed, and the conclusion will answer the question as whether the results and research hypotheses are aligned.

Chapter 2

2. Theory

2.1 Linguacultural space of European languages

Kretov with his colleagues Voevudskaya, Merkulova, and Titov (2016) presented a map of linguacultural space of European languages. In order to generate the map information about the words included in the parametric vocabulary core of each of the 35 official languages of Europe, three or more parameters were used. The semantics of these vocabulary cores was analysed, the number of overlaps or matches for each pair of languages was calculated. The match is recognized when words definitions are 50 % or more. To determine the proximity of the lexical-semantic systems of two languages, the number of definition overlaps is divided by the mathematical average of the size of the cores of the two languages being compared, which gives a value - correlation coefficient.

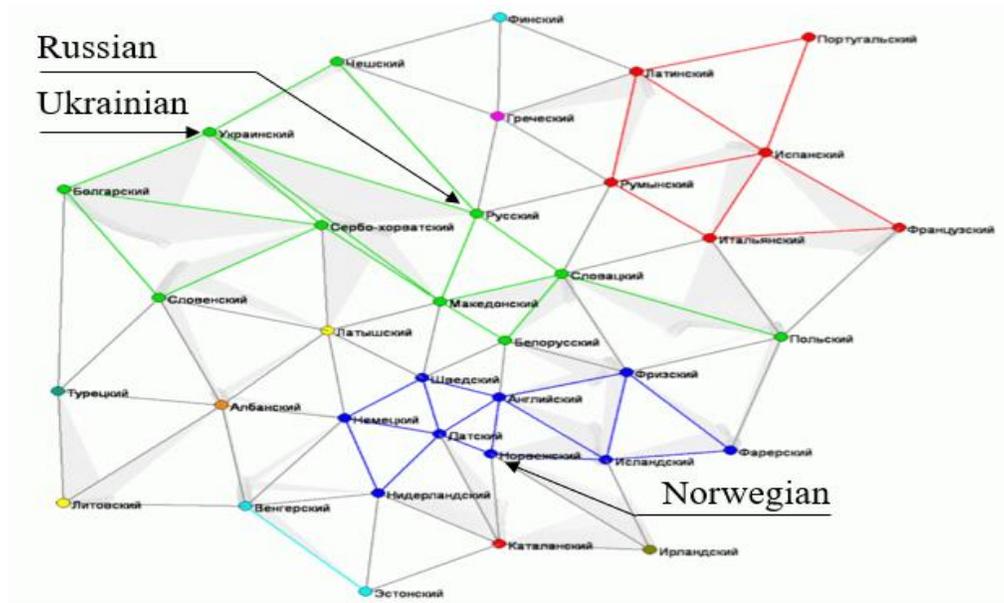


Figure 2.1: Map of linguacultural space of European languages (Kretov, et al., 2016)

The linguistic and cultural space centre of Europe is formed by Germanic languages, forming a compact connected figure. The English-Danish-Norwegian triangle is in the centre, the addition of which Swedish forms a rhombus. Adding Danish-Swedish German to the line forms a triangle and a German-Swedish-Danish-English rhombus. An unexpected result is that for the Germanic group, the centre is neither English nor German languages but English and Danish, which has 5 connections in the German language group and one with Catalan. Slavic languages are in contact with the Baltic (Latvian), Balkan (Albanian, Turkish), Finno-Ugric (Finnish), Greek, Latin, Romance (Romanian, Italian, French) and Germanic (English, Swedish, Frisian, Faroese) languages. When analysing the map, it should be noted that it doesn't reflect a completeness because it describes 35 objects and their connections by projecting it on two-dimensional plane. Nevertheless, even such imperfect visualization of the linguistic and cultural space of Europe gives sufficient analysis and information. (Kretov 2016).

Thus, there are 7 intra-group connections in the Russian and Norwegian while Russian and Ukrainian together with Macedonian forms intra-group itself as well as one more group with Czech. This fact shows how similar Russian and Ukrainian are to each other and how different Russian and Norwegian are from linguacultural angle.

2.2 Lexical distances

In 1997, Ukrainian linguist and Professor Konstantin Tishchenko proposed a map of vocabulary differential distances of European languages. Tishchenko proposed measuring the difference between languages by calculating how many cognates and borrowings they share: the higher percent of shared words means longer distance between languages.

According to the author, Russian and Ukrainian languages' vocabulary difference is 38%. Ukrainian language is the closest to Russian, but Russian is not closest Ukrainian. Ukrainian and Belarusian differ only by 16%, Russian and Bulgarian is by 27%. A very interesting fact is that between Ukrainian that uses Cyrillic alphabet and Czech that uses Latin alphabet, the distance is the same as between Ukrainian and Russian - 38%. Norwegian (Bokmål) in its turn is closest to Danish by 5% difference. (Tishchenko, 2000)

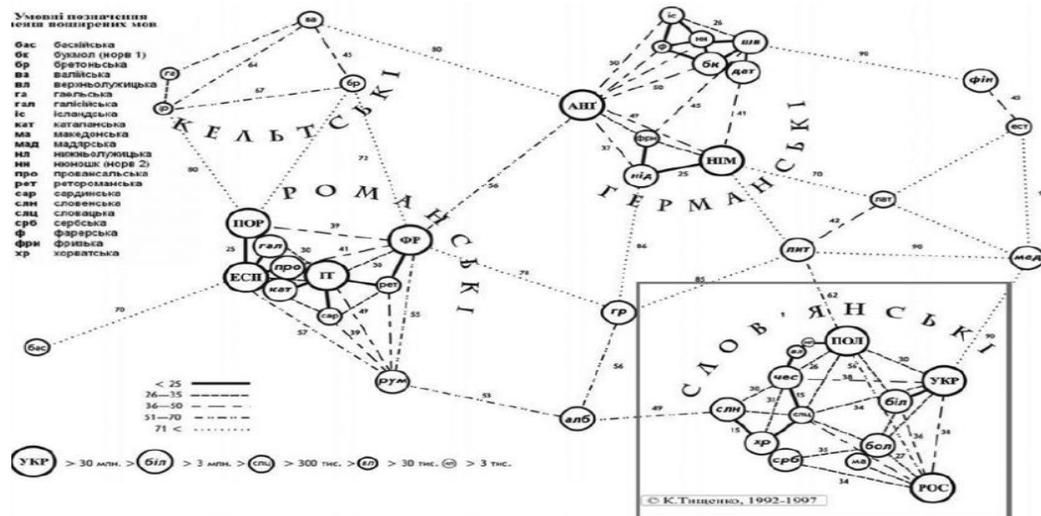


Figure 2.2: Vocabulary differential distances of European languages proposed by Tishchenko (Tishchenko, 2000).

Almost two decades later, the map was borrowed and improved by Steinbach in 2015. He changed the language of the map from Ukrainian to English, made some layout changes and added more languages. When it comes to Norwegian Steinbach considered Norwegian Bokmål and Nynorsk as two languages and therefore, he split up Norwegian accordingly because Bokmål is closer to Danish while Nynorsk is closer to Icelandic (<https://alternativtransport.wordpress.com/2015/05/05/34/>)

Both proposed maps (Tishchenko's and Steinbach's) were criticised mainly for their validity. Only shortened vocabulary was taken for each language comparison and some cognates can be false because they can look alike but have no meaning. There can be international words too (<http://www.openculture.com/2017/08/a-colorful-map-visualizes-the-lexical-distances-between-europes-languages.html>). But even though neither map is perfectly accurate it gives a broad picture of lexical distance among European languages.

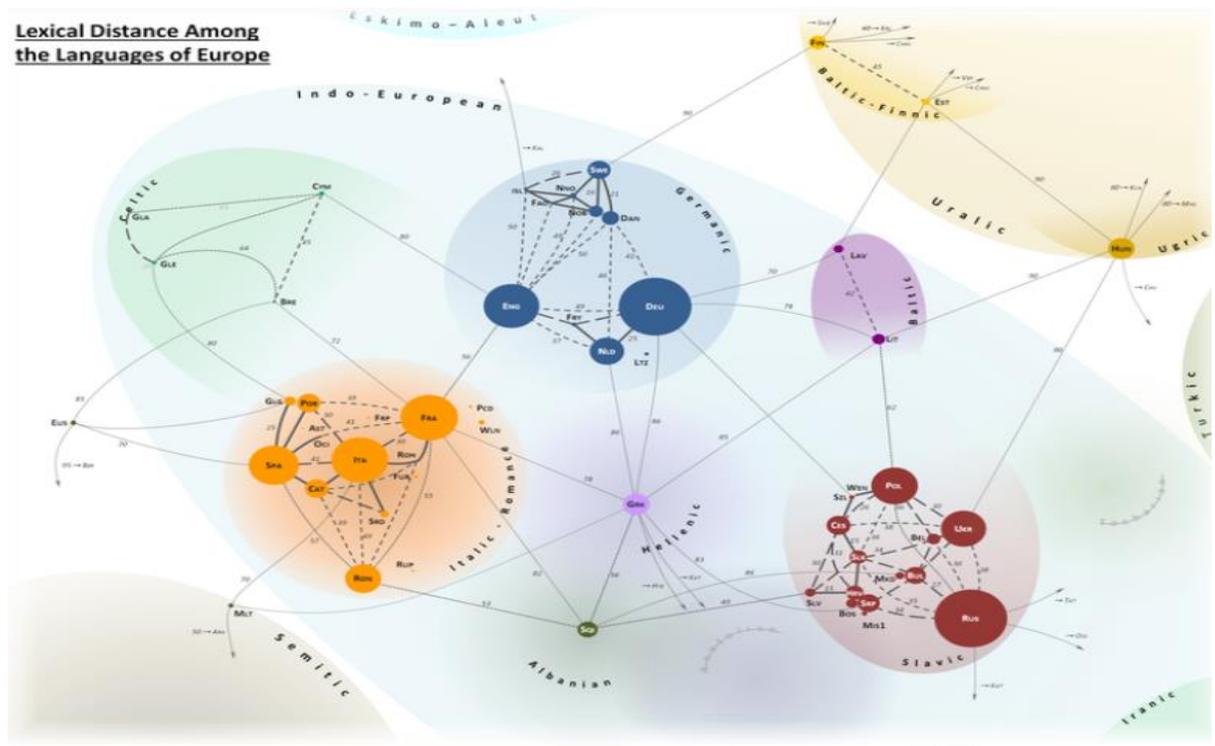


Figure 2.3: Lexical Distance Among Languages of Europe by Steinbach (<https://alternativetransport.wordpress.com/2015/05/05/34/>)

At the same time, there are quite a few scholars who present the percentage of lexical similarity among Slovak languages. The results show that Ukrainian and Russian have 86% lexical units in common, that is way higher than proposed by Tischenko. (Toshovich, 2010).

86% is a high percentage and it only strengthens the case for how close these two languages are to each other. Having been looking for any research related to Russian and Norwegian lexical similarity and not being able to find any data on the percentage of common vocabulary I decided to try to perform some calculations myself.

Internet bulletin published an article “Same words in Russian and Norwegian”. They are around 600 (<https://www.bergenrabbit.net/2013/04/odnakovy-e-slova-v-russkom-i-norvezhsk/>).

According to Wikipedia Russian vocabulary contains 150.000 words, Norwegian 330.000 (https://en.wikipedia.org/wiki/List_of_dictionaries_by_number_of_words).

I used the following metrics:

$$\frac{600}{((329400+149400) + 600)} = 0,0012$$

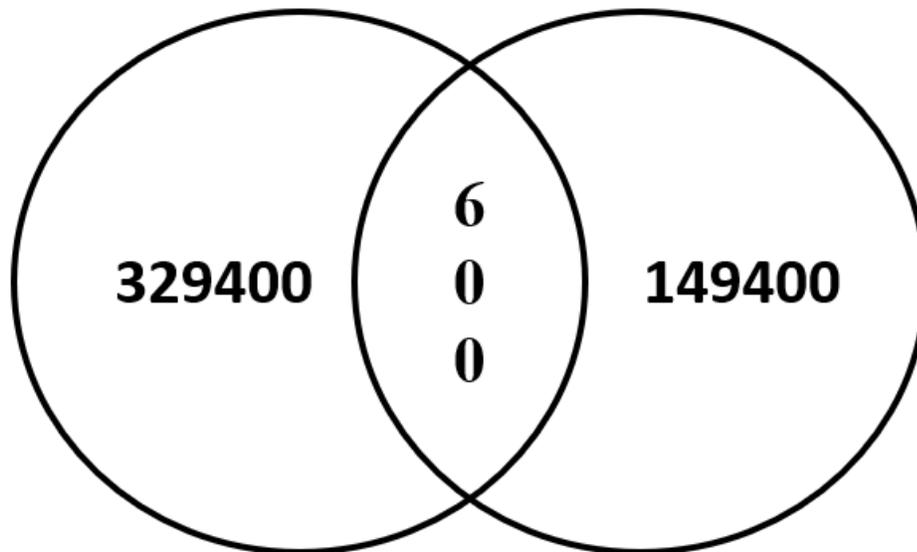


Figure 2.4: Calculations visualisation

The calculations above can't be taken as a scientifically proven fact, but it was rather made as an attempt to demonstrate approximately, the percentage of similarity of the Russian and Norwegian languages by 0,0012% compared to lexical similarity for Russian and Ukrainian by 86%.

