

MASTER'S THESIS

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In Applied Linguistics
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The relationship between language dominance and
language switching among Hungarian-English
bilinguals

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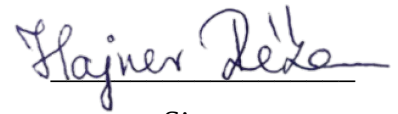
Declaration

Undersigned Réka Hajner I declare that this thesis has been prepared at the Institute for Hungarian and Applied Linguistics at the University of Pannonia in order to get the Master's Degree in Applied Linguistics.

Furthermore, I confirm that this thesis and the work presented in it are my own and have been generated by me as the result of my own original research.

I am aware of the fact that the Department that announced the topics can use my results freely.

Veszprém, 25. 04. 2022.

A handwritten signature in blue ink, reading 'Hajner Réka', written over a horizontal line.

Signature

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Preface

One of the main questions of bilingualism research is the nature of how the bilingual brain produces speech and switches between the languages. Bilingual production is based on the inhibition and activation of different languages, and theories have been proposed to account for how it happens (e.g.: Green, 1986). Results have been contradictory about whether the weaker language (L2) or the stronger language (L1) is more difficult to inhibit (e.g.: Meuter & Allport, 1999; Christoffels et al., 2007; Mosca & De Bot, 2017). The aim of the present research is to gain insight into bilingual language control in language production; how language switching happens; and how language dominance, the language history, frequency of use, proficiency and attitude influence the language switching cost.

This paper presents the results of an experiment conducted among Hungarian - English bilinguals ($N = 43$). The participants completed the evaluation of their language dominance and a picture-naming task inducing language-switching. To assess language dominance, the Bilingual Language Profile questionnaire was used (Birdsong et al., 2012) and its results were analysed together with the reaction times during the picture-naming task. The effect of language balance and imbalance, accommodation to code-switching, target word frequency and extralinguistic factors on language switching were considered. Results suggest that language dominance is strongly associated with performance at the language switching task, and so is word frequency; extralinguistic differences and accommodation to the task proved to be non-influential factors.

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CHAPTER 1: INTRODUCTION

Bilingualism (i.e.: the use of two languages on a daily basis by the definition of Grosjean (1989)), and the speech production of bilinguals is a widely researched topic in linguistics. According to bilingual speech production models (such as Green, 1986) when planning speech, the two languages in the brain of a bilingual are both active to a certain extent (for an overview, see Kroll et al., 2012). When selecting words, the word forms of both languages are active and are competing for selection, and it requires effort to inhibit the word from the non-intended language. However, as it takes effort to inhibit one language, it also takes effort to reactivate it when needed. The Inhibitory Control Model (Green, 1986) states that the more dominant one language is for the speaker, the more effort is needed to inhibit it, hence the more effort is needed to reactivate it. Thus, for a bilingual whose dominant language is Hungarian, it would take a longer time to switch to English, and then, it would take longer time to switch back to Hungarian, than for a bilingual whose languages are balanced. One of the motivations of this research is that most studies have focused on typologically similar language pairs (e.g.: English, Dutch, German, Spanish) (see for instance: Santesteban & Costa, 2016; Mosca & de Bot, 2017; Declerck et al., 2019); however, little is known about Hungarian-English bilingual language production (Navracsics, 2004).

In order to answer the main research questions, first, participants will fulfil a questionnaire (Bilingual Language Profile by Birdsong et al. (2012)) focusing on their language history, use, proficiency, and attitude in Hungarian and English. This questionnaire provides data about the language dominance of the participants, which will then be used during the analysis of the results.

As the second phase of the experiment, participants complete a computer-based picture-naming task which allows their reaction times to be measured. In this task they will be asked to name the presented picture as quickly and accurately as possible. The pictures presented are of everyday objects, animals, body parts, etc. Participants have to face altogether 80 trials, during which the order of the target language is not predictable; there are trials where the required answer is in different language than the previous one (switch trials), and where the answer is the same language as the previous stimulus (repetition trials). Participants see each picture twice, once in Hungarian and once in English.

In this paper, the above-mentioned experiment focusing on the relationship of codeswitching (language switching) and language dominance of Hungarian-English bilinguals will be presented. First, the theoretical background will be reviewed based on existing literature, featuring an overview of bilingualism, speech production models and the experimental data. Based on the literature, research questions will be formed, and the hypotheses will be created. To answer the research questions, the design of the experiment will be presented, and its participants, instruments, and procedure will be discussed. Finally, the results of the experiment will be presented and discussed, and conclusions will be deducted based on the results and by comparing them to data from other experiments.

1.1 Bilingualism

In order to extend the knowledge on the switching cost of bilinguals, first it has to be determined who is considered a bilingual. There have been various definitions of bilingualism developed in the last half century, from strictly referring to individuals who have the skills of a native speaker in two languages (Bloomfield, 1933; Thiery, 1978), to the “lighter” definitions such as language users who possess at least one language skill out of reading, writing, speaking, and listening (Haugen, 1969). In this thesis, however, the definition by Grosjean (1989; 1997) will be used as a working definition, and those individuals who use two languages on a daily basis will be considered bilinguals.

As bilinguals use two languages on a daily basis, it is often the case that the two languages are used for different purposes. The result of this is that the proficiency of bilinguals is not the same in the two languages in all areas and is often domain-specific (i.e.: if one only uses one language during work, and another at home, they might not be able to use the languages in the other domain). It might also be the case that the traditional language skills (reading, writing, speaking, listening) are used to different extent in the two languages. These phenomena are summarised in the complementary principle by Grosjean (1997, p. 165), which states the following:

Bilinguals usually acquire and use their languages for different purposes, in different domains of life, with different people. Different aspects of life require different languages.

As an implication of the complementary principle, it can be stated that a bilingual should not be considered as two monolinguals in one person (Grosjean 1989; Malt & Sloman, 2003), since their language skills are different in the two languages. This also indicates that bilinguals do not produce and perceive speech as if they were monolinguals, and research also shows that switching off one of their languages completely is not possible (Kroll et al., 2006; 2012; Marian & Spivey, 2003). Rather, bilingualism is dynamic (Hernandez et al., 2005; Kroll et al., 2012): the languages of a bilingual influence one another in both directions (cross linguistic influence (CLI)) (Dussias, 2003; Hartsuiker et al., 2004; Jared & Kroll, 2001; Kroll & Stewart, 1994; MacWhinney, 2005); the proficiency of the language user can change based on training, immersion (Lambert & Freed, 1982; Linck et al., 2009), or attrition (Bátyi, 2015; Schmid, 2010).

To be able to handle two languages, bilinguals need a developed control mechanism, and it has been found that indeed, they have an increased cognitive control compared to their monolingual peers (Abutalebi & Green, 2008; Hasegawa et al., 2002). It has also been observed that bilinguals have advantages in certain areas of cognition, such as ignoring irrelevant information, conflict resolving or switching between tasks (Bialystok et al., 2009). Bilinguals have better metalinguistic skills (Bialystok, 1988) and working memory as well (Bialystok et al., 2014). The influence of bilingualism does not fade with age, furthermore, bilinguals are diagnosed with diseases connected to dementia 4.5 years later than monolinguals (Bialystok et al., 2007; Craik et al., 2010).

1.2 Speech production models

Nevertheless, it is not a negligible achievement that bilinguals are able to produce and comprehend speech and writing in more than one language. The issue of speech production has been one of the focal interests of psycholinguists for several decades as it is the most observable part of speech behaviour. In this thesis, the most widely used model of speech production will be discussed, which was developed by Willem J. M. Levelt in 1989. The Speaking Model gives a thorough description of how monolinguals produce spoken language, based on analysing speech errors and hesitation markers (e.g.: filled or silent pauses). The model is a blueprint and is based on the available empirical evidence back in the late 80s. Since then, several research including brain imaging studies have validated the components and working mechanisms of the model

(e.g.: Indefrey, 2007). However, as the focus of the thesis is the population who handle two languages in the mind when speaking, bilingual models will also be elaborated on. These bilingual speech models were based on Levelt's original model, complemented with the phase at which the language selection happens.

Levelt's Speaking Model (1989; 1992; 1993; 1995; 1999, as in De Bot & Bátyi, 2022) consists of three main components: the conceptualiser, the formulator, and the articulator. These are the processing components (illustrated with boxes), which are connected to the knowledge components (illustrated with ellipses), such as the mental lexicon. The Speaking Model can be seen in Figure 1.

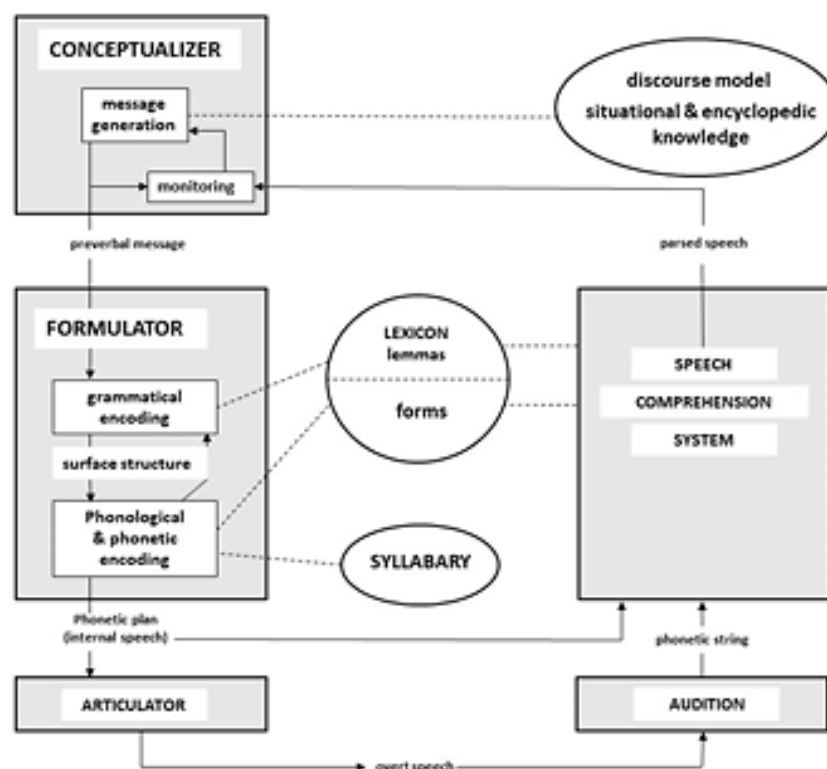


Figure 1. Levelt's speech production model (Levelt, 1989 adapted by De Bot & Bátyi, 2022)

The first phase of speech production is the conceptualisation and planning. It is a pre-linguistic stage, where general decisions are made about what to say, relying on the situational and general knowledge as well as on the speaker's own understanding on how communication works. The basic unit of conceptualisation is the idea; it was observed that speakers tend to hesitate more at the beginning of a new idea, and during speaking about the idea the amount hesitation markers decreases and fluency increases.