For a bilingual, the language proximity facilitates the lexicon formation of L2. The connections of lexemes similar to those existing in the native language are acquired first. Then comes the formation of relationships specific to the lexical-semantic system of a foreign language. Relationships specific to the lexical-semantic system of a foreign language are then formed. Language proximity provokes bigger interference. The interference reflects the process of reorganizing the mental lexicon under the influence of a new language acquisition (Novak, 2009)

2.3 Cyrillic

Cyrillic (Cyrillic script) is the alphabet that is used for writing the words in Russian, Ukrainian, Belarusian, Bulgarian, Serbian and Macedonian languages, as well as many languages of non-Slavic nations living in Russia and its neighbors.

The Cyrillic alphabet is named after Cyril, the creator of the Glagolitic alphabet - the first Slavic alphabet. The authorship of the Cyrillic alphabet belongs to the missionaries - the followers of Cyril and Methodius. The oldest monuments of Cyrillic writing date back to the turn of the 9th-10th centuries: towards the end of the 800s or the beginning of the 900s. Most likely the scrip was invented in Bulgaria. At first it was the Greek alphabet with its 24 letters. Then, 19 letters were added to indicate the sounds of the Slavic language that were absent in the Greek language. Since the 10th century, people began to use Cyrillic in Russia (Lisbach, & Meyer, 2013).

Over the course of three centuries, the Russian alphabet has undergone a series of reforms. A result of which a modern Russian alphabet consisting of 33 letters has appeared. This alphabet also became the basis of many non-Slavic languages of the former USSR: Mongolia, Chinese (Dungan), Altaic (Kazakh, Kyrgyz), Arabic (Uyghur) (Lisbach, & Meyer, 2013).

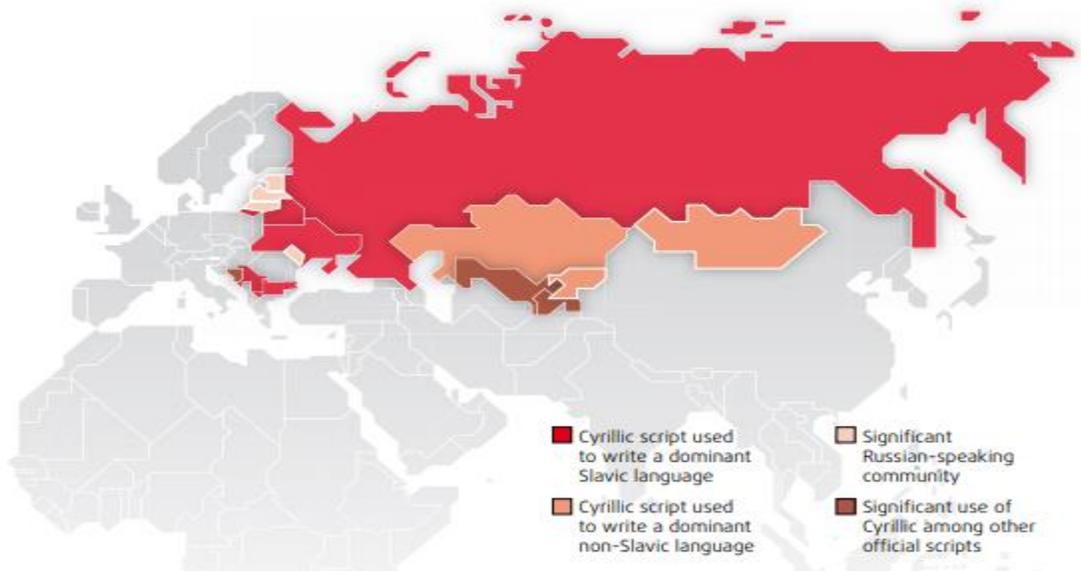


Figure 2.5: Usage of the Cyrillic script around the world (Lisbach, & Meyer, 2013).

2.4 Latin

The Latin alphabet was created in the same way as the Cyrillic alphabet, based on the Greek alphabet. Latin is considered one of the most ancient writing systems used by ancient Romans. It formed the basis of the letter of most peoples of Western Europe. Its name originates from the Latin tribe. Latin is a branch the Etruscan alphabet, which is accordingly from the Greek letter. The Etruscans who ruled the early Roman Empire adopted and modified the version of the Greek alphabet. The Etruscan alphabet was adopted and changed by ancient Romans for writing in Latin (Ullman, 1980).

In the Middle Ages, manuscript copywriters adapted the Latin alphabet for a group of Romance languages, direct descendants of Latin, as well as Celtic, Germanic, Baltic, and some Slavic languages. In the colonial era and in times of evangelism, the Latin alphabet spread far beyond Europe and began to be used to record the languages of American, Australian and African natives. Recently, linguists have also begun to use the Latin alphabet for transcription, the creation of writing standards for non-European languages (Ullman, 1980).

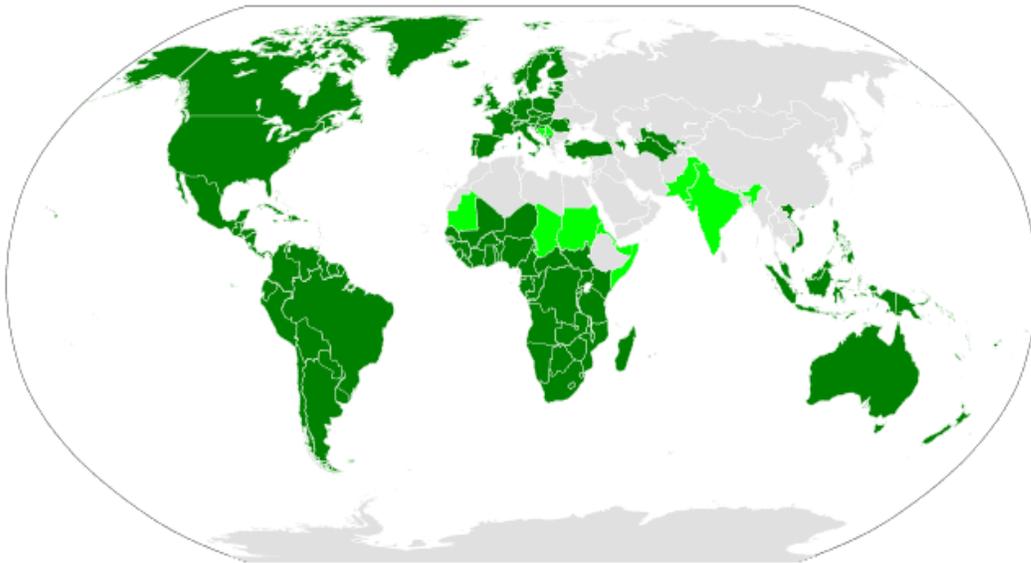


Figure 2.6: Usage of the Latin script around the world (https://en.wikipedia.org/wiki/Latin_alphabet)

2.5 Comparing Cyril and Latin alphabets

When comparing the history of Cyrillic and Latin alphabets, it is worth noting one interesting fact. The letters were formed at a time when the Greek archaic was divided into two branches: Roman monumental writing and Greek capital writing. Thus, these two written systems are related and have the same roots. However, the appearance of the Cyrillic alphabet took place with a large time delay from the Latin alphabet, which in its turn by the 9th – 10th centuries already formed Caroline minuscule.

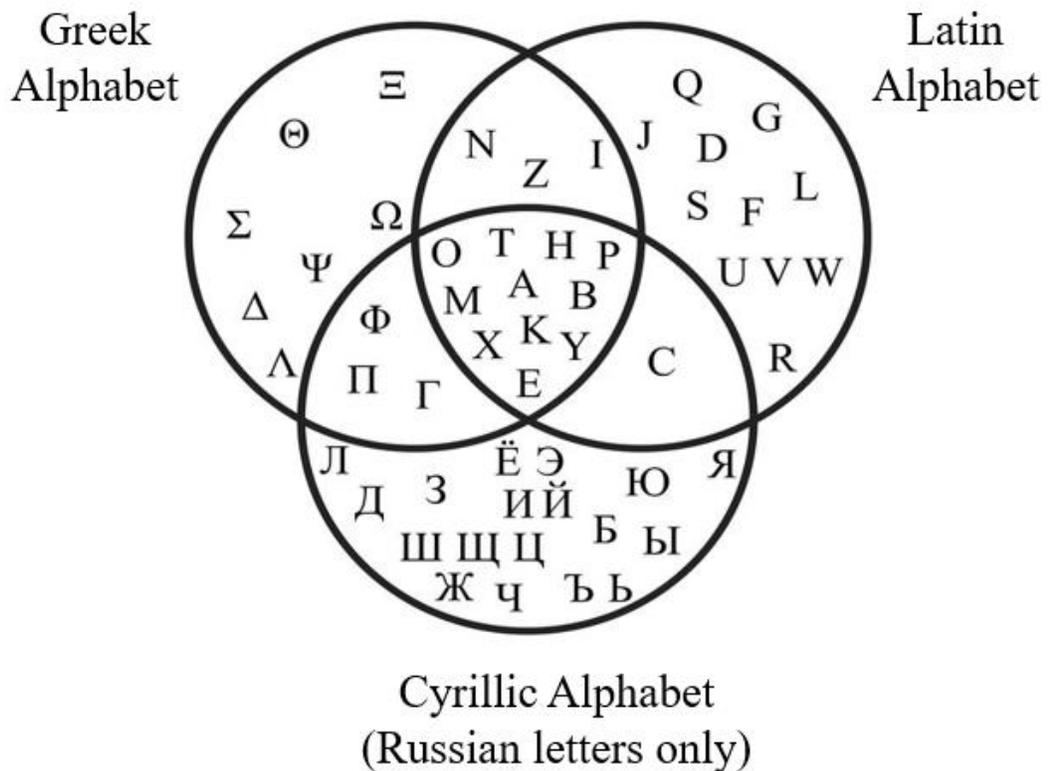


Figure 2.7: Letters in common (Matt Baker, <https://usefulcharts.com/>)

With a detailed examination of the Cyrillic and Latin letters, one can notice some similar features in the formation of graphemes. The Cyrillic type of handwriting – Skoropis’ which with the Caroline minuscule, and, therefore, the Latin script, is related not only by the common features of the construction of graphemes, but also by a large number of elements. This is not the case with other forms of Cyrillic writing (Bennett, 2011).

A comparative analysis of the Cyrillic and Latin alphabets has shown that the features of one third of the letters (about 35%) of the modern Russian alphabet coincide with the graphic forms of Latin characters. This is when both uppercase and lowercase versions of printed and written characters were considered (Cojocaru et al., 2016).

Latin alphabet	Cyrillic alphabet
a/A	a/A
B	Pronounced „V“ [v] as in vault
c/C	Pronounced „S“ [es] s as in salt, but with the tip of the tongue touching the edge of the lower teeth
e/E	E
H	Pronounced „N“ [en] n as in not but the tongue touches the back of the upper teeth
K	K
M	M
o/O	o/O
p/P	Pronounced „R“ [er] r tilled
T	T
u	Pronounced „I“ [ē]
y/Y	Pronounced „u“ [u] or [oo] u as in flute, but the lips much rounder
x/X	Pronounced „h“ [xa] ch in German ach

Table 2.1: Letters used both in the Latin and the Cyrillic alphabet (Ledić, & Rosandić, 2019).

2.6 Orthographic distances between Norwegian, Russian and Ukrainian

Levenshtein distance is a measure of the difference between two sequences of lines relative to the minimum number of insertion, deletion and replacement operations necessary to transfer

one line to another. For identical lines the editing distance is zero. Levenshtein developed an algorithm that allows you to evaluate how similar one string is to another. The algorithm makes it possible to obtain a numerical estimate of the similarity of strings. The main idea of the algorithm is to calculate the minimum number of delete, insert and replace operations that need to be done on one of the strings to get the second (Zhang, 2018)

Levenshtein distance had been used by different scholars throughout decades but Kessler (1995) was the one who used it in his research in the linguistics field for the first time. His experiment was to group the Irish Gaelic dialects and measure the linguistic distances between them (Kessler, 1995).

Later on, Dutch dialects and Norwegian dialects were measured by Levenshtein distance which showed good results and the matrix seemed to work. (Gooskens, & Heeringa, 2004).

Inspired by the research of Zulu et al. (2008) who measured the orthographic distance between the official South African languages and here is presented an attempt to measure the distance between Norwegian, Russian and Ukrainian languages in terms of orthography as Norwegian and Russian with Ukrainian don't share the same script (see 2.5).

50 of the most common nouns in the Russian language were picked up. These 50 nouns were translated into Ukrainian and Norwegian. For the best possible results all nouns in Russian and Ukrainian were transliterated into Latin script. Norwegian letters Ø Å Æ and letter combinations SKJ were transliterated too.

Python programming language was used to run the data. Python is not a new programming language; it was first introduced in 1991. This is a powerful programming language with a huge number of modules and libraries for almost any task. Python is universal and therefore it is suitable for solving problems in various fields, including linguistics. It is actively used in machine learning, data analysis and its visual presentation. (Van Rossum, 2007).

For this analysis, the average values of the Levenshtein distances were taken for visualizations, not the sums (Nor-Ukr: 205, Nor-Rus: 199, Ukr-Rus: 88) as it is done in the research works described above because average values are easier to read in this regard.

	Norwegian	Ukrainian	Russian
Norwegian	0	4.456521739	4.326086957
Ukrainian	4.456521739	0	1.913043478
Russian	4.326086957	1.913043478	0

Table 2.2: Distance matrix

In the process of learning different computer models and applications while taking LING310 last year at the University of Bergen, Hierarchical clustering was among the methods had to learn to apply. It was used by Zulu et al. (2008) in their research. There were 11 languages involved in that research and therefore it was a good plan to use clustering. The current research involves only 3 languages therefore clustering is not a good option. The relationships between Ukrainian, Russian and Norwegian for the matrices taken from Levenshtein distance are presented visually in Figure 2.10, using the heatmap.

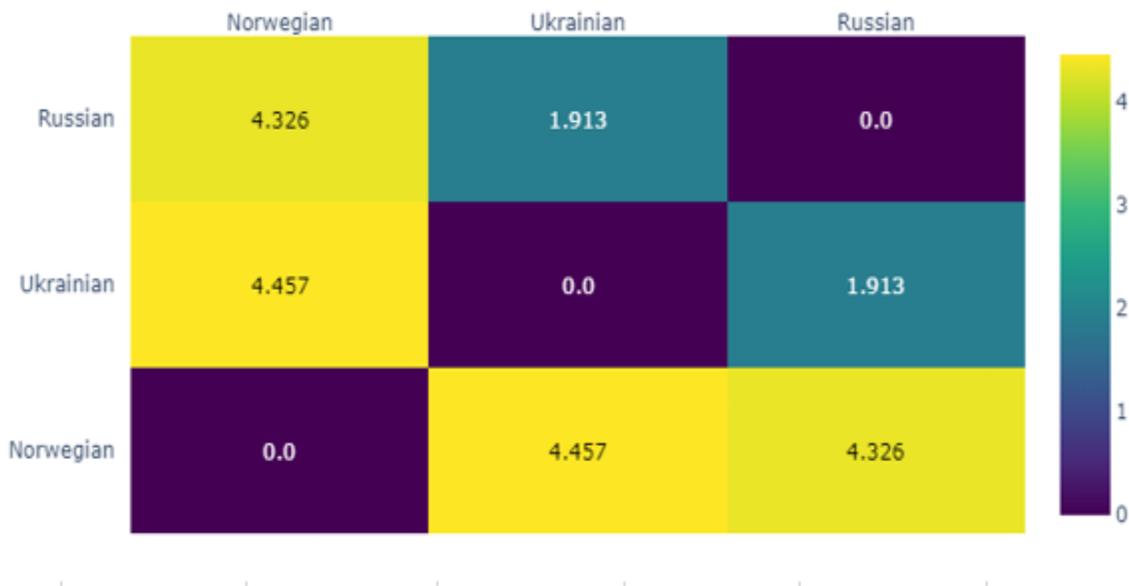


Figure 2.8: Heatmap visualizes matrix of distances

The results are as expected and go in line with the lexical distance between the same languages described in 2.2. Ukrainian and Russian are very close to each other while both Ukrainian and Russian are very far from Norwegian. A very interesting fact though is that Russian is slightly closer to Norwegian than Ukrainian. This is presented in the visualization in Figure 2.11. The language dissimilarities are mapped onto a 3-dimensional space because there are three languages and 3-dimensional space visualizes it in the best way.

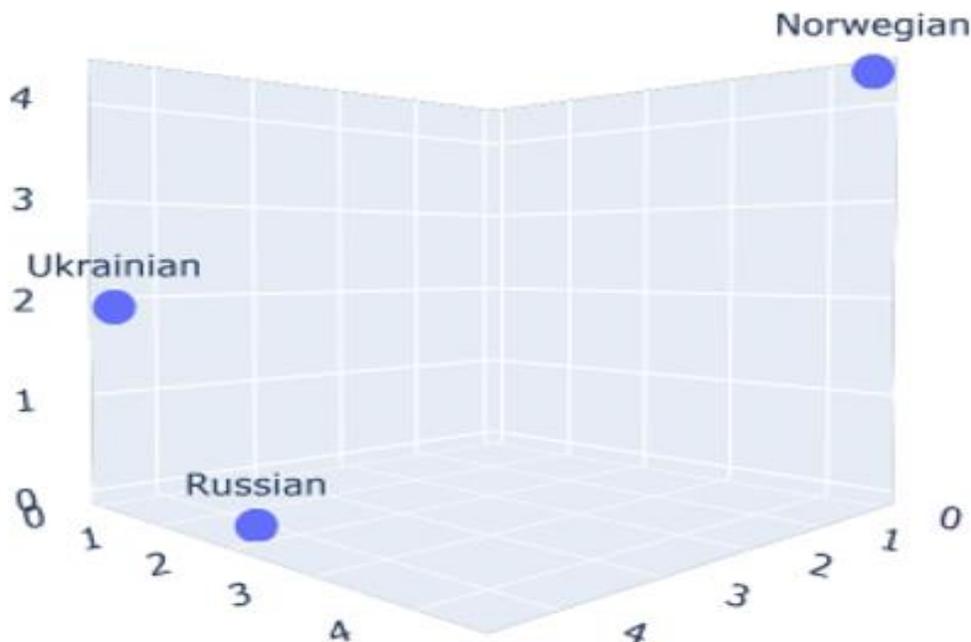


Figure 2.9: 3D-scale plot. Dissimilarities between Ukrainian, Russian, and Norwegian dictionaries (based on the distance matrix).

This proximity may be because Russian contains more borrowings or loanwords from Latin while Ukrainian has its own equivalents, a good example being the names of the months of the year. As Norway and Russia share a border in the north it stands to reason that some words will have migrated both ways. We may need to go back a century or two to find the earlier origins when sailors from Scandinavian countries travelled the world spreading a new language along with

new trading relationships. Logically new Norwegian words will have been incorporated into the local coastal Russian languages from this time onwards.

The provided results cannot be treated as 100% accurate but Levenshtein distance can give a reasonable overview and with a good visualization tools it supports the theory of language distances.

	Ukrainian	Russian	Norwegian
1	Січень	Январь	Januar
2	Лютий	Февраль	Februar
3	Березень	Март	Mars
4	Квітень	Апрель	April
5	Травень	Май	Mai
6	Червень	Июнь	Juni
7	Липень	Июль	Juli
8	Серпень	Август	August
9	Вересень	Сентябрь	September
10	Жовтень	Октябрь	Oktober
11	Листопад	Ноябрь	November
12	Грудень	Декабрь	Desember

Table 2.3: Months of the year in Ukrainian, Russian and Norwegian

2.7 Lexical representation of languages in the mind of a bilingual individual

A controversial subject in the psycholinguistic studies of bilingualism is the question of systems of lexical representations of two languages: their structure, the nature of the relationship of their units with each other and the system of concepts. There are two opposite hypotheses, one of which postulates the existence of independent systems of lexical representations for each language. According to the second hypothesis, lexical representations of both languages are stored in a single extended system. Various authors have argued in favor of both points of view.

2.7.1 Interdependence Hypothesis

Interdependence Hypothesis is presented by W. Weinreich (2010) who believes the lexical representation of two languages in the form of a single system on the subordinate type of bilingualism. It suggests that the linguistic units of the second language coexist in close interconnection with the units of the first and, at the same time, do not have a direct relationship with the conceptual system. This hypothesis arose as a result of teaching a foreign language mainly by the translation method, when a foreign language word is constantly linked to the equivalent word of the native language. Thus, the access of the word of a foreign language to the corresponding concept can be carried out only indirectly, through the word of the native language (Weinreich, 2010).

Most authors who support this hypothesis point out to the fact that neither the first nor the second bilingual language, regardless of their level of proficiency, are the same as any of these languages for the monolingual groups (Bialystok E. & Hakuta K, 1994; Zavyalova, 2001).

Researchers argue that these differences occur as a result of storing units of two languages in the form of a single representation system and, therefore, their mutual influence one language on other. Cook (1992) notes that, for example, English - French bilinguals have representations of both English and French, different from the representations of the same languages in monolinguals. According to the author, if two languages were represented by different systems, each of them would be an independent structure, and the first bilingual language would be the same as that of monolingual (Cook, 1992).

Today, it is generally accepted that one cannot consider the linguistic structure of bilingual as the sum of two corresponding monolingual structures, since in the course of mastering a foreign language the mutual influence of languages on each other is inevitable. As a result of such interaction, the individual forms another, completely different from monolingual, speech organization; in this case, both the first and the second bilingual languages will use mechanisms that differ from the mechanisms functioning in the speech of the monolingual (Zavyalova, 2001).

There are also numerous evidences that bilingual children have linguistic advantages over their monolingual peers as they have deeper knowledge of the language and better understanding of its abstract structure; this phenomenon is considered as a confirmation that the units of two languages are interconnected and mutually affect each other (Bialystok & Hakuta, 1994).

It is worth of noting that the code-switching phenomenon is a factor that confirms the hypothesis of shared storage in a number of researches works. E. Bialystok and K. Hakuta (1994) emphasize that the ease and speed with which a person is able to switch from one language to another indicates that language units coexist in close interconnection and are stored together rather than separately (Bialystok & Hakuta, 1994).

2.7.2 Independence Hypothesis

According to the Independence Hypothesis lexical representations of both languages form separate, independent systems that are not interconnected. Each of these systems is directly linked to the system of concepts, while the concept is an intermediate element that mediates the access of a unit of one language to a unit of another (Kollers, 1966).

The existence of separate lexical systems is supported by the fact that in a situation of a free associative experiment, intralingual associative connections are stronger than interlanguage ones. Although bilingual subjects switch codes freely, they prefer to respond with associations within the same language. Separate representations of lexical systems are indicated by the fact that bilinguals (both children and adults) do not mix two languages in a communication situation. Evidences in favor of data represented in the internal vocabulary are autonomous and are the following:

- differentiation of languages depending on the context, communicative situation, purpose of usage and the language of the interlocutor
- the ability of a bilingual individual to switch the language code in a timely manner (Schreuder, R., & Weltens, 1993)

Thus, the main argument for the existence of separate lexical systems in the minds of bilinguals is considered stronger (the ability to clearly distinguish between two languages).

Differences of language organization of a bilingual compared to the organization of the language in monolinguals testify in favor of the Interdependence hypothesis. Moreover, we can observe the phenomenon of switching the language code is interpreted in favor of both points of view.

A number of questions arise that none of the above hypotheses can answer. For example, the Independence hypothesis of lexical representations cannot explain the fact that languages interact with each other, while the Interdependence hypothesis does not provide a satisfactory answer to the question of how units of different languages are distinguished during the production and perception of speech by bilingual. All this leads to the assumption that a simple answer to the question of shared / separate storage of lexical units of two languages simply does not exist. The effective use of two lexical systems by the same speaker implies that their representations cannot be completely autonomous in the mind, since it is proved that languages constantly interact with each other (Desmet, T., & Duyck, W. 2007). At the same time, the bilingual brain must somehow make clear distinctions between units of two languages, without mixing them together. Such a formulation of the question led to the appearance of compromised points of view trying to resolve the existing contradictions. Some of them are described below in this chapter.

2.7.3 The Sub-set Hypothesis

The Sub-set hypothesis was proposed by M. Paradis (1985). It is based on the subsystem of lexical representations. The author suggests that the bilingual lexical organization is a single storage, the links between the elements of which are strengthened as a result of their constant shared use. Thus, the words of both languages are stored in identical ways in a single system, while the elements of each language form relatively independent subgroups that can be extracted separately. This hypothesis implies that, in general, the elements of one language are more strongly connected with each other than with the elements of another language, forming intralingual subgroups. Interlingual connections of units of different languages also exist, but they are weaker than intralingual ones. Thus, the sub-set model combines the features of both separate and shared storage of lexical representations, implying the relative independence of the units of each of the languages, and on the other hand, their relationship to each other. There are situations in which

intralingual connections can weaken, which leads to the strengthening of interlingual connections. Under certain conditions, a subgroup can consist of units of two different languages, or both types of connections can be equally strong. A German word can appear in the mind of a bilingual when searching for a needed word in English and be unable to find the proper one. This the access to German and English lexicon is equal (Paradis, M. 1985).