The conceptualisation phase also involves macro- and microplanning. In macroplanning, linearisation and instrumentality happens; speakers choose the order in

which information should be presented and select pieces of information that helps them best achieve their communicative goals. In microplanning, speakers carry out the detailed planning of each individual speech act. These processes result in the creation of the pre-verbal message, which cannot be considered language yet.

The second phase of speech production according to Levelt's model (1989) is the formulation, in which the formulator and the mental lexicon are involved. There are two distinct processes of formulation: the grammatical and phonological encoding, connected to different aspects of the desired lexical entries. During grammatical encoding, functional and positional processing takes place. In functional processing, the meanings and syntax of lexical items (lemmas) are accessed and selected from the mental lexicon, then they are given their appropriate function to achieve the speaker's intended meaning.

While attempting to access the intended items from the mental lexicon, there is one "challenge" the speaker has to overcome: spreading activation. Spreading activation, which is an automatic process, means that whenever a lexical item is activated, other nodes connected to it are also activated; for example, if a speaker wants to produce the word "scarf", activating the concept of scarf spreads and activates lexical items with similar meaning (e.g.: jacket, gloves, cold) and similar sound pattern (e.g.: scar). These nodes are all competing to be selected, and language users have to inhibit the activation of undesired lexical items for successful communication.

Then, in positional processing, the selected lemmas are organised into an ordered string, a sentence frame is created and the lexical item in focus position is selected. Besides grammatical encoding, phonological encoding also takes place here. It accesses the morphosyntactic and phonological information (lexemes) of the lemmas selected during grammatical encoding from the mental lexicon and creates the phonetic plan by activating the individual sound segments of the target word (inner speech). Phonological encoding also includes generating the pattern for intonation, pauses and loudness.

Lastly, the phonetic plan reaches the articulator and is converted into actual speech. The articulator consists of the lungs, larynx, pharynx, and the mouth. The basic unit of articulation is the syllables; articulation only starts when all syllables of the target word have been retrieved.

It is also important to mention how self-monitoring happens in Levelt's blueprint (1989). There are two feedback loops which are responsible for correcting mistakes in

the process, one internal and one external. The internal checking mechanism is at the stage when the phonetic plan (internal speech) is created and ready to be pronounced, while the external feedback monitors speech already articulated. This means that errors are most likely corrected by producing the originally intended phoneme, lexeme or sentence structure after the mistake has already been made.

1.2.1 Language selective bilingual speech production models

Having discussed Levelt's monolingual speech production model, bilingual models derived from the Levelt's work can now be focused on. To account for the possibility of different languages as outputs of the original model, psycholinguists had to explain which phase language selection occurs at. This resulted in the creation of two different views on bilingual speech production: language selective and non-selective models (Colomé, 2001; Costa et al., 1999; Grosjean, 2013; Hermans et al., 1998; Jared & Kroll, 2001). The first argues that language selection occurs early in the conceptualisation phase, so bilinguals are able to activate one of their languages and ignore the other (e.g.: De Bot, 1992; La Heij, 2005). It also assumes the existence of a "language switch" that bilingual speakers use to switch between their languages (MacNamara & Kushnir, 1971). This idea has does not have too many supporters, since the majority of empirical evidence suggest that bilingual speech production process is language non-selective (for an overview see for instance Kroll et al., 2012). The language non-selective models, or competition for selection models propose that lemmas are not linked to one lexeme only, but to lexemes of different languages, thus language selection happens in the formulation phase (e.g.: Green, 1986).

The early bilingual models based on Levelt's Speaking model belonged to the language selective category. The first such model was created by De Bot (1992), and it proposed the idea that in the micro-planning phase during conceptualisation one of the languages of the speaker is activated and this information is encoded in the pre-verbal message, similarly to the intended register being encoded in monolingual speech at the same phase of speech production. One of the problems with the model originated from this idea; it did not explain the cases when speakers unintentionally use more languages in the same utterance or conversation (i.e. codeswitching) (De Bot & Bányi, 2022). The model of Kormos (2006) solves this problem by proposing that language cues are added to each concept separately, which allows codeswitching at a later stage of speech production than the conceptualisation phase, while Costa, Miozzo and Caramazza

(1999) support the idea of language tags of L1 or L2 on lexical items. Other supporters of this approach followed this idea later (La Heij, 2005; Poulisse & Bongaerts, 1994), agreeing that language selection is part of the conceptualisation phase, but also claiming that the activation of certain lexical items co-activate neighbouring items, at times resulting in unintentional codeswitches.

1.2.2 Language non-selective bilingual speech production models

On the other hand, language non-selective models vary in terms of where exactly language selection occurs. Some suggest that language selection happens in the lexical selection phase. In this thesis, one of the most influential language non-selective models will be discussed and tested empirically, the Inhibitory Control Model (ICM) by Green (1986; 1993; 1998).

The basis of the Inhibitory Control Model is the spreading activation (i.e. when accessing a lemma, other nodes connected to it are also activated and have to be suppressed). Green's model (1986) explains that the same process happens when bilinguals select the intended lemmas in their communication, both languages are activated, and speakers inhibit the languages which is not currently in use. The ICM also assumes that each lexical item has a language tag indicating their belonging to L1 or L2.

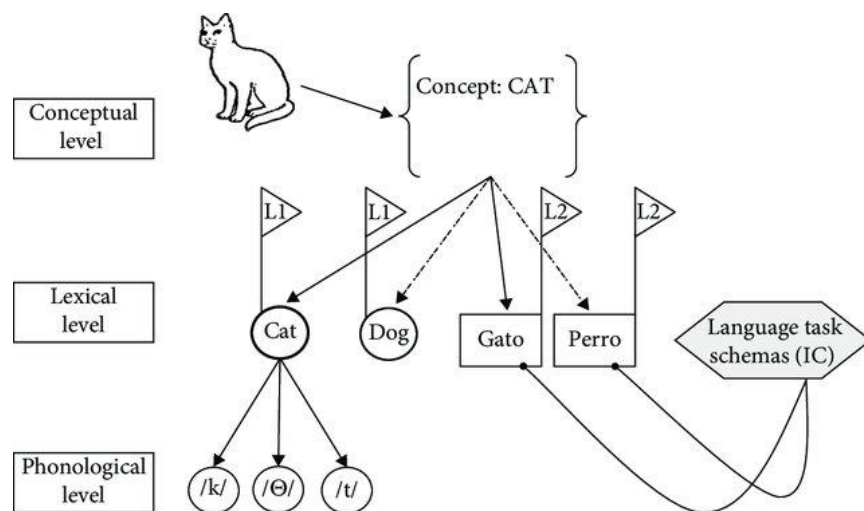


Figure 2. Inhibitory Control Model (Green, 1986)

However, as Grosjean (1989) argued, it is highly unlikely that a bilingual uses their languages for the same purpose and in the same domain of life, thus one of their languages is usually more dominant. Green (1986; 1993; 1998) claims that due to this imbalance, nodes of different languages are activated to various extent, thus the

inhibition a bilingual has to enforce differs based on their dominant language. This means that to produce an utterance in the non-dominant language, the speaker has to inhibit nodes which are more active than the desired one; in other words, the more dominant a language is for a bilingual, the more it has to be suppressed to produce another language. To reactivate a language after it was inhibited also depends on its dominance; the more dominant it is, the more its reactivation cost is. This phenomenon is called the switching cost, which, according to Green (1986) is dominance-related, asymmetric inhibition.

1.3 Language dominance

From the ideas of Grosjean (1989) and Green (1986) emerges the notion of language dominance, which should not be considered equal to language proficiency, even if they often correlate (Birdsong, 2006; Gertken et al., 2014). In this thesis, the working definition of language dominance will be that of Harris et al. (2006, p. 264), saying:

Language dominance refers to which language is generally most accessible in day-to-day life. It is the language that is most highly activated, and can be the default language for speaking and thinking.

Language dominance, such as bilingualism as a whole is also dynamic, it can shift during the lifetime of a bilingual, regardless of proficiency, e.g.: in case of immigrants (Harris et al., 2006). However, it is not only such events that can influence the languages of a bilingual. Language dominance can also change based on the settings a bilingual is in or the topic of the discussion (Grosjean, 2001; Lim et al., 2008); and it is also influenced by psychosocial factors (i.e.: when, and with whom bilinguals use which language) (Pavlenko, 2004). Thus, in accordance with Grosjean (2001), it can be stated that a bilingual person is continually monitoring to what extent each of their languages can be used, in other words, what language mode they can be in. The language mode is a continuum from the monolingual mode to bilingual mode, which can shift based on various factors. The factors include the social settings (such as the proficiency or the relationship of the speaker and receiver), topic, stimulus from the environment etc. A visual representation of the language modes can be seen in Figure 3.