Agreeing with Paradis' Subset Hypothesis, De Bot underlines that lexical elements of L1 and L2 form different subsets which are activated to a certain degree, depending which language the bilingual is currently speaking. All subsets belong to the same lexicon and it is believed that the lexicon is independent from language (Poulisse & Bongaerts 1994).

2.7.4 The Sub-set Hypothesis

The Conceptual Hypothesis is based on the theory that the type of bilingualism (mixed or subordinate), which determines the specifics of organizing systems of lexical representations of two languages, is not a stable characteristic of a bilingual individual. It is assumed that at the initial stage of mastering the language the so-called "word association model" is formed, based on linking the word of a foreign language with the native word (Potter et. Al 1984).

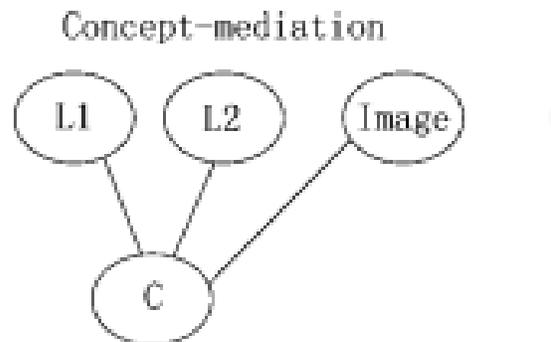


Figure 2.10: Concept-mediation (Dong et Al 2005)

Further in this process a direct connection between a foreign word and a concept is formed. This leads to the fact that interlingual connections of words cease being actualized. Such a model was called the "concept mediation model", because the concept of a foreign unit is understood by referring to the corresponding concept (Potter et. Al 1984).

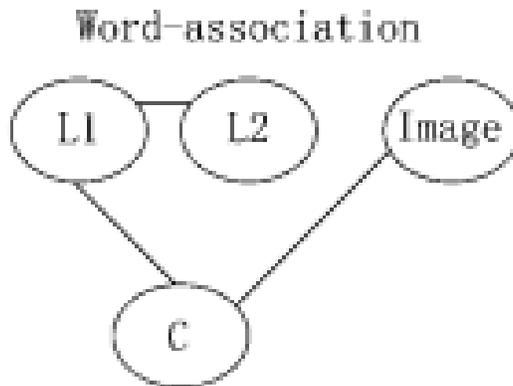


Figure 2.11: Word-association (Dong et Al 2005)

This hypothesis was tested on by a number of experimental studies in groups of bilinguals with native English and foreign French, German, or Italian (Kroll & Curley 1988).

To confirm that interlanguage (translational) connections are made exclusively at the verbal level (word level) and do not imply access to the deep level of concepts, an experiment was conducted based on the method proposed by M. Potter (1984). Potter's methodology involves the fulfillment of two types of tasks by subjects: 1) translation of a number of words from a foreign language into their native language; and 2) naming of objects depicted in pictures (the same words are used in both tasks) (Potter et. Al 1984).

The authors proceeded from the fact that naming images requires mandatory access to the corresponding concept. Therefore, if the bilingual needs the same amount of time to translate the word as to name the image, it indicates the actualization of the verbal - conceptual connection in the translation process. If the translation task is completed faster, then this process is carried out by referring exclusively to verbal connections. The data obtained showed that translation tasks are

performed by subjects faster than tasks for images naming, as a result of which it was concluded that the translation process is carried out at the level of words and does not affect the deep level of concepts. Further studies based on the application of free and directed associative experiments confirmed the adequacy of the Conceptual Hypothesis. It turned out that interlingual verbal connections (translation) are actualized mainly by subjects with a low level of knowledge of a foreign language. In groups with a higher level of a foreign language knowledge associations based on actualization of verbal - conceptual connections predominated (Potter et. Al 1984).

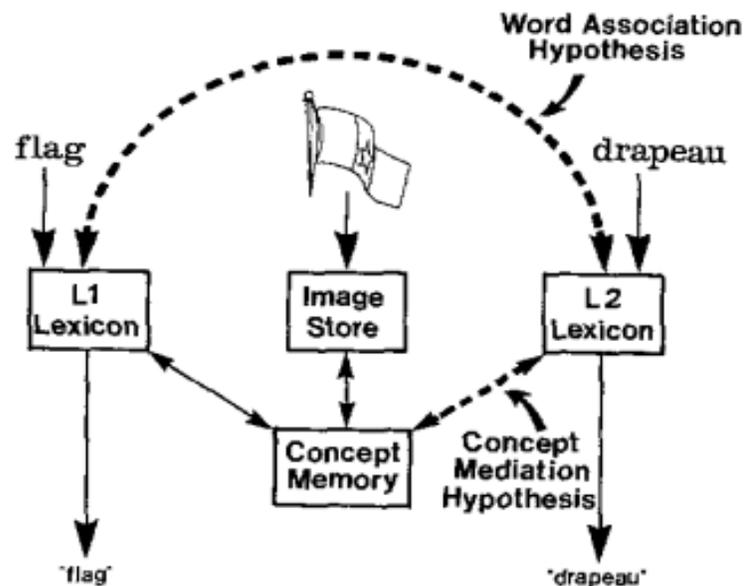


Figure 2.12: Conceptual hypothesis (Potter et. Al 1984).

2.7.5 Asymmetry Hypothesis

According to Asymmetry hypothesis, neither verbal nor verbal-conceptual connections in the internal vocabulary of a bilingual individual are mutually exclusive: depending on a number of factors, the same individual at the same stage of training can use a foreign language in both

subordinate and coordinative models. This implies that the word of a foreign language in the mind of bilingual can be simultaneously linked to both the word of the native language and the corresponding concept. Asymmetry hypothesis recognizes the possibility of verbal and verbal-conceptual connections coexistence at the same stage of study a foreign language, with varying degrees of severity. So, it is assumed that there are two types of connections between the representations of words in the lexicon: a strong connection of a foreign language word to a native word and a weaker connection in the opposite direction. Verbal-conceptual pairs are similarly organized: the connection between the word of the native language and the concept is stronger than the connection between the same concept and the corresponding word of the foreign language.

Experiments with Dutch students who study English or French as a foreign language were carried out. It showed that one of the factors determining the subjects' use of a particular type of connection is the specifics of the lexical units themselves: frequency of use, similarity of root morphemes in the words of different languages, as well as the degree of concreteness/abstractness of the concepts they express. For example, according to the results obtained, the words denoting specific concepts were identified by subjects by directly referring to the corresponding concept, while words denoting abstract concepts were in most cases correlated with equivalent units of the native language (de Groot & Hocks, 1995).

The studies examined conclude that the systems of conceptual and lexical representations in the bilingual consciousness are organized in a similar way: both of them have the features of both joint and separate storage. In this case, the forefront is the consideration of the question of what factors and how to determine the structure of both representative systems; how they are restructured, on which the change in the types of relations between their units depends, etc.

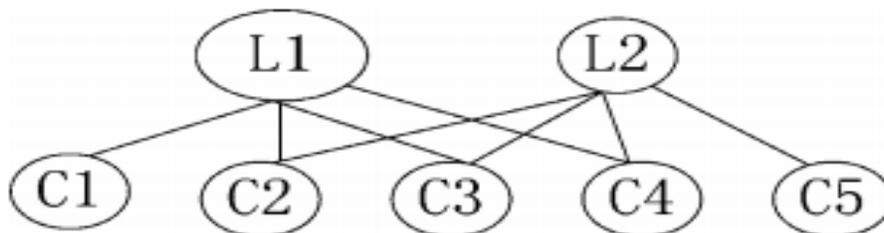


Figure 2.12: L1 and L2 stand for particular L1 and L2 words. C1 to C5 stand for an arbitrary set of five conceptual components, some of them are shared, some are not.

2.8 Trilingual mental lexicon

Along with studies of bilingualism, it has become necessary to study the various kinds of relationships between specific languages represented in the mental lexicon of multilinguals. Leshchenko et al. (2018) conducted an experiment, the purpose of which was to analyze and model interlingual interactions in the combined mental lexicon of trilinguals who speak Komi-Permyak, Russian and English. The researchers assumed that these languages in the minds of the trilingual form a complexly organized triangle, all whose elements actively interact with each other regardless of differences in acquisition of each of the languages, as well as the frequency of their use in individual communicative areas. The results of the study showed that multidirectional routes of interlanguage ties are formed in the lexicon of a trilingual person. They are characterized by high potential activation and they compete with each other as well as cause code switching. Code switching within a single associative-verbal pair can be triggered by various types of triggers: linguistic and extralinguistic. The researchers argue that the study can visualize the models of interlanguage connections causing code switching in speech of combined trilinguals. It clearly demonstrates that in trilingual mental lexicon all three languages are closely linked (Leshchenko et al., 2018).

Tymczynska (2012) in her study on lexical processing in online translation tasks taking Polish, English and German languages for the experiment, suggested her own Model of trilingual mental lexicon. Development of her model is based on the already existing Revised Hierarchical Model (RHM) proposed by Kroll and Stewart (1994).

The Revised Hierarchical Model is grounded on two principals: connection strength between the words and conception in the memory of bilingual. The first one is that L1 words are more closely related to concepts than the L2 words. The second is that the L2 words are more connected with their semantic correlates in L1 than vice versa. The revised hierarchical model assumes that during the initial stage of acquiring L2, the person uses the existing connections between the word and the concept in L1 to gain access to the new words of L2. Thus, a strong lexical relationship is established between L1 and L2 but reverse connect is weaker. As a person

becomes proficient in L2, he will be able to associate the words of L2 with concepts directly, but these connections will still be weaker than between concepts and words of L1, unless a person is a bilingual of a coordinated type (Kroll & Tokowicz, 2005).

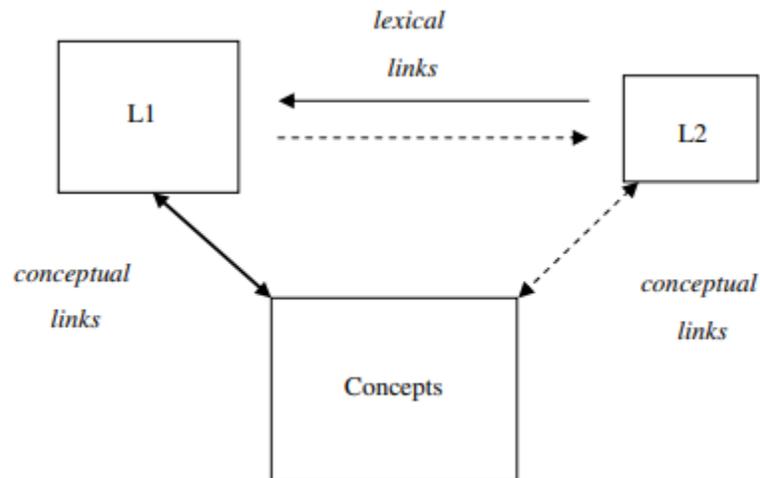


Figure 2.14: The Revised Hierarchical Model (Tymczynska, 2012)

As Tymczynska (2011) conducted her experiment on lexical processing in online translation tasks, she took RHM as a basis and developed a model to show the mental lexicon of a conference interpreter with three languages combined. However, the experiment was added with a control group subjects of which were non-interpreting students. Therefore Tymczynska (2011) created one more model that is more relevant for our studies: model for trilingual mental lexicon.

The brain of a trilingual tends to interlanguage interaction in lexical processing, especially between representations L2 and L3. Thus, the connection between L1 and L3 is weaker than other lexical links. This process is determined by the order of language acquisition.

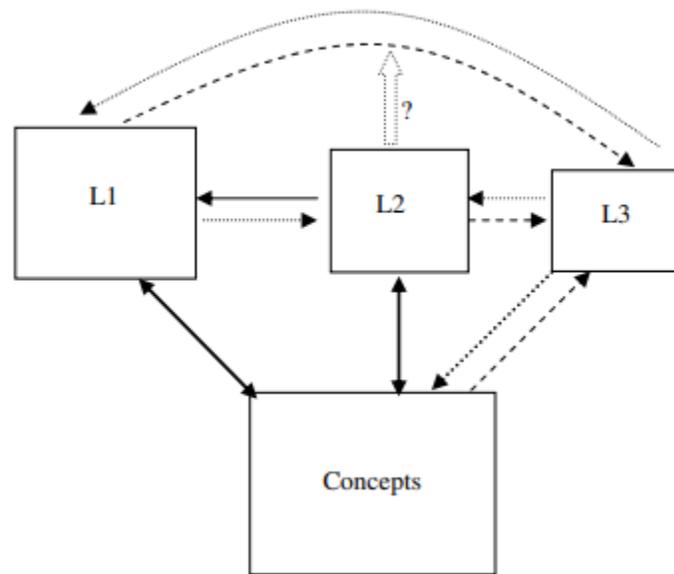


Figure 2.15: Model of trilingual mental lexicon (Tymczyńska, 2011).