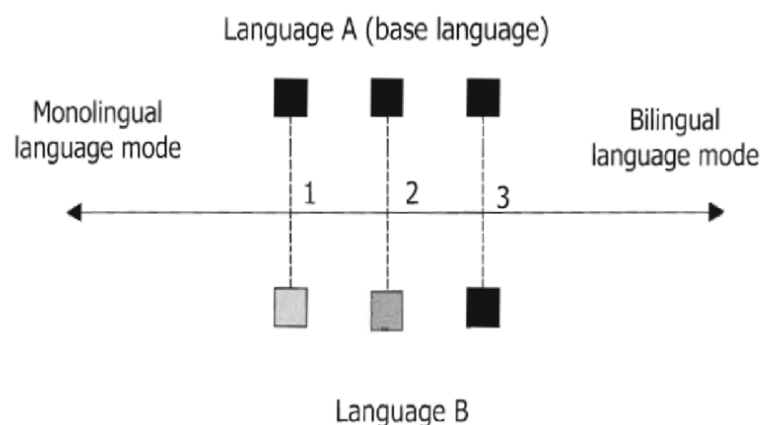


Figure 3. Languages Modes model (source: Grosjean, 2001)

Nevertheless, even if the language mode of bilinguals changes from monolingual to bilingual mode, their overall dominance can be measured and examined. In order to do this, various language dominance tests have been created, which provide a great help for researchers to gain further insights into how the bilingual mind works. The dominance tests to be discussed in this thesis are the Bilingual Language Profile (BLP) (Birdsong et al., 2012); Language Experience and Proficiency Questionnaire (LEAP-Q) (Marian et al., 2007), the Bilingual Dominance Scale (BDS) (Dunn & Fox Tree, 2009) and the Self Report Classification Tool (SRCT) (Lim et al., 2008).

Bilingual Language Profile (henceforth: BLP) is an instrument for assessing language dominance of the participants through self-report in a questionnaire format, created as a standard and guide for researchers of bilingual interaction, cognition, or success (Gertken et al., 2014). It was designed to include and measure the various dimensions of language dominance besides proficiency (Birdsong, 2006; Gertken et al., 2014), such as cultural identification (Marian & Kaushanskaya, 2004), motivation (Piller, 2002), language history and use. The importance of knowing language dominance lies in the fact that it affects “language behavior, cognition and emotion” (Gertken et al., 2014, p. 208), influences patterns of code-switching (Basnight-Brown & Altarriba, 2007), language choice (Dewaele, 2004, Tamamaki, 1993), and even lexical memory representation (Heredia, 1997). Language dominance can be used in education (Brunner, 2010), academic and clinical research (Gollan et al., 2010; Howell et al., 2004), or in language therapy (Lim et al., 2008).

In BLP dominance is thought of as a continuum rather than a dichotomous concept (Gertken et al., 2014; Grosjean, 2001). Thus, with BLP it is possible to accurately assess

the language profile of bilinguals and observe variation within certain groups such as bilinguals with high dominance or relatively balanced bilinguals.

The BLP questionnaire uses self-evaluation, which is one of the most common methods in dominance profiling (e.g.: Cutler et al., 1992; Rah, 2010; Tokowicz et al., 2004). It is also agreed upon that bilinguals are able to assess their language skills and experience (Bairstow et al., 2014; Flege et al., 2002; Golato, 2002; Gollan et al., 2012; Langdon et al., 2005; Lim et al., 2008; Marian et al., 2007).

There are other existing reliable and accepted instruments for measuring language dominance, such as the Language Experience and Proficiency Questionnaire (LEAP-Q) (Marian et al., 2007), the Bilingual Dominance Scale (BDS) (Dunn & Fox Tree, 2009) or Self Report Classification Tool (SRCT) (Lim et al., 2008). The first on the list, LEAP-Q is an excellent tool to assess the languages of a bilingual individually, but it provides no information on the relating strengths of the two languages (Gertken et al., 2014). LEAP-Q is also considered rather lengthy and complex; on the contrary, the BDS assesses the language dominance of respondents in only twelve questions (Gertken et al., 2014). The BDS can be an optimal choice for researchers whose target population is illiterate, simultaneous bilingual (meaning that they acquired the two languages at the same time) (Amengual & Blanco, 2011 as in Gertken et al., 2014), but when applied to late L2 learners (such as the target population of this thesis), it can result in invalid assessment (Gertken et al., 2014). Lastly, the SRCT is a tool to define the language dominance specifically of Singaporean English – Mandarin communities for clinical purposes (ibid.), which would also not be a suitable choice for the target population of the present paper.

1.4 Experiments on bilingual speech production

In order to support the models of speech production with empirical data, experiments have been conducted on bilingual speech production, codeswitching, and inhibition. To test their hypotheses, researchers designed a wide variety of tasks over the decades of experimenting with bilingual speech production, such as the Stroop task (Stroop, 1935), or Simon task (Simon & Wolf, 1963). One of the most frequently used tasks is the picture naming. Picture naming can be used to induce codeswitches, and it is also a useful tool to avoid presenting the orthographical representation of words (e.g.: if the writing systems of a bilingual's languages are different). Studies measuring switching

cost by picture or number naming feature two types of trials: *repetition* (stimuli of the same code, e.g. L1-L1) and *switch trials* (stimuli from different codes, e.g. L1-L2). The expected reaction time to repetition trials is slower than the reaction time to switch trials, as well as the results of switch trials are usually less accurate (Meuter & Allport, 1999).

Current studies on codeswitching and switching cost focus on the switch between dominant and non-dominant languages, registers, modalities, and the potential facilitating power of cognates. Declerck et al. (2019) directs attention to code switching between registers (formal/informal French) and languages (French and English). They conclude that there is a similar control mechanism for the two different types of switching. Researchers are also interested in the codeswitches between sign and non-sign languages (i.e.: bimodal bilinguals) (Emmorey et al., 2008; Morford et al., 2011; Pichler et al., 2019; Tang & Sze, 2018). In the findings of Tang and Sze (2018), in the language production of bimodal bilinguals the two languages are often present at the same time (code-blending, simultaneous production), and the “traditional” code-switching rarely occurs. It has also been observed that bimodal bilinguals are also prone to CLI (Emmorey et al., 2008; Morfold et al., 2011), even though their languages are not phonologically similar.

Several papers have focused on how cognates affect codeswitching (Bobb & Wodniecka, 2013; Hoshino & Kroll, 2008; Santesteban & Costa, 2016). In these experiments, two types of words are presented to the participants: those that do not share their form in the bilinguals’ languages (e.g.: horse – ló) and those that do (e.g.: bomb – bomba). The conclusion of these experiments was that picture of cognates in the bilinguals’ languages were named faster than non-cognates, even in cases when the writing system of the languages are different (e.g.: Japanese-English (Hoshino & Kroll, 2008)).

Other language pairs which are markedly different from each other have also been studied, such as Hungarian and English. The speech production of Hungarian-English bilinguals has been explored by the works of Navracsics (see for instance: 2004; 2014), focusing on codeswitching, codemixing, pauses and discourse markers of participants’ narration of comic strips, picture or colour naming tasks. Her works also examined the bilingual mental lexicon through various aspects (Navracsics, 2006; 2007).

To test the Inhibitory Control Model (Green, 1986; 1993; 1998) numerous studies of dominance-related switching costs were designed. The results were controversial, with

some papers observing an asymmetric inhibition pattern (Jackson et al., 2001; Macizo et al., 2012; Meuter & Allport, 1999), while others refuting it (Bobb & Wodniecka, 2013; Fink & Goldrick, 2015; Peeters et al., 2014; Reynolds et al., 2016). However, it was also found that in case the participants were balanced bilinguals (neither of their languages was particularly dominant), the switching cost was also balanced, symmetrical (Christoffels et al., 2007; Declerk et al., 2013; Fink & Goldrick, 2015; Swieter & Sunderman, 2008). Furthermore, with extended practice, the switching cost has been reported to be reduced (Meuter & Allport, 1999) even for unbalanced bilinguals.

The recent paper of Mosca and De Bot (2017) presents a bilingual perception and production experiment to fill the gap in the knowledge on the differences and similarities between the two processes. They conducted two experiments with Dutch-English bilinguals, a lexical decision task (pseudowords versus existing words in Dutch and English) for the perception component and a picture naming task for the production part. In the picture naming task participants had to name the pictures in Dutch or in English (indicated by green or blue background) during single-language and mixed-language blocks, which consisted of repetition (75%) and switch trials (25%). Altogether 14 pictures were used in this experiment in a total of 168 trials. Their data show that repetition trials were named faster in both L1 and L2 than switch trials. They also concluded from the results that balanced bilinguals produced symmetric switching costs, asymmetric reactivation cost was only observed when participants had a substantial dominance difference between their languages. These conclusions are in line with the study of Mosca and Clahsen (2016) and Christoffels et al. (2007), stating that symmetrical switching cost can be expected if a bilingual is unbalanced but a highly proficient L2 user.

The series of experiments conducted by Linck, Schwieter and Sunderman (2012) are also worth discussing. Their participants were trilingual (L1 – English, L2 – French and L3 – Spanish), and the focus of the experiments was to find out how inhibitory control affects codeswitching. The participants had to perform a Simon task and a picture naming task. Their results show that for multilinguals, switching cost into L1 was higher than the other cases, and the lowest switching cost was into L3, which supports the ICM (Green, 1986).

1.5 Research questions

Even though numerous speech production experiments have been conducted on bilinguals in order to see whether there is a symmetrical or an asymmetrical switching cost (see for instance: Reynolds et al., 2016), oftentimes the languages compared are typologically similar (e.g.: English-Dutch, English-German, etc.). This, however, is not true in case of the present thesis, where the target population is Hungarian-English bilinguals.

The goal of the present study is to shed light on the connection between language switching and language dominance of bilinguals.

The thesis aims at answering the following questions:

- 1) To what extent is language dominance related to language switching in Hungarian-English bilinguals?
- 2) To what extent are extralinguistic factors and accommodation to the task related to language switching in Hungarian-English bilinguals?