Chapter 3

3. Methodology

Psychologists' interest in the implicit memory (remembering and subsequently reproducing any material or action without realizing the very fact of remembering and reproducing it) is constantly growing (Anderson, 2000).

A person can any time be affected by a wide variety of stimuli that do not reach consciousness. However, the direction of the choice of action made by a person is very much determined by these unconscious traces of external influences. From this point of view, implicit memory can be understood as the result of unconscious influences, stored for some time and manifested in a faster identification of an object that previously was in sight, or in a more accurate execution of a previously performed action. The neurophysiological and neuropsychological data indicate the adequacy of explicit and implicit memory (Schacter, & Buckner, 1998).

For example, in studies of implicit memory while teaching patients with local lesions of the hippocampus, the following results were demonstrated: patients with amnesia who repeatedly performed a difficult task (circle the image of a star, controlling their movements only with a mirror), but completely forgot about it, after some time solve the same problem more precisely and faster, although taking the problem as a new one. Such phenomena are not uncommon in everyday life. For example, a person can completely forget the model name of the car he saw in the morning and in the evening when completing a crossword puzzle with a very high probability of reproducing it (Gabrieli, 1998).

Researchers use the term “priming” to refer to the phenomena described above.

3.1 Priming in modern linguistic research

The concept of priming came to linguistics from medical and psychological science and refers to uncontrolled impacts used by researchers to describe the mechanisms of perception,

attention and memory. The priming effect is widely used to describe the influence of the previous information on the perception and processing of further information, without the active participation of a person. Results of numerous studies have shown that if a test word is preceded by a prime, the subjects make decisions faster and more correctly. Studying the priming effects can help to understand the mental structure of the linguistic apparatus. In psycholinguistics priming is widely used to explain processes connected to human speech activity (Fedorova, 2009).

In a classical experiment with priming, a subject sees a set of words, pictures, or objects. Then starts a test: presenting the material of familiar and new objects. The subject has either to name them or to add them or make a decision - reacting quickly (Squire, Knowlton & Musen, 1993).

Priming can have different durations - from tenths of a second in perceptual tasks to months in the case of naming an object or recalling the word by a once presented picture (Mitchell & Brown, 1988; Sloman et al., 1988).

3.2 History of the priming study

The first scientific description and justification of the phenomenon of priming belongs to John Bargh (1996) and his colleagues who studied the behavioural characteristics of people: automaticity and unconscious behaviour in social conditions. Bargh and his colleagues, L. Burrows and M. Chen (Bargh, Chen, & Burrows, 1996), conducted an experiment in which university graduates were offered the opportunity to interpret 30 different phrases containing 5 words each. Participants were told that their linguistic abilities were tested but in fact, the focus of researchers was on the effect of priming. Each participant received one of two options for the assignment, differing in the set of words. In the first version aggressive words were used that characterized negative interference in social interaction or communication between two people by a third person: *aggressively, bold, rude, bother, disturb, intrude, annoyingly, interrupt, audaciously, brazen, impolitely, infringe, obnoxious, aggravating, and bluntly*. Other group of words were positive stimuli: *respect, honor, considerate, appreciate, patiently, cordially, yield, polite, cautiously, courteous, graciously, sensitively, discreetly, behaved, and unobtrusively*. The most important

stage of this experiment was its final: after the students completed the task, they were asked to go out of classroom and find an experimenter in order to get the next task. But when the student approached the experimenter, he, as if not noticing the student, was talking with his assistant at the office door. As it turned out, these conditions were intentionally set by the experimenters in order to find out if there are differences in the behaviour of students primed by the words of aggression from the behaviour of those who are primed with words of politeness. The other goal was also to test whether there will be a difference in the length of time through which students decide to interrupt the leader talking to the assistant. As a result, the subjects primed to politeness, never interrupted the conversation, and the ones who primed to aggression in most cases (82%) interfered in the conversation on average five minutes later (Bargh, et al., 1996).

Despite the fact that this technique was originally proposed in the cognitive research paradigm for studying visual perception, it became clear over time that the experimental possibilities of priming are wider. It can be used as a methodology for the study of implicit memory, because the method includes fixation, storage, processing and extraction of information. (Hermans, et al., 2003).

Several researchers believe that priming is applicable not so much to memory studies as to studies of perceptual attention (Friedman, et al., 2003). It should be noted that the experimental procedures for priming are very diverse. Among them so-called priming to a place where an inconsistent pointer (in the form of a point or an arrow) acts as a prime to the place where the target stimulus will be presented in the future. The prime focuses the subject's attention on a specific location on the screen and forms indicative reactions (Kovyazina, & Kuznetsova, 2013).

When it comes to linguistics, the concept of priming is not new at all. Back in the late 60s and early 70s there were two main views on modeling the mental lexicon. One view is that mental lexicon is presented in the form of a hierarchical network (Collins, & Quillian, 1969). The second view is that vocabulary is in form of stimuli that "operate directly on mental states" (Elman, 2004, p.306). Later, owing to a series of experiments where the priming was used for the first time, developed models of organization of the mental lexicon were explained. As a result of this experiment, D. E. Meyer and R. W. Schvaneveldt (1971) discovered the relationship between prime and recognition speed of subsequent stimuli. Researchers found that after presenting the

word "nurse", the word that is related to it in meaning will be recognized faster (for example, "doctor"), than unrelated (for example, "pencil"). The first experiment conducted using the priming technique, can be categorized as semantic priming. (Hoey, 2005).

Thus, priming is a unique technique for controlling subjects' attention and their response manipulation presented after the prime stimuli.

3.3 Types of priming

Depending on the connection type between the prime and the target, several types of priming are distinguished. Each type works in a certain way and can have different effects (Bargh, 2006):

1. The **positive** and **negative** priming-effects consider how priming affects processing speed. The positive effect of priming speeds up processing and also speeds up extraction of information from memory, while the negative effect of priming slows it down (Nkrumah, & Neumann, 2018).
2. **Semantic** priming is based on the connection or similarity of two objects in value or on their belonging to the same semantic category. The faster response to the word "banana" after it was previously primed with the word "yellow" is an example of a semantic priming effect (Holcomb, 1993).
3. **Associative** priming involves the use of two stimuli, which are usually related to each other. For example, "cat" and "dog" are two words that are often related to each other in memory, so the appearance of one of the words may cause the subject to respond faster when the second word (Xavier Alario, Segui, & Ferrand, 2000).
4. **Repetition** priming occurs when the stimulus and response are repeatedly paired. Because of this, subjects are more likely to respond in a faster way faster each time a stimulus appears (Henson, Shallice, & Dolan, 2000).
5. **Perceptual** priming includes stimuli that have similar shapes and sizes. It uses imagination and recognition. A good example of perceptual priming is when respondents are asked to

turn three-letter combinations into words associated with the words of the previous task with external signs found in the similarity of acoustic or visual (Akhutina, & Kashirskaya, 2000).

6. **Syntactic** priming is the tendency of individuals when speaking to generate such syntactic structures that were previously somehow involved in this type of communication. Very often, when we unconsciously adapt to the dialogue, we have at our disposal a certain set of phrases that correspond to the real discourse in which we interact with other individuals: an example is the coordinated remarks of participants in any everyday dialogue (Branigan, 2007).
7. **Conceptual** priming is based on the connection of two objects that are conceptually related. Words such as “table” and “chair” are likely to show the effect of priming, because they are in the same conceptual category (Schreuder, d'Arcais, & Glazenberg, 1984).
8. The **masked** priming effect includes part of the initial stimulus, which is somehow hidden, for example, using hash marks. Even if the entire stimulus is not visible, it still causes an answer. Words in which certain letters are obscured are one example of masked priming (Gomez, Perea, & Ratcliff, 2013).
9. **Reverse** priming (reverse priming) - people realize that they are tuned to a specific action, and act in the opposite way (Laran, Dalton, & Andrade, 2011).

3.4 Lexical decision task

Models of words visual recognition are utilized to understand the mechanisms of the perception of words while reading. They are developed to accurately describe, predict and reproduce the phenomena being fixed in word recognition and reading experiments (Norris, 2013). Numerous experiments are aimed to discover more and more nuances of word perception. At the same time, the human cognitive system is a single complex mechanism. Therefore, how a person thinks and understands words should determine how he thinks or solves problems. The most

common procedures in experiments on the visual recognition of words are the lexical decision task and priming procedures (Lapteva, et al., 2018).

The lexical decision task has been used for experimental purposes since the time of A. Marcel (1980) who was one of the first to show that a person is able to understand the meaning of a word that is not recognized. To study the effects of unconscious information processing (both graphical and verbal), various experimental paradigms are used. One of the most popular is the priming, when the subject is presented with a stimulus (usually a word) for a very short time (10 - 25 ms) followed by visual masking. After numerous experiments, it has been stated that although the subject cannot account for of the stimulus presentation, since he is not aware of it, the semantic meaning of this stimulus directly affects the efficiency of the cognitive task that immediately follows the prime. The lexical decision task is used both in combination with the priming or without it. Performing this task, the subject must recognize what was presented to him on the screen: a real word or a pseudo word (non-word). A stimulus (either a word or a non-word) is presented for a short time, so that the subject does not have time to identify it, however, this time should be sufficient to see the letters and to read a word. In other words, the subject does not have time to realize whether the presented letters form a meaningful word, or the presented stimulus is a non-word. The complexity of this simple task involves not only a short time for perceiving the stimulus perception, but also the fact that a non-word can have a set of letters which by spelling can resemble a word. Thus, the subject is forced to react fast each time he reacts on the presented stimulus (Agafonov, 2013).

3.5 Participants

Twenty-two native Ukrainian speakers with Russian as their second mother tongue and Norwegian as a third language learnt in Norway, participated in the experiments. There were 5 males aged 25-40 and 15 females aged 18-60. 50% of participants use Norwegian language daily at home (having Norwegian speaking spouse) as well as at work, while the rest use Norwegian primarily at work and in their leisure time. All twenty-two persons were recruited in Bergen, Norway through “Ukrainians in Bergen” Facebook group. None of them reported of having

dyslexia impaired vision. All began learning Norwegian in adulthood and most of them in Bergen. All are the first generation of immigrants from Ukraine to Norway who have lived in Norway not less than three years. All learned Norwegian Bokmål but because of living Bergen for a long time, some participants have mastered the Bergen dialect too. Further, 80% of the subjects have a higher education. Proficiency of the Norwegian language was not rated other than self-estimation: on a question whether one can read newspapers in Norwegian, everyone gave a positive response.

Half of the participants didn't speak any English. However, some participants reported proficiency in one or two languages in addition to those which were engaged in the experiment.

Those who have lived in Norway for more than 15-20 years were tested orally as to whether they have a language attrition. The speech of immigrants who became bilinguals or multilinguals is undergoing changes under the influence of the local language. Simplified syntax, poor vocabulary, or the appearance of an accent are all signs of language attrition which is called L1 attrition meaning the loss of the first language. The length of stay in a foreign country significantly affects the level of knowledge of the mother tongue, especially if it is not in use regularly. L1 loss is accelerated if the bilingual is particularly keen on learning a second language or if the first language is associated with psychological trauma (Köpke, (2007), Pavlenko, (2004))

There was no compensation offered as a participation reward and all participants took part willingly and anonymously.

3.6 Experimental materials

Pavlov (1927) defined the word as a universal stimulus, a special kind of signal. Stimuli can be any factor that affects the body and causes response or reaction (Pavlov, 2010).

The stimuli consist of a list with 40 Norwegian and Russian word pairs and 40 Ukrainian and Russian words pairs. All words are nouns, common words. No terms were used.

For experiment 1 Russian target words were used, primed by Norwegian words. For experiment 2 Russian target words were also used but were primed by Ukrainian words.

Each word pair represents a relation between prime and target which is divided into 4 groups:

	Meaning	Form
Cognates	Yes	Yes
Translations	Yes	No
False Cognates	No	Yes
Unrelated	No	No

Table 3.1. Word pair relations

3.6.1 False Friends

False friends are words that are similar in sound and spelling in different languages but have different meanings. The origin of such words can be completely different in the similarity of their pronunciation or spelling. Sometimes such words can have a common origin. This is explained by the fact that over the time, in one language meaning of the word develops one way while in another language it does in different way. That is why the meanings of the words can turn out to be completely different (Chamizo-Domínguez, 2012).

False friends can also be called lookalikes. In the Russian and Norwegian languages, false friends can exist due to having only one meaning in one language and several meanings in the other language. The same applies to Russian and Ukrainian false friends.