The hypothesis of this paper is that the results will support the Inhibitory Control Model (Green, 1986; 1993; 1998); the data from the experiment will show asymmetrical inhibition, so switching to the stronger language is expected to be slower than switching to the weaker one. It is also hypothesised that by the end of the experiment, participants will be accommodated to the task and their reaction times will be faster. More frequent words are anticipated to be reacted to faster as well.

CHAPTER 2: METHODS

2.1 Participants

The target population of this experiment was Hungarian-English bilinguals. There were 43 participants in the experiment. The mean age of the participants was 24.58 years ($SD = 6.89$), with the minimum being 18 years and maximum being 54 years. Regarding their gender, 21 (49%) participants were female, and 22 (51%) were male. All participants were currently living in Hungary. The vast majority of the participants ($N = 40$, 93%) were born and raised in Hungary; however, there were three participants (7%) whose country of origin was different (namely: Ukraine (Transcarpathia), United Kingdom, Romania (Transylvania)). Nevertheless, the mothertongue of all participants was Hungarian.

Considering the highest level of education, every participant was enrolled at university. 28 participants (65%) were currently attending university for their Bachelor's degree; 11 participants (25%) had their BA degree as highest level of education. There were also 2 participants (5%) with Master's level degrees, and 2 participants (5%) who have completed their PhDs.

2.2 Instruments

2.2.1 Bilingual Language Profile

The first part of the experiment on switching costs of Hungarian-English bilinguals was a questionnaire based on Bilingual Language Profile (Birdsong et al., 2012). A more thorough discussion of the principles behind choosing this instrument can be found in Section 1.3.

The Bilingual Language Profile questionnaire consists of four modules (19 questions) and one additional section for gathering biographical information. The first module focuses on the language history of the participants, collecting information about the age at which they acquired their languages, years they spent in a country, family, or workplace where their target languages were dominantly used. The second module consists of questions concerning language use. Participants were asked to indicate the percentage in which they use their Hungarian, English, or other languages out of 100% in various areas of their everyday life, such as with friends, family, at school or during talking to themselves. The third module focuses on the proficiency of the participants in

Hungarian and English. It includes questions about their writing, speaking, listening, and reading skills, which they had to indicate on a Likert scale from 0 (not good) to 6 (very good). Lastly, Module 4 is dedicated to language attitude, with questions about with what culture do the participants identify themselves, which language they want to be considered a native speaker of, etc. Their answers had to be indicated on a scale from 0 (not at all) to 6 (to a great extent).

The biographical module of the original Bilingual Language Profile questionnaire was modified to provide valid information about the Hungarian participants. First, participants were presented with the necessary information about the experiment, the contact information of the author and the supervisor of the thesis and were asked if they accept the terms. Then they were asked about their age, sex, current place of residence and country of origin. It was also required to give their highest level of formal education, which was modified to the appropriate levels of the Hungarian education system. The complete questionnaire used can be found in Appendix 1.

The questionnaire was administered on Google Forms in English. The questionnaire was distributed to the participants of the experiment online, completed questionnaires were then assessed and the dominance scores were calculated by the author of the thesis.

In order to calculate the language dominance of the respondents, the BLP assigns weights to the different components to account for the different number of questions. The instructions of calculating the language dominance scores are provided on the BLP website (Birdsong et al., 2012). The scores of the two languages are subtracted from one another; in this case, the English score is subtracted from the Hungarian score. This way, those participants whose language dominance score is positive are more dominant in Hungarian, while respondents with negative score are more dominant in English. The maximum value of one's language dominance is +218.

In this section, the dominance score of the participants will be presented. The mean score of the participants was +59.39, meaning that on average, they are rather dominant in Hungarian. However, there is a great variance in the scores ($SD = 33.72$). There were 3 participants with dominance in English (P5 with -28.33; P9 with -18.25 and P32 with -.18). The highest dominance score on the Hungarian side was P49 with +126.68; and there were 5 other participants with scores close to +100.

Based on the scores, participants were grouped into five different categories, shown in Table 1.

Title	Score	Participants #	Hungarian dominance #	English dominance #
Balanced	0-19	5	3	2
Slight dominance	20-39	8	7	1
Medium dominance	40-69	10	10	0
Medium strong dominance	70-94	14	14	0
Strong dominance	95+	6	6	0

Table 1. Distribution of participants by language dominance

2.2.2 Picture naming task

The second stage of the experiment consisted of a picture naming task, where participants were asked to watch videos and say the name of the presented pictures as fast and accurately as they can. There were four videos altogether: two single-language practice blocks in English and in Hungarian, and two mixed-language videos to induce code-switching.

All four videos were specifically designed and created for the purpose of the thesis. The videos began with 3000ms of blank screen before the picture naming sessions started. Before each picture, participants saw a short intermission, which consisted of a fixation point for 200ms and blank screen for 400ms, during which an audio signal was played so that it ended precisely when the picture was shown after the intermission. Pictures were shown for 3000ms, during which time participants had to name it in the required language. The required language was signalled by the colour of the background of the pictures (yellow background for the Hungarian language and blue background for the English language), as shown in Figures 4 and 5. After every fourth trial, a blank screen was shown for 3000ms.

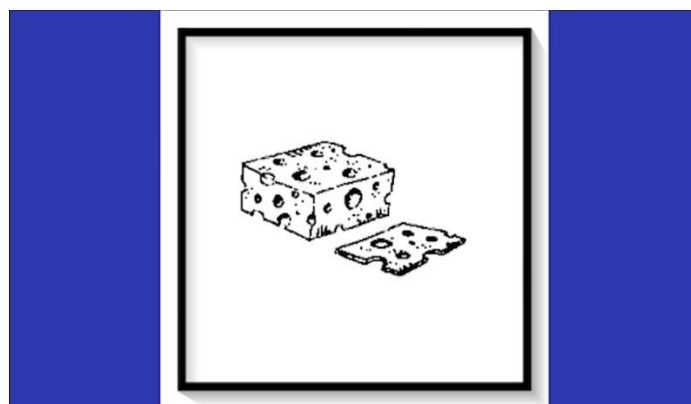


Figure 4. Example of stimulus (English)



Figure 5. Example of stimulus (Hungarian)

The single-language blocks featured 4 – 4 trials, and the mixed-language blocks included 40 – 40 trials. The pictures in the mixed-language sessions were organised into ten groups, each with four words. Every group had different combination of the two required languages so that the order of languages are not predictable for the participant, as shown in Table 2. The language composition of the groups in the two mixed-language sessions were the complete inverse of each other; all participants completed both sessions, but half of them started with the first list and the other half with the second list.

List#1	List#2
2221	1112
2121	1212
1112	2221
1221	2112
1212	2121
2212	1121
1121	2212
1211	2122
2112	1221
2211	1122

Table 2. Distribution of target languages

The pictures used in the experiment were created by the International Picture-Naming Project (IPNP) by the Center for Research in Language (CRL) at the University of California (see for instance: Székely et al., 2005). In the experiment pictures illustrating nouns, such as everyday objects, animals, body parts were included. All pictures were black-and-white drawings of the target word. The procedure of selection was implemented manually, based on various factors. Firstly, cognates or similar sounding words were eliminated (e.g.: guitar-gitár; panda-panda). Then, the

classification of words into levels (e.g.: A1, A2, B1, etc.) of EnglishProfile (2015), based on the Common European Framework of Reference (CEFR) (Council of Europe, 2001), was taken into consideration. Lastly, the database of IPNP was used to select words with similar frequency in both languages (n.d.). The frequency of the English words was examined in the British National Corpus (n.d.); the Hungarian words were searched for in Magyar Nemzeti Szövegtár (n.d.). There was no significant difference between the frequencies of the words in the two languages, $t(39) = -.41$, $p = .68$. There was no attempt to match the words on the basis of the number of syllables or characters in either of the languages.

The list of selected words by their target name in English and Hungarian can be seen in Table 3, together with the level at which they are learned based on CEFR (Council of Europe, 2001) and their respective frequency. The target names (or dominant names) are used in reference to the IPNP, in which these names emerged from the data; these names were dominantly used by the participants and were not preselected. The words selected for the experiment were mostly A1 (52%, $N = 21$), A2 (30%, $N = 12$) and B1 (15%, $N = 6$) level, one word (“pumpkin”) was not found on the list (English Profile, n.d.).

The instruments used for the picture-naming task can be found in Appendix 2.

English	English frequency (/million words)	Hungarian	Hungarian frequency (/million words)	Level (CEFR)
bat	10.47	denevér	3.98	B1
bed	146.07	ágy	73.89	A1
belt	20.45	öv	14.36	A2
bird	38.23	madár	54.38	A1
bone	23.48	csont	29.81	B1
book	241.42	könyv	281.94	A1
bread	36.21	kenyér	50.37	A1
camel	3.58	teve	4.06	B1
carrot	3.70	répa	3.69	A2
cat	37.88	macska	25.09	A1
chair	72.31	szék	58.69	A1
cheese	25.04	sajt	12.44	A1
clock	27.64	óra	506.11	A1
cow	13.34	tehén	16.89	A1
dog	77.80	kutya	77.69	A1
door	230.68	ajtó	104.31	A1
ear	27.42	fül	54.90	A1
egg	24.19	tojás	30.77	A1
fire	134.15	tűz	76.98	A2
fish	107.04	hal	41.91	A1
ghost	13.00	szellem	61.32	B1
heart	131.62	szív	141.50	A2
horse	74.30	ló	35.81	A1
lion	11.94	oroszlán	9.03	A2
map	40.26	térkép	39.32	A2
mouse	17.28	egér	15.75	A2
pen	20.72	toll	21.72	A1
pumpkin	0.64	tök	14.40	N/A
ring	66.94	gyűrű	14.95	A2
shoe	11.11	cipő	28.68	A1
snake	7.20	kígyó	9.65	A2
spider	6.48	pók	5.40	B1
strawberry	3.71	eper	2.05	B1
sun	110.25	Nap	62.38	A1
tie	27.83	nyakkendő	6.70	A2
tree	59.82	fa	132.75	A1
umbrella	7.61	esernyő	2.86	A2
violin	5.58	hegedű	7.98	A2
waiter	6.72	pincér	10.61	A1
window	97.64	ablak	96.87	A1

Table 3. Target words, their frequency and levels

2.3 Procedure

As the first step of data collection, a pilot experiment was conducted among 8 participants. Based on their feedback, the list of stimulus words was altered, and the instrument was finalised.

During the data collection phase, first, participants were asked to complete the Bilingual Language Profile questionnaire online. Then, they were contacted to organise the completion of the picture-naming component. In the picture-naming experiment, participants were informed about their task, what the video will look like, and that their answers will be recorded. The language of instruction was Hungarian.

Participants first completed the practice sessions. They had the opportunity to practice the single-language blocks as many times as they wished, until they felt confident with recognising the required language based on the background colours. The mixed-language blocks, however, could only be completed once.

The participants of the experiment were divided into two groups before the task. The first group started with the English practice block, and the first list in the mixed-language session. The second group started with the Hungarian practice-round and the second list in the mixed-language session. Both groups completed the other sessions too, the only difference was the order of the languages and lists.

CHAPTER 3: RESULTS

After data collection, the analysis of the results will be presented. To start the analysis, first, the reaction times were measured with the software Praat and administered to Excel. Then, the software R was used to provide invaluable insights into the results. Only reaction times which featured the target word from the responses were used for the analysis. Instances where participants did not respond to the stimulus or did so in the non-target language were excluded. If the response featured a word semantically similar to the target word in the target language, the response was accepted (e.g.: “rat” for the target word “mouse”, or “kitty” for “cat”).

Based on the reaction times, databases were built for the analysis. In the databases, the average values of reaction times of participants were calculated based on various factors. This way, the mean value of reaction times for the different target languages, trial types or word frequency was acquired. This data was used for t-tests and correlation analyses. In the following section, the results of the aforementioned analyses will be presented. Since the mothertongue of all participants was Hungarian, and for the sake of simplicity, L1 will denote Hungarian in all cases, and L2 will denote English, even if the dominant language of the participants would require a different notation. Thus, in the analysis, L1 will be synonymous with Hungarian, and L2 will equal to English, regardless of the dominance of the participants, except when stated otherwise.

The average reaction time of the 43 participants was 1149.05 milliseconds, when both languages are included. Looking at L1 and L2 separately (Figure 6), no significant difference was found between the reaction times to the Hungarian (L1) ($M = 1150.62$, $SD = 164.85$) and English (L2) ($M = 1147.49$, $SD = 153.38$) stimuli, $t(42) = .22$, $p = .83$.

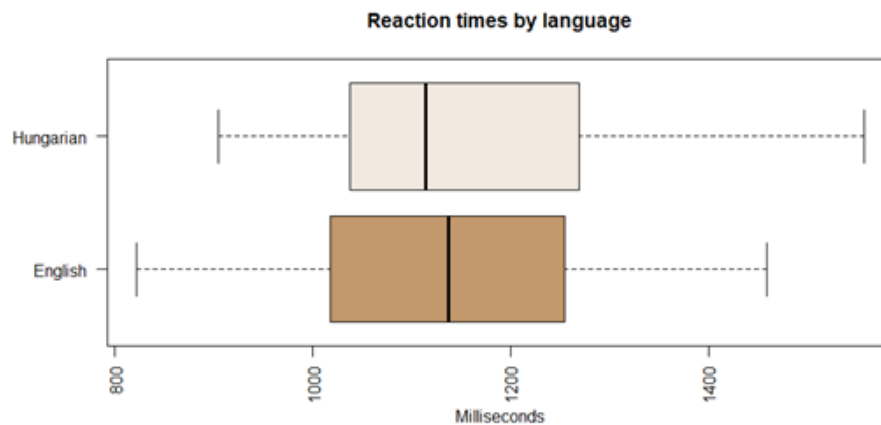


Figure 6. Reaction times by language

Since all words were presented in both languages, it was also measured whether there is a considerable difference between the reaction times for each variant of the words. No significant difference could be found between the production each word in L1 ($M = 1152.34$, $SD = 120.7$) and in L2 ($M = 1151.21$, $SD = 141.76$), $t(39) = -.05$, $p = .95$. This is reported by Figure 7.

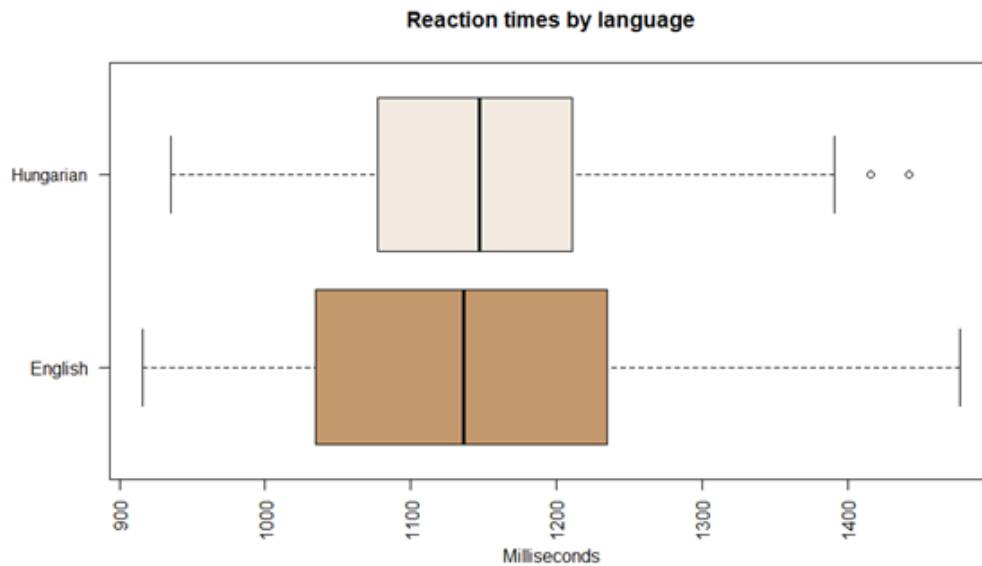


Figure 7. Reaction times per word by language

Next, switch trials (from L1 to L2 and from L2 to L1) were examined, to see if it takes more time for participants to code-switch than to produce the same language. Interestingly, no significant difference could be discovered between the switch trials ($M = 1156.82$, $SD = 161.87$) and repetition trials ($M = 1138.88$, $SD = 148.57$) either, $t(42) = -1.61$, $p = .12$. The relationship of the trial types can be seen in Figure 8.



Figure 8. Reaction times by trial type

Switch and repetition trials of the two languages separately, however, show different results. Data shows a significant difference between the repetition ($M = 1133.02$, $SD = 165.58$) and switch trials ($M = 1165.94$, $SD = 173.06$) when the target language was Hungarian (Figure 9), $t(42) = -2.58$, $p < .05$. This phenomenon is not present when the target language was English (Figure 10), no significant difference could be observed between repetition ($M = 1146.14$, $SD = 159.9$) and switch ($M = 1149.04$, $SD = 163.94$) trials, $t(42) = -.18$, $p = .86$.

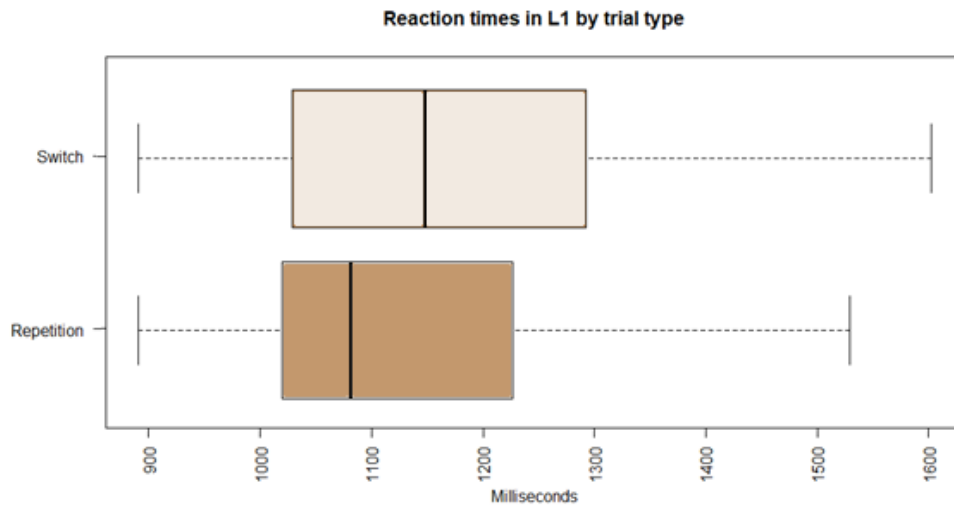


Figure 9. Reaction times in L1 by trial type



Figure 10. Reaction times in L2 by trial type

In the instrument for the picture-naming task, there was a 3000ms pause after every 4th trial to help participants cool down. This feature was also used for analysis; reaction times were examined if there was a language switch after the pause ($N = 8$) or the language remained the same ($N = 10$). The reaction times were significantly different

when participants had to switch between languages after the 3000ms pause (Figure 11) ($M = 1187.43$, $SD = 179.6$), and when the required language was the same ($M = 1232.21$, $SD = 178.19$), $t(42) = 2.55$, $p < .05$. Interestingly, it was the switch trials that displayed shorter reaction times, and not the repetition trials. No significant difference was found between switch trials after the pause requiring switch to Hungarian ($M = 1173.89$, $SD = 206.69$) and English ($M = 1200.78$, $SD = 218.71$), $t(42) = -.76$, $p = .45$.