3.6.2 Cognates

In experiments aimed to test hypotheses about the lexical decision tasks, cognates are often used. Cognates are words that have a similar origin and, as a result, similar phonology and orthography to the languages that are tested. The semantic similarity of cognates usually varies and does not completely coincide, and therefore cognates are divided into identical and non-identical forms. Cognates are developed in the process of historical interaction between two or

more languages. If the languages don't belong to the same languages group, cognates developed as a result of language borrowings (Inkpen et al., 2005) (Voga & Grainger, 2007).

Banana – банан – банан is a classical cognate for Norwegian, Russian and Ukrainian accordingly.

3.6.3 Translations

Translations are the words with the same meaning but having different forms or spelling. For the experiment, to create a group of translates was not enough to take any words and have their translations because some words can have several meanings while being translated into other language. That is mostly applied to the Norwegian-Russian group of words. Finding words appropriate for translations for Ukrainian-Russian demanded a lot of attention as these two languages share quite a few cognates and therefore translated words would miss the meaning for the experiment. It was important to keep the word in one language and its translation of the same length.

3.6.4 Unrelated

Unrelated is a group of words that share neither form nor meaning. For the experiment it is important to group the words that are not associated with each other. This is because once a person starts thinking of any word in Russian for example, immediately comes a Norwegian word from the same group of association. Therefore, to group a pair of a Norwegian word *vann* with Russian word *кружка (cup)* will not work.

3.6.5 Non-words

A non-word is a pseudo-word or a fake word, a bunch of letters that resemble a real word (in terms of its spelling and phonological structure) but does not actually exist in the language (Arndt et al., 2008).

All 4 word groups (10 word pairs in each group) were added by non-words, 40 non-words per a group (40 Norwegian, 40 Russian and 40 Ukrainian), 120 non-words in total.

3.7 Experiment Procedure

The experiment took place at the language laboratory at the Humanitarian Faculty at the University of Bergen. The room is soundproof and equipped with a computer and a control box, a table and a chair. There are no distractions in the room to make sure that the participants concentrate their maximum attention on the task performance. Mobile phones were on silent mode during the experiment. The room is a part of the classroom. It is an individual experiment which means that each subject was alone in the laboratory room during the test. The experiment responsible was waiting outside of the room, in the classroom. At time there were classes in the classroom but since the lab is a soundproof the participant didn't experience any noise from outside.

3.8 Experiment Design

The whole experiment is a cross-linguistic masked prime lexical decision task. SuperLab 4.5 is used to program the experiment. SuperLab is a Macintosh software that can facilitate psycholinguistics experiments measuring reaction time. The SuperLab has been used by students and staff of Bergen University for some years and has proved to be a great tool to conduct the experiments.

The computer was equipped with the Cedrus response box. The box is used as a response pad. The pad has 5 buttons: left, right, upper, lower and middle. For the experiments there are only two possible answers, therefore the participants use only left button (marked in red) as a *no* respond and right button (marked green) as a *yes* respond. The Cedrus response is a very simple and practical pad to use for the experiment compared to keyboard or mouse due to its simple layout and limited number of buttons. It helps participants to concentrate on the experiment rather than

on finding the right button to press. In addition to this according to Cedrus (2020) webpage respond box gives a 2-3 millisecond resolution of reaction time while the fastest for keyboard is 10 milliseconds (Cedrus 2020). This gives better results and improves data collection.

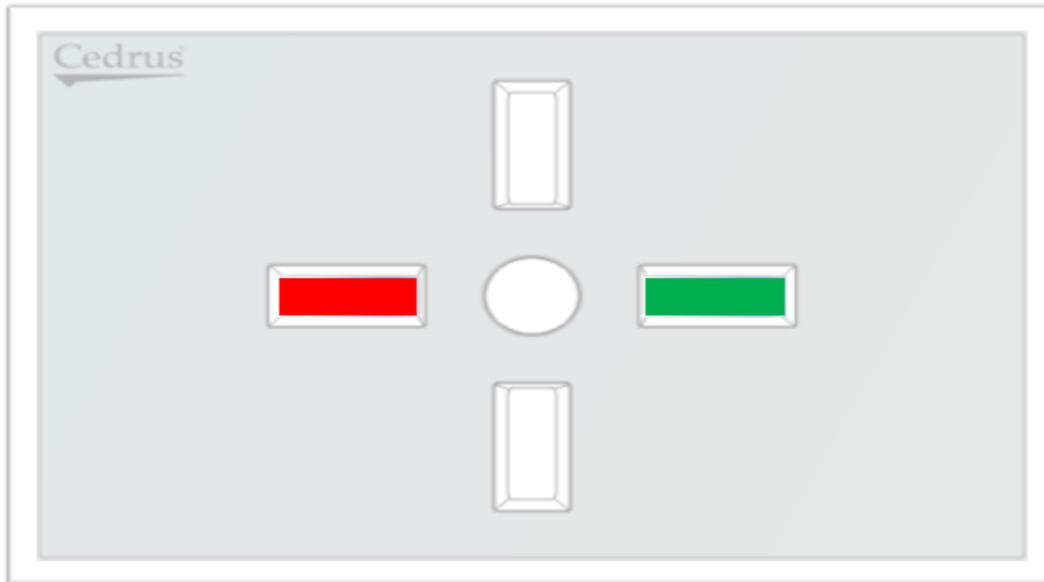


Figure 3.1: Cedrus response box RB-54

There were two experiment sets. The first one is a masked prime from Norwegian (L3) to Russian (L1). The second is also a masked one primed from Ukrainian (L2) to Russian (L1). Thus, Russian target words were primed by Norwegian words and Ukrainian words.

The following sequence was used in the test: fixation point (1000ms), a forward mask (100ms), prime stimulus or a blank screen (50ms), backward mask (100ms), target stimulus (1000ms). The same sequence was used for both sets of the experiment. Unmasked prime differs from masked prime by its length: 100ms while masked is 50ms. Thus, in masked prime the prime word is almost invisible and the participants can report that they didn't see primed words although they are there.

All target words in Russian were typed in upper case letters while all stimuli both in Ukrainian and Norwegian were typed in lower case letter. This helps the participants know which word they must react to. Each word was programmed to be either a target word (marked as a form or meaning relating to a prime) or a non-word.

Randomized type of words presentation was chosen.

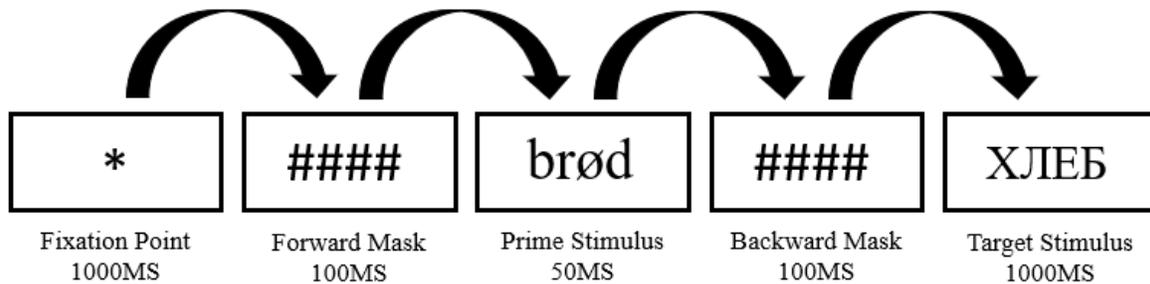


Figure 3.2: Priming sequence for experiment set #1 from L3 (Norwegian) to L1 (Russian)

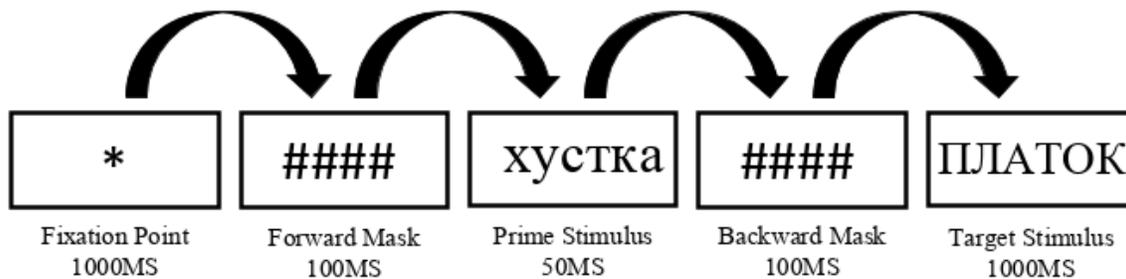


Figure 3.3: Priming sequence for experiment set #2 from L2 (Ukrainian) to L1 (Russian)

The experiment is divided into 2 sets and each set consists of 3 blocks: an introduction block, a training block and the experiment block itself. In the introduction block the participant reads the instruction. The training block's aim is to test the experiment and to tune the participant on the experiment. There are 4 trials in the block and the participants get a *smile* (😊) as a feedback. Once the trial block is over, the experiment block starts right away but the participants do not get feedback anymore.

3.9 Performing the experiment

All participants were given a timeslot according to the scheduled period in the lab. Before the participant sits at the table with the computer the experiment responsible gives introduction about the length of the experiment (20 minutes) and gives oral instructions. Each participant is asked whether he/she has dyslexia. Everyone was informed that participation is voluntarily, anonymous and one is free to leave whenever he/she is willing to. After an oral instruction the participant gets into the lab and sits comfortably at the table with the screen. He/she reads the instruction (in Russian) on the screen. The task was to read the words that pop up on the screen and react on Russian words by pressing the green button if a word exists in Russian language or red button if it is a pseudo word. The participants are asked to react as fast as they can, but they are not aware of the aim of the experiment as such. When the first set is over the instruction pops up on the screen again explaining the same procedure but with Ukrainian language involved into the experiment instead of Norwegian. The participant is informed that the experiment has a training section which follows by the test itself without indicating that training is over thus there is no break between these two sections. The participants would continue performing the task. Whenever the participant is ready to begin, by clicking any button, the experiment would start immediately.

After the experiment is completed, a participant leaves the room informing the experiment responsible that the experiment is completed. The timeslots were scheduled in such a way that participants would not meet each other on the premises.

The results have been saved into the folder at the computer where each subject gets a number 1-22 accordingly.

Chapter 4

4. Results

The results of two sets of the experiment will be described in this chapter. Both sets aim to test differences in the influence of form and meaning across Russian and Ukrainian for the first set and Russian and Norwegian for the second set. The goal is to discover how form and meaning influence reaction time in lexical decision tasks, both sets were masked prime where priming direction L3L1 (Norwegian-Russian) and L2L1 (Ukrainian-Russian).

4.1 The first experiment set L3L1 (Nor-Russ)

This first set is a replication of the experiment that was conducted in 2018 Fall semester as a term paper for the course Ling306 Experimental Psycholinguistic. At that time there were 8 word-pairs in each category. Russian (L1) was primed by Norwegian (L2 although some spoke English so Norwegian was L3). The participants were Russian speaking individuals mainly from Russia who live in Norway and learnt Norwegian when being adults. All of them were reached out through Facebook group “Russian speaking in Bergen” and in total 20 people took part in the experiment in 2018.

4.1.1 Participants

Twenty-two participants took part in the first set of the experiment. None of the participants took part in the experiment in 2018. All of them spoke L1 Russian as a mother tongue as well as Ukrainian as a second mother tongue L2 Ukrainian. All of them came to Norway where they learnt L3 Norwegian in adulthood just like participants of the experiment in 2018. Some of them spoke English before they came to Norway. All individuals are born in Ukraine (Ukrainian part of the

USSR). Everyone is a member of a Facebook group “Ukrainians in Bergen” and that is the source of enrollment to be subjects for the experiment.

4.1.2 Experiment

In the present experiment 2 word-pairs were added to each category having 10 word-pairs in each category. Four categories are cognates, False Fiends, Translations and Unrelated. 40 word-pairs in total where Russian words were primed by Norwegian ones. They were supplied with 40 non-word pairs. Masked prime was used, frequency was matched for each word-pair and a randomized sequence for word-pairs was chosen.

4.1.3 Results

The data were analyzed in R (R development core team 2018) using a linear mixed effects (LME) model. Only correct responses were taken from RT data. No participants were excluded but 5 items of incorrect answers were excluded from the data.

lmerTest was used to estimate a linear regression equation and estimate the variance in a Mixed Effects Model (Kuznetsova et al., 2016). The model equation is the following:

$$RT \sim \text{Primed} * \text{Meaning} * \text{Form} + (1 | \text{Trial}) + (\text{Primed} + \text{Meaning} * \text{Form} | \text{Participant})$$

We look at all interactions between Priming, Meaning and Form relations, with variance estimated from Trials (each could have a different starting point) and Participants, who could have different effects for priming and meaning and form.