Figure 11. Reaction times after pause by trial type

Looking at switching to the different languages, interestingly, no significant differences can be found between switching to Hungarian ($M = 1165.94$, $SD = 173.06$) and switching to English ($M = 1149.04$, $SD = 163.94$), $t(42) = -1.18$, $p = .24$. If the data of the three participants who are more dominant in English than in Hungarian are excluded, the results are even less significant, and on average participants still switch slightly slower to Hungarian ($M = 1162.22$, $SD = 167.94$) than to English ($M = 1153.68$, $SD = 178.2$), $t(39) = .59$, $p = .56$.

By calculating the switching cost (subtracting the reaction times of repetition trials from switch trials in each language), no significant differences were found in Hungarian ($M = 32.92$, $SD = 83.61$) and in English ($M = 2.9$, $SD = 106.61$), $t(42) = 1.63$, $p = .11$. The next step towards finding the answer to the research question was to calculate the difference between the switch trials to the different languages. This way, it can be clearly shown to which language participants switch to with more ease, and it can be contrasted to their dominance score. The averages of switching to English were subtracted from the mean values of switch trials to Hungarian. Thus, if the result was negative, it indicated that the switch to English was slower than the switch to

Hungarian; and if the result was a positive number, switching to Hungarian was slower than the switch to English. This data is shown in Figure 12.

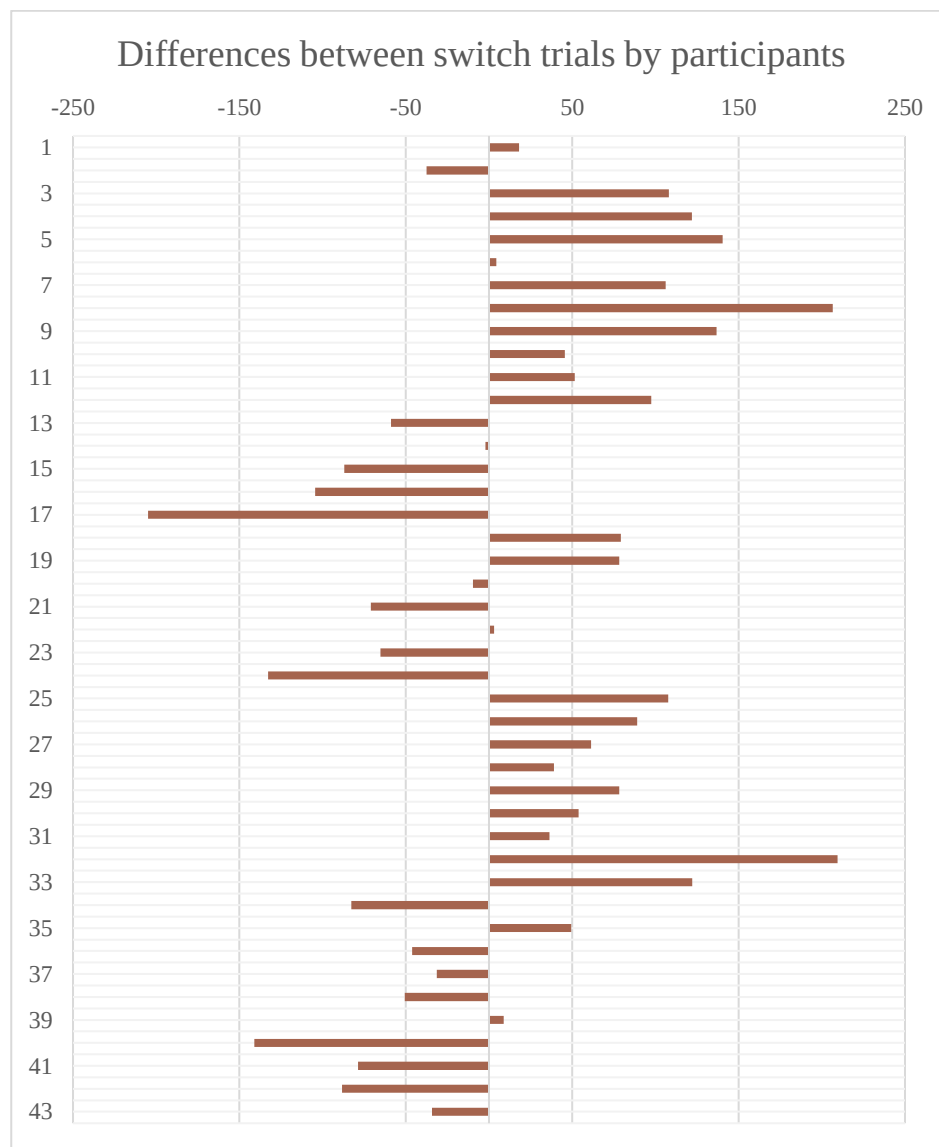


Figure 12. Differences between switch trials by participant

Even though there were only 3 participants out of 43 who showed dominance in English, the difference between the switch trials to L1 and L2 was more evenly distributed. The score of 42% of the participants ($N = 18$) was negative, indicating that they switched to Hungarian faster than to English, while 58% of the participants ($N = 25$) switched faster to English. On average, the difference of switch trials between the two languages was 16.9 ms ($SD = 93.87$). The minimum value (fastest switch to Hungarian compared to the switch to English) was -204.88 ms, and the maximum value (fastest switch to English compared to the switch to Hungarian) was 209.51 ms. In

Table 4, the group, gender, language dominance, and difference between L1 and L2 switching of each participant is included, which will be further analysed.

Participant	Group	Gender	BLP	L1-L2 Switch (ms)
1	1	M	81.82	-98.49
2	2	M	70.28	-95.06
3	1	M	18.08	-122.19
4	2	M	37.30	-45.59
5	1	M	-28.33	83.17
6	2	M	66.02	160.91
7	1	F	33.23	-185.14
8	2	F	9.81	155.15
9	1	F	-18.25	0.14
10	2	M	80.92	58.75
11	1	F	86.36	-32.94
12	2	M	78.55	-67.92
13	1	F	67.37	161.00
14	2	F	74.28	165.41
15	1	F	68.38	152.53
16	1	F	39.68	37.98
17	2	F	89.44	-17.56
18	1	F	60.02	84.82
19	2	M	80.18	71.88
20	2	F	62.38	19.68
21	1	M	99.70	-210.44
22	1	F	96.98	68.53
23	2	F	75.09	-6.59
24	1	M	48.85	-115.57
25	2	M	-0.18	-47.67
26	1	M	19.79	142.62
27	2	M	39.50	125.06
28	1	M	70.37	-106.81
29	2	M	37.87	-298.15
30	1	F	78.82	-28.70
31	2	M	51.49	-50.31
32	1	F	31.42	-165.94
33	1	M	74.55	-50.87
34	1	F	96.98	78.00
35	2	M	20.16	273.24
36	1	F	54.76	-0.76
37	2	M	97.17	-16.67
38	1	M	45.22	-69.46
39	2	F	113.96	-311.91
40	2	F	90.81	-298.36
41	1	F	126.68	-4.93
42	2	F	76.56	-105.98
43	2	M	52.67	150.83

Table 4. Group, gender, language dominance and switching differences of participants

To attempt to answer the research question of this paper, the relationship between the language dominance scores and the differences between the switch trials to L1 and to L2 was analysed. There was a significant, strong negative correlation found between language dominance and the difference between the switch to different languages, $r(41) = -.58$, $p < .001$. This means that the smaller the dominance score of the participants was (i.e.: the more dominant English was for them), the higher the difference between the switch to L1 and L2 was. As a high value of the latter indicates that participants switch faster to English than to Hungarian, it can be concluded that participants produced their stronger language faster.

Figure 13 shows the difference between L1 and L2 switches by the established groups based on dominance scores. As it can be seen, the more dominant English is for the participants (i.e.: the closer the score is to zero), the faster they switch to English. As the dominance shifts to Hungarian, the difference between L1 and L2 switches also shift towards the negative domain, showing faster switches to Hungarian, the stronger language.

By merging the dominance groups into two (participants below and above +40 dominance), results show a clear difference in switching based on the results of the BLP. The difference between switching to Hungarian and to English of the group with dominance score lower than +40 is significantly higher (i.e. they switch to Hungarian slower) ($M = 100.84$, $SD = 78.21$) than the group with dominance score higher than +40 ($M = -19.48$, $SD = 75.51$), $t(22.16) = 4.68$, $p < .001$.

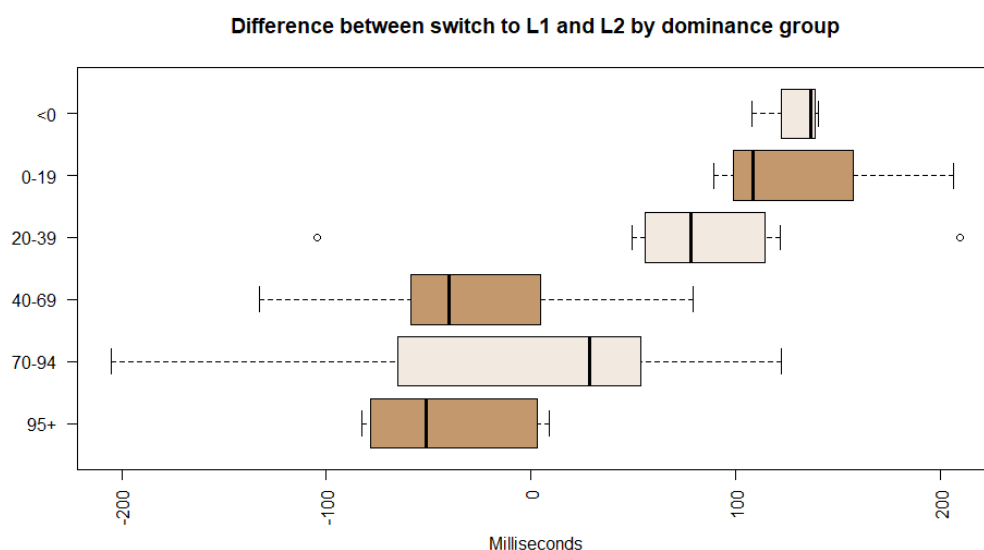


Figure 13. Differences between switch to L1 and L2 by dominance group

The difference between the switch trial to English and to Hungarian was also compared to various other factors, which is reported in Figure 14. Besides language dominance, other factors also seem to have an influence on the difference between the switch trials to the languages. The age of the participants is in a non-significant, weak, positive correlation with the difference of the switch trials, $r(41) = .22$, $p = .16$. This suggests that the older the participants are, the less time it takes them to produce English.

The relationship of the difference between the switch trials and years of learning English is also similar. There was a non-significant, medium, positive correlation found between these factors, indicating that the longer participants have been learning English, the faster they may switch to it, $r(41) = .30$, $p = .054$.

The relation between the difference of switch trials and the components of the Bilingual Language Profile were also examined. To be able to compare the results, for each component, the score given for the English answers were deducted from the score for the Hungarian answers. This means that if the result is low (negative), the participant is more dominant in English than in Hungarian, or if it is close to zero, the participant is a balanced bilingual in that domain. Figure 14 shows that the strongest correlation is between “Switch difference” and dominance in language proficiency, $r(41) = -.55$, $p < .001$. The second one, showing significant, medium, negative correlation is language history, $r(41) = -.44$, $p < .01$. Thirdly, language use also has a significant, medium, negative correlation with the difference between switch trials to L1 and L2, $r(41) = -.36$, $p < .05$. This data can also be observed from the correlation of L1 use and “Switch difference”, $r(41) = -.27$, $p = .07$; and L2 use and “Switch difference”, $r(41) = .43$, $p < .05$. The negative correlations, such as between language proficiency, language history, language use and L1 use and “Switch difference” suggests that the more dominant one is in English, the faster they can switch to English. The only correlation that was positive was between L2 use and “Switch difference”, which indicates that the more one uses English, the faster they can switch to it.

Figure 14 also shows that there is no significant, or strong correlation between age or years of learning English and language dominance, suggesting that even if participants started learning English at a very young age, they are not necessarily more dominant in English than those who are younger, or started learning English later.

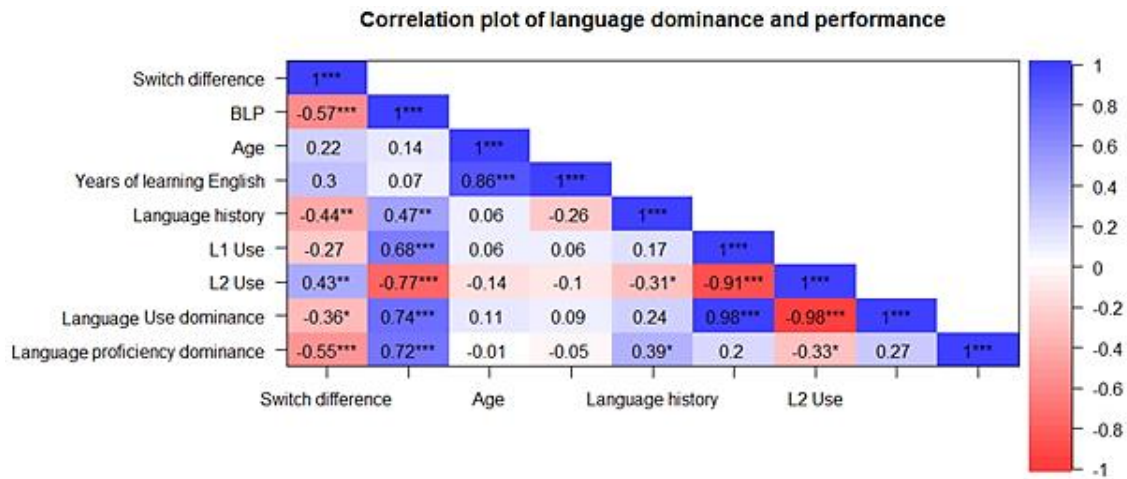


Figure 14. Correlation plot of language dominance and performance

The gender of participants was also taken into consideration. The correlation was even stronger in case of female participants, $r(19) = -.62$, $p < .01$. In case of male respondents, the correlation between their dominance and language switch trials was also significant, strong and negative, $r(20) = -.47$, $p < .05$. The difference between female ($M = -5.41$, $SD = 109.31$) and male ($M = 38.19$, $SD = 72.6$) participants in terms of the difference between switches to the languages was non-significant, $t(34) = -1.53$, $p = .13$. This data is shown in Figure 15.

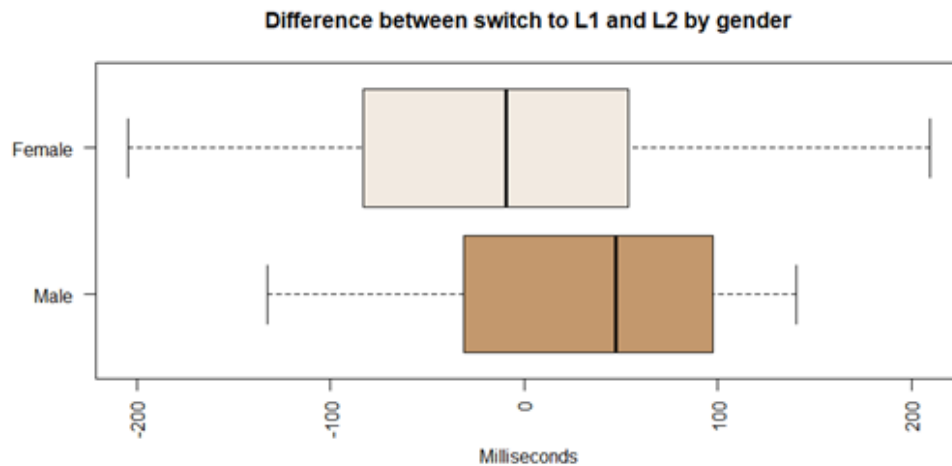


Figure 15. Difference between switch to L1 and L2 by gender

The potential influence of accommodation to the task should also be examined. There was no significant difference between switch trials after at least two repetition trials ($M = 1143.66$, $SD = 167.33$) and switch trials which came in after one another in blocks ($M = 1139.38$, $SD = 156.35$), $t(42) = -.28$, $p = .78$. The effect of accommodation can also be indicated by whether the reaction times of participants became shorter by

the end of the experiment. For this purpose, the instrument was divided into four parts, each containing 20 trials. No significant difference was found between the switch trials during the first ($M = 1135.135$, $SD = 194.18$) and fourth part ($M = 1173.341$, $SD = 190.95$) of the picture naming session; in fact, the reaction times became slower, $t(42) = -1.5$, $p = .14$. Figure 16 shows the reaction times of switch trials over the course of the experiment divided into four parts.

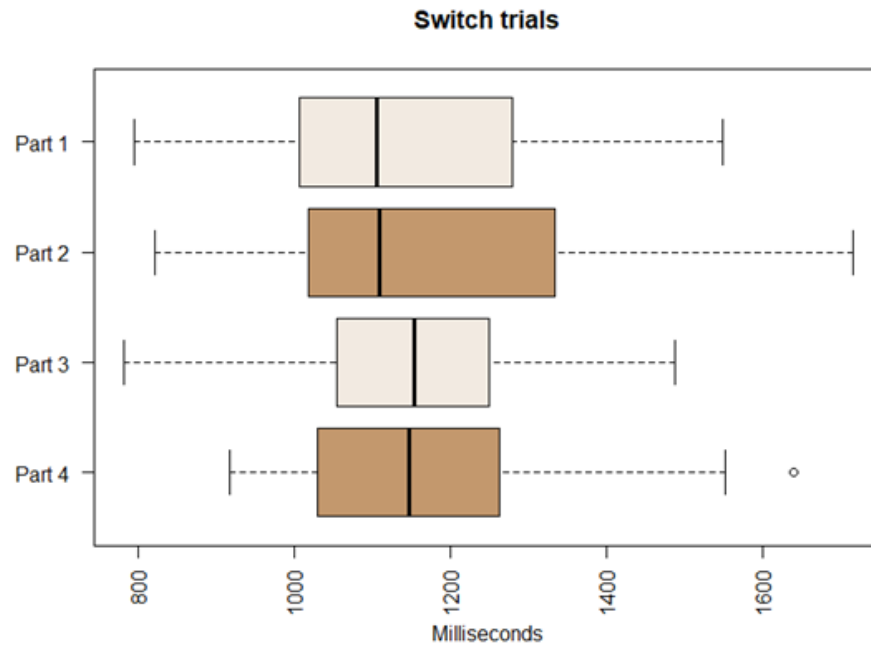


Figure 16. Switch trials during the course of the experiment

During the design of the instrument, two groups were created to ensure that the potential priming effect of the languages and target words are as little as possible to make the instrument valid. The only difference between the groups was that Group 1 saw Video 1 first and Video 2 second, while Group 2 saw Video 2 first and Video 1 second. The reaction times of the groups for Video 1 (first video for G1, second for G2) are presented in Figure 17. The figure shows that in case of Video 1, there is a non-significant difference between Group 1 ($M = 1207.5$, $SD = 150.91$) and Group 2 ($M = 1107.31$, $SD = 190.5$), $t(38) = 1.91$, $p = .06$.