The estimated RT is:

$$RT = 692.7 \text{ (unprimed, unrelated)} - 4.6 \text{ (primed)} - 41.0 \text{ (meaning)} + 11.8 \text{ (form)} + 8.5 \text{ (primed and meaning)} - 36 \text{ (primed and form)} - 0.9 \text{ (meaning and form)} - 2.8 \text{ (primed meaning and form)}$$

Calculated the estimated RT data is presented in Table 4.1.

	Primed	Unprimed	effect
Unrelated			
-Meaning -Form	688.1	692.7	-4.6
FalseFriend			
-Meaning +Form	663.9	704.5	-40.6
Translation			
+Meaning -Form	655.6	651.7	3.9
Cognate			
+Meaning +Form	627.7	662.6	-34.9

Table 4.1: Estimated RTs from regression Experiment 1

The significant effects were found from an Analysis of Variance estimated by the Mixed Effects model with variance estimated from both subjects and items (test trials) simultaneously.

Type III Analysis of Variance Table with Satterthwaite's method						
	Mean SS	DF	DF	F	PR(>F)	
		within	between			
Primed	39066	1	62.4	4.66	0.0347	*
Meaning	132235	1	58.6	15.77	0.0002	***
Form	6308	1	62.0	0.75	0.3891	n.s.
Primed:Meaning	1570	1	79.6	0.19	0.6665	n.s.
Primed:Form	43353	1	79.6	5.17	0.0257	*
Meaning:Form	129	1	64.9	0.015	0.9016	n.s.
Primed:	59	1	79.6	0.007	0.9331	n.s.
Meaning:Form						

Table 4.2: ANOVA table for the regression analysis (Mixed Effects Model) Experiment 1

Main effects

Primed : $F(1, 62.4)=4.7$; $p = 0.035$ *

Meaning : $F(1, 58.6)=15.8$; $p=0.0002$ ***

Interaction Effects

Primed : Form : $F(1, 79.6)=5.2$; $p=0.026$ *

There is an effect of priming. As can be seen in Table 4.1, the rows that are associated with form have a priming effect, which is between 30 and 40ms faster when primed by form.

There is also an effect of Meaning, but this is not a priming effect. The rows in Table 4.1 are faster for both Translations and Cognates.

That cognates are generally faster. Cognates are similar in both form and meaning and are much more likely to be co-activated. This goes in line with the results from Lemhöfer et al (2004) where cognate effects were found. Bilinguals in English and Dutch were tested to perform a lexical decision task. There were control words and the cognates that are the same in spelling in English and Dutch. Cognates showed faster time in recognition by the subjects than control words in English and Dutch.

There is no priming effect for Translations. This might indicate that it takes longer to activate meaning from Norwegian to Russian.

Another reason could be an effect of script difference. It takes longer to activate the phonological representation that is used to activate Norwegian words and may also take longer to spread activation to activate a Russian lemma.

One more reason potentially could be lower proficiency in the Norwegian language. For those who are most proficient the co-activation may be faster. This may create more variance if the participants are not matched for proficiency in Norwegian. Since no Norwegian proficiency test was performed before the experiment, we assume this could be the case. However, further research is needed.

Figure 4.1 shows us two parallel lines, which indicate that form and meaning do not interact, but each add their part of the effect.

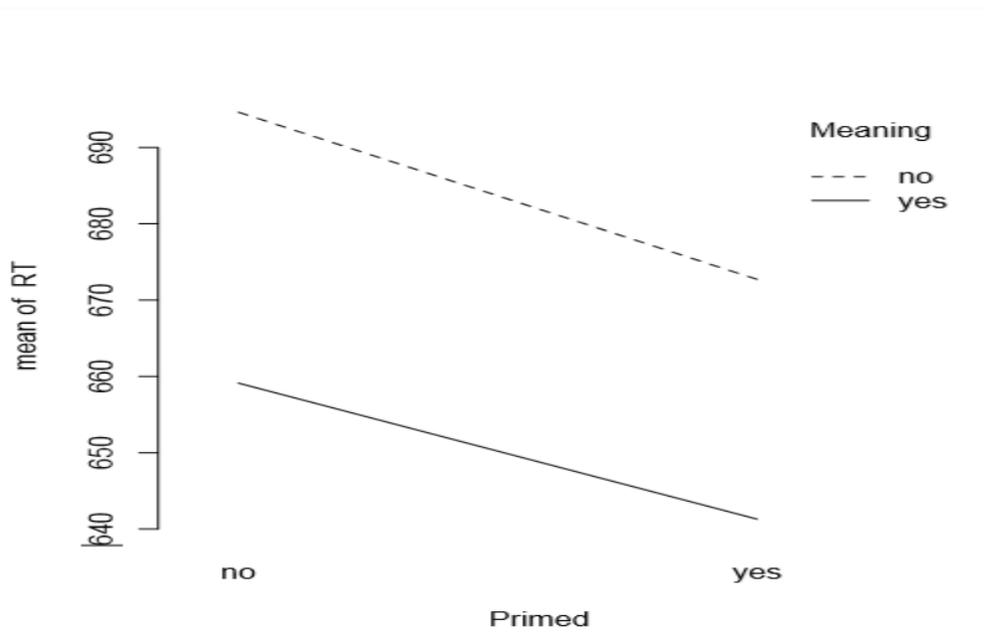


Figure 4.1: Interaction of language and meaning for set 1 of the experiment

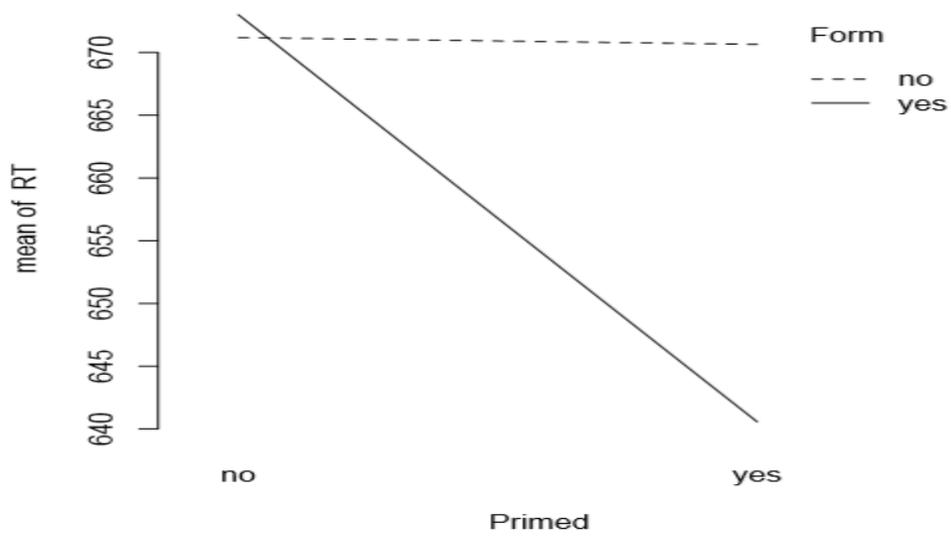


Figure 4.2: Interaction of language and form for set 1 of the experiment

Figure 4.1 shows the reaction time for all 4 categories plus nonwords. The results are different from the experiment that was conducted in 2018. Form priming was stronger than meaning priming then and False Friends were primed. That was different from earlier experiments where meaning priming were strongest. The current set of the experiment shows RT over 300ms, where Cognates are faster, Translations are faster, while Nonword are slower.

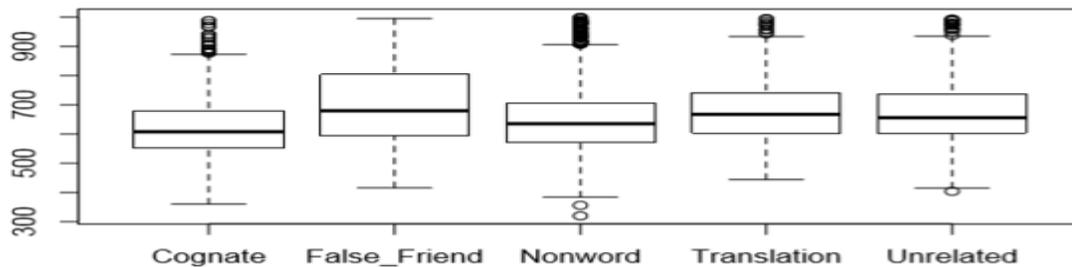


Figure 4.3: Boxplot of RT across all categories for Nor-Rus set of the experiment

4.2 The second experiment set L2L1 (Ukr-Russ)

This second set of the experiment was meant to test differences in the influences of form and meaning across Ukrainian and Russian in order to compare whether the RT will be the same for languages with the same script (present set) and with different script (the first set).

4.2.1 Participants

Twenty-two participants took part in the second set of the experiment. These are the same individuals as for the first set as the second set followed by the first one.

4.2.2 Experiment

Again, 10 word-pairs in each category were chosen. Four categories are cognates, False Friends, Translations and Unrelated. 40 word-pairs in total where Russian words were primed by

Ukrainian ones. They were supplied with 40 non-word pairs. Masked prime was used, frequency was matched for each word-pair and randomized sequence for word-pairs was chosen.

4.2.3 Results

The data were also analyzed in R (R development core team 2018) using a linear mixed effects (LME) model. Only correct responses were taken from RT data. No participants were excluded but 11 items of incorrect answers were excluded from the data.

lmerTest was used to estimate a linear regression equation and estimate the variance in a Mixed Effects Model (Kuznetsova et al., 2016). The model equation is the following:

$$RT \sim \text{Primed} * \text{Meaning} * \text{Form} + (1 | \text{Trial}) + (\text{Primed} + \text{Meaning} * \text{Form} | \text{Participant})$$

The estimated RT is:

$$RT = 688.2 \text{ (unprimed, unrelated)} - 11.9 \text{ (primed)} - 10.4 \text{ (meaning)} + 13.1 \text{ (form)} + 22.3 \text{ (primed and meaning)} - 8.3 \text{ (primed and form)} - 25.6 \text{ (meaning and form)} - 69 \text{ (primed meaning and form)}$$

Calculated the estimated RT data is presented in table 4.3.

	Primed	Unprimed	effect
Unrelated			
-Meaning -Form	676.3	688.2	-11.9
FalseFriend			
-Meaning +Form	681.1	701.3	-20.2
Translation			
+Meaning -Form	688.2	677.8	10.4
Cognate			
+Meaning +Form	598.4	665.3	-66.9

Table 4.3: Estimated RTs from regression Experiment 2

The significant effects were found from an Analysis of Variance of variance estimated by the Mixed Effects model with variance estimated from both subjects and items (test trials) simultaneously.

Type III Analysis of Variance Table with Satterthwaite's method						
	Mean SS	DF	DF	F	PR(>F)	
		within	between			
Primed	87042	1	33.5	8.75	0.0056	**
Meaning	152365	1	29.8	15.31	0.0005	***
Form	72527	1	34.1	7.29	0.0107	*
Primed:Meaning	8182	1	66.1	0.82	0.3678	n.s.
Primed:Form	101367	1	66.2	10.19	0.0022	**
Meaning:Form	172929	1	35.0	17.38	0.0002	***
Primed:	65934	1	66.2	6.63	0.0123	*
Meaning:Form						

Table 4.4: ANOVA table for the regression analysis (Mixed Effects Model), Experiment 2

Main effects

Primed : $F(1, 33.5) = 8.75$; $p = 0.006$ **

Meaning : $F(1, 29.8) = 15.3$; $p = 0.0005$ ***

Form : $F(1, 34.1) = 7.3$; $p = 0.011$ *

Interaction effects

Primed : Form : $F(1, 66.2) = 10.2$; $p = 0.002$ **

Meaning : Form : $F(1, 35) = 17.4$; $p = 0.0002$ ***

Primed : Meaning : Form : $F(1, 66.2) = 6.6$; $p = 0.012$ *

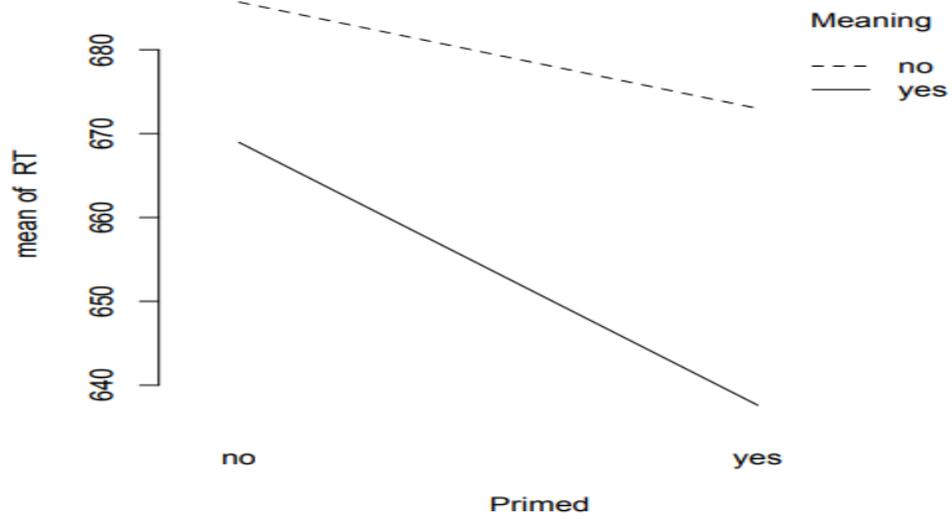


Figure 4.4: Interaction of language and meaning for set 2 of the experiment

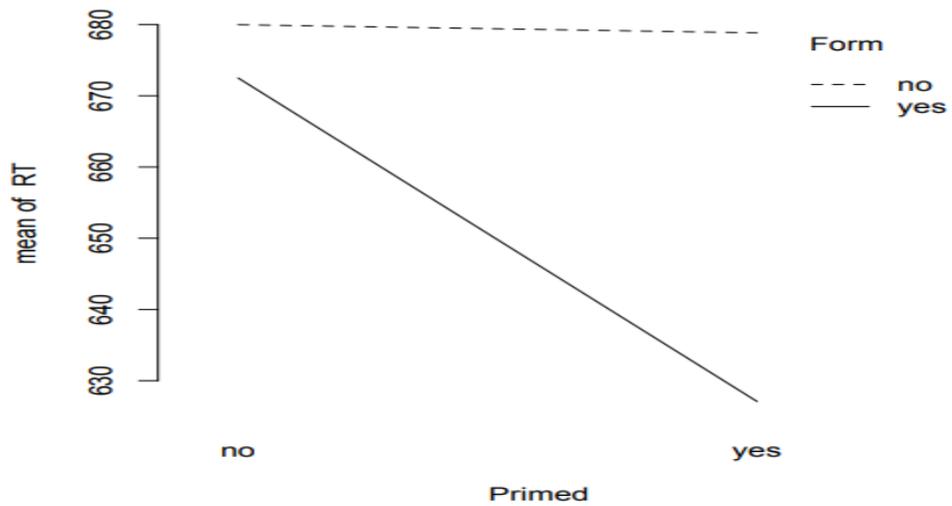


Figure 4.5: Interaction of language and form for set 2 of the experiment

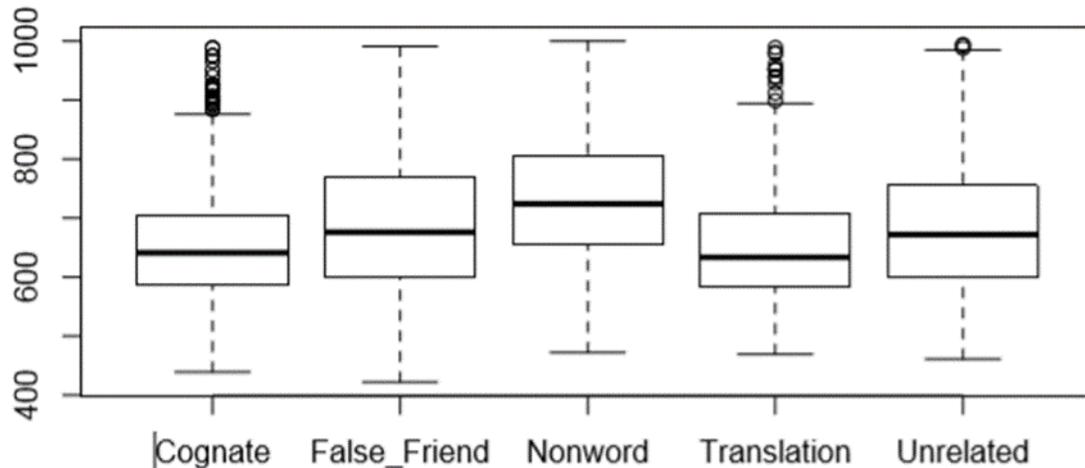


Figure 4.6: Boxplot of RT across all categories for Ukr-Rus set of the experiment.

Figure 4.4 shows the reaction time for all 4 categories plus nonwords. Current set of the experiment also shows RT over 300ms, where Cognates and Translations are faster. There is a strong effect for primed Cognates which can be explained by being primed by the same writing systems.

There is an effect of priming. This effect is stronger than in experiment 1. The main effect of priming is the cognate effect. There is an effect of form. Unprimed form is the slowest to decide.

There is a priming effect for form. We see that the main contribution is from cognates.

There is no priming effect of meaning. Not surprising because two languages share the same orthography.

There is an interaction between meaning and form. This may be attributed to the large effect of cognates. This is an interaction that is clear in the difference between Translations and Cognates, and it is illustrated in Figure 4.4 and 4.5.

There is a large cognate effect

4.3 Results for nonwords

Nonwords used in the test are pseudowords. Pseudowords are simple sequences of phonemes that are not real words that exist in the language spoken by the participants, although they consist of combinations of sounds typical of a particular language (Warren, 2013).

Only correct decisions for nonwords were taken for RT analysis. Figure 4.7 shows no overall difference in priming.

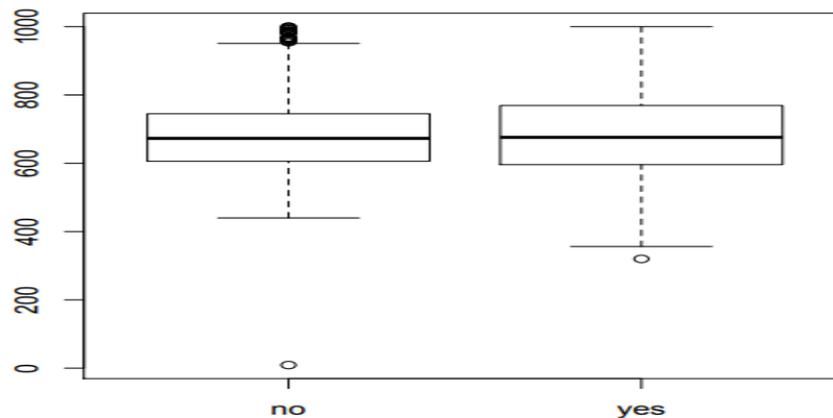


Figure 4.7: Boxplot of RT for nonwords.

RT = 735.1 + 6.1 (primed) -78.3 (L3L1) -24.9 (primed and L3L1)
 L3L1 is faster to decide and L2L1 and L2L1 react differently to priming. Interaction plot shows there is no significant effect for priming.

	Primed	Unprimed	effect
experiment 1	741.2	735.1	+6.1
experiment 2	638.0	656.8	-18.8
diff	103.2	78.3	

Table 4.5: Estimated RTs from regression (NONWORDS)

Interaction plot shows a difference for priming.

INTERACTION $F(1, 69.1) = 10.3$ $p=0.002^{**}$ L3L1 is faster when primed; L2L1 is slower when primed.

PRIMING $F(1, 61.0)=0.8$ n.s.

DIRECTION $F(1, 21.3)=105.3$ $p < 0.0001$ *** L3L1 is faster $735.1 - 78.3 = 656.8$ ms (not primed; 78ms). Primed L3 $735.1+6.1 - 78.3 - 24.9 = 638$ ms (L2L1 unprimed = 735.1; primed $735.1+6.1 = 741.2$)

The effect is 78.3 faster for L3L1 (Nor-Rus). This indicates that it was easier to make non-words decisions (primed or not) in the experiment set 1 because Norwegian doesn't activate Russian words. Ukrainian might activate Russian words due to the same script. Therefore, it is easier to decide non-words in the experiment set 1 than in the set 2.

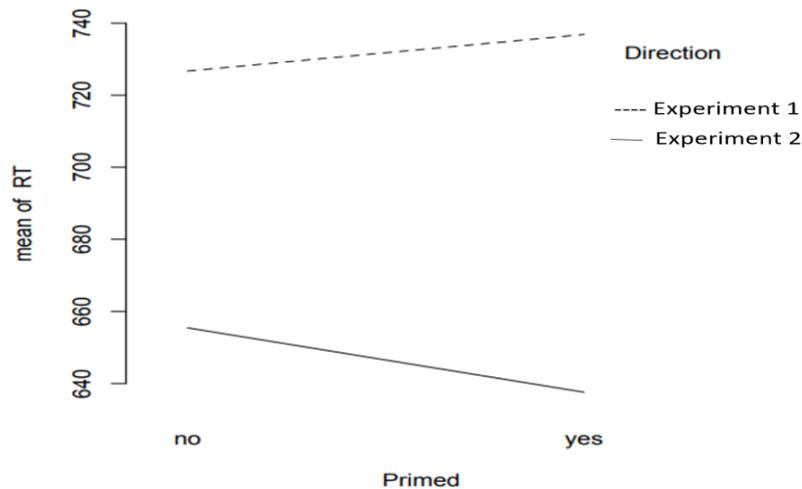


Figure 4.8: Mean reaction times for nonwords in four experiments

Chapter

5. Conclusion

5.1 Discussion

Lexical access is a process in which linguistic information about a language unit is extracted from a person's memory: meaning, morphological and phonetic form. Lexical access consists of two stages. When perceiving a word, the sequence of steps is as follows: first, phonological information is processed, then semantic.

Processing with passive perception of the word begins 50 ms after reading. You can separate a word from a non-word in a time interval of 200-300 ms. This task often does not require access to the semantics of the word (Schacter, 1990).

The perception of words is a complex multilevel process that can be influenced by a number of factors such as word frequency, word representability, word length, spelling neighbors of a particular word, as well as many subjective factors of each individual depending on personal vocabulary and experience in interacting with words. Among these characteristics, there is a priming effect, which can also affect the processing of certain information, including the perception of the word.

The present study examined the reaction between the first and second language and compare it with the reaction between the first and third language using masked prime. The main interest of the research is to investigate how meaning and form of words affect a trilingual recognition process.

The trilingual individuals who are very close to balanced bilinguals in L1 (Russian) and L2 (Ukrainian) and who learned L3 (Norwegian) when moved to Norway were tested.

The results show meaning advantage in cross-linguistic priming which go in line with the previous research and experiments conducted in the laboratory of Bergen University:

Stremme et al (2014) tested fluent in English and Norwegian participants and compared it with the participants who were fluent in English but new beginners in Norwegian. The results showed the priming effect for meaning for all groups. The contrast to this study is that a difference in orthography seems to delay meaning activation.

Sverreson (2016) conducted the experiment with native German and Spanish speakers living in Norway. They were tested in a cross-linguistic primed lexical decision task. The test was designed to measure the priming effect of Norwegian prime words on L1 target words. The results showed significant meaning advantage for German speakers and no so significant meaning priming for Spanish speakers. The similarity to the present study is that the German speaking students get more proficient in Norwegian faster than Spanish speaking students. This may be an effect of close languages; it matches the observations presented in the present study.

The present study was inspired by the study conducted in 2018 when 20 Russian native speakers (L1) mastering Norwegian (L2) in their adulthood were tested. The findings demonstrated form priming is stronger than meaning priming, which confirms part of the present study. The further research was needed as the results didn't go in line with the other studies. Now as the experiment was extended and improved the results are as expected.

5.2 Final Conclusion

The findings show meaning effect advantage over the form in both experiments. One main difference is Form priming of False Friends in Experiment 1. In experiment 2, there is a stronger effect of cognates, which indicate that meaning activation kicks in.

Our hypotheses were that Russian (L1) will experience a stronger priming effect from Ukrainian (L2) primed words than from Norwegian (L3) primed words and that Norwegian words (L3) will have more significant priming effect on meaning related target words for Russian Native Speakers (L1) than Ukrainian words (L2).

The results show more significant priming effect in Form for the L1 (Russian) words primed by L2 (Ukrainian) words than those primed by L3 (Norwegian) words. The finding supports the hypotheses presented above. The priming effect is stronger in the group of Russian

and Ukrainian languages that uses Cyrillic (shared script) compared to the group of languages (Russian and Norwegian) that use Latin and Cyrillic scripts.

5.3 Further Research

The research was conducted on the participants who are very close to being balanced bilingually in Russian and Ukrainian. This was an obstacle in checking whether the study can support the Model of trilingual mental lexicon presented by Tymczynska (2011). It would be useful to set an experiment similar to the present one adding English language and taking away one of the participants native languages (Russian or Ukrainian). The possible hypothesis here could be that Norwegian words (L3) are activated in Russian or Ukrainian (L1) by English (L2) because the participants learnt English (L2) before they came to Norway where they learnt Norwegian (L3), as L3 is usually connected more closely to L2 than to L1.

One more future research question is related to cognates and the organization of the mental lexicon: are there differences in priming effects? Especially, are there differences between cognates supported by all three language and cognates that are only supported by one language pair. For the cognate supported by only a language pair, are there differences between an early and a late second language for cognates?

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