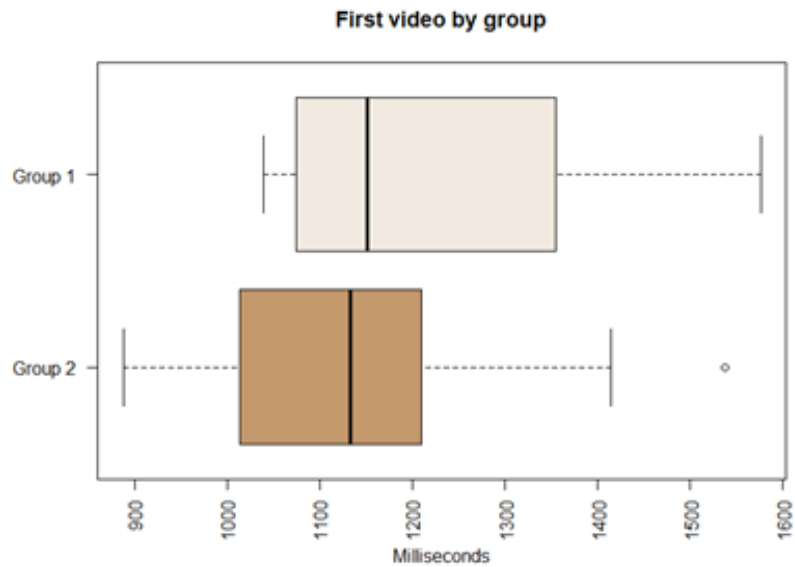


Figure 17. Reaction times to the first video by groups

Figure 18 shows the reaction times for Video 2 (second for G1, first for G2). There is also no significant difference between the performance of Group 1 ($M = 1136.61$, $SD = 118.78$) and Group 2 ($M = 1141.47$, $SD = 170.52$) in case of Video 2, $t(35) = -.11$, $p = .91$.

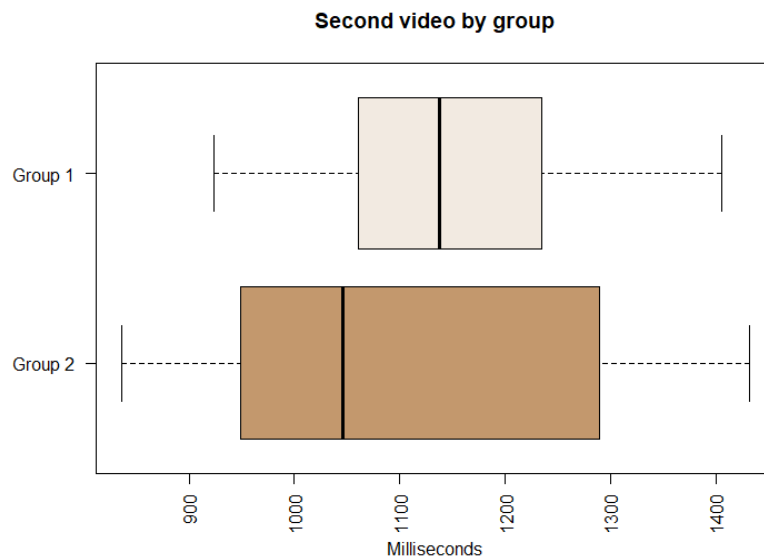


Figure 18. Reaction times to the second video by group

Looking at each word individually, as it can be seen on Figure 19, there was a significant difference found between the first ($M = 1174.247$, $SD = 145.19$) and second group ($M = 1127.39$, $SD = 144.1$) of participants, $t(158) = 2.05$, $p < .05$. There was no significant difference between the reaction times analysed by words between females

($M = 1151.56$, $SD = 138.76$) and males ($M = 1151.65$, $SD = 142.64$), $t(158) = -.004$, $p = .99$.

In case of Group 1, they displayed a significant difference between the first video by words ($M = 1211.47$, $SD = 174.25$) and second video by words ($M = 1137.02$, $SD = 97.46$), $t(39) = 2.76$, $p < .01$. However, in the second group, there was no significant difference between the first video by words ($M = 1110.63$, $SD = 152.78$) and the second video by words ($M = 1144.14$, $SD = 134.71$), $t(39) = 1.42$, $p = .16$. To sum it up, the first group had lower reaction time for the words of Video 2 than to Video 1, while the second group did the opposite, with lower reaction time for Video 2 than to Video 1. However, since the order of presenting the instruments was different, it can be observed that both groups performed better during Video 1 than Video 2.

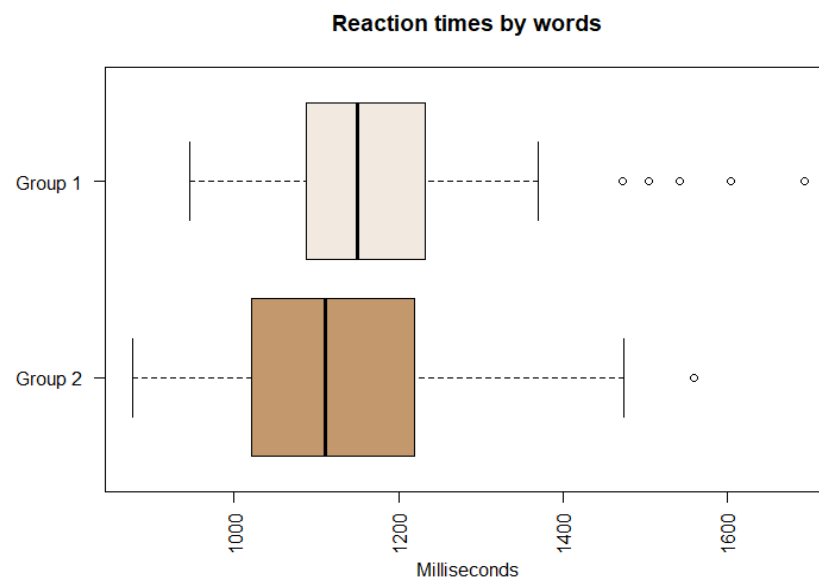


Figure 19. Reaction times by words by group

Another factor to consider is the frequency of the target words. There was a significant, medium, negative correlation found between the frequency of the target words and the reaction times of the participants, $r(78) = -.27$, $p < .05$. This implies that the more frequent a word is, the shorter the reaction times were.

Another considerable source of information are the errors of the participants. In this section, mistakes are cases when participants did not respond to the stimulus or did so in the non-target language. From this data, the accuracy was calculated, referring to the ratio of target responses to the non-target responses by each word. Data presented by Table 5 shows that the vast majority of words (80%, $N = 64$) were of 100% accuracy;

however, there are certain words that were found particularly difficult by the participants. The words with the least accuracy were the following: bat, waiter, violin, camel, belt, pumpkin. It is also important to note that it was not only the foreign language that participants had difficulties with, but errors were also made for Hungarian stimulus. The least accurate words in Hungarian were pincér (waiter), hegedű (violin), öv (belt).

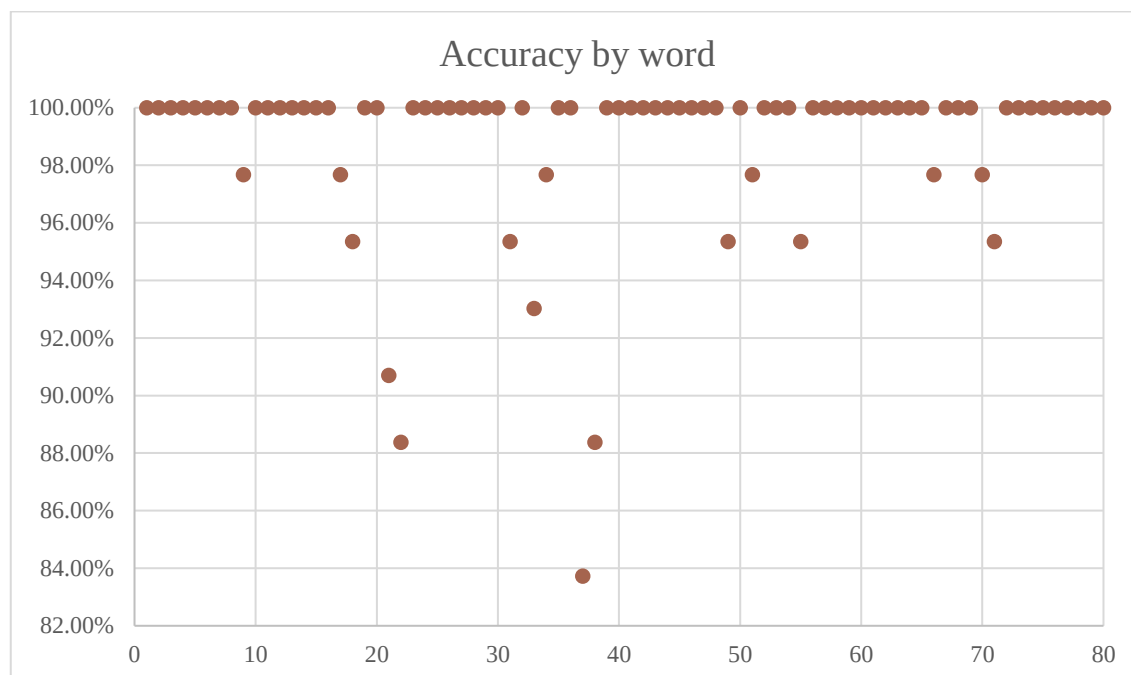


Table 5. Accuracy by word

The frequency of target words might also influence the accuracy of their production. There was a significant, weak, negative correlation between the frequency of words and the errors by words, $r(78) = -.23$, $p < .05$. This implies that the more frequent a word was, the less errors were made; less frequent words were mistaken more often.

Besides the accuracy rate for individual words, the accuracy of participants was also calculated. For this purpose, the cases where participants did not respond, or did respond in the non-target language (English, Hungarian, or other language) were considered as errors, and responses in the target language which were semantically close to the target word were considered acceptable. As Table 6 shows, there were 19 (44%) participants whose accuracy is 100%, i.e.: there were no errors in their responses. This implies that for the majority of participants, there were target words they could not produce, or did so in the non-target language. The average value of accuracy is 98,84%, with a standard deviation of 1.35, and the lowest score was 93,75%.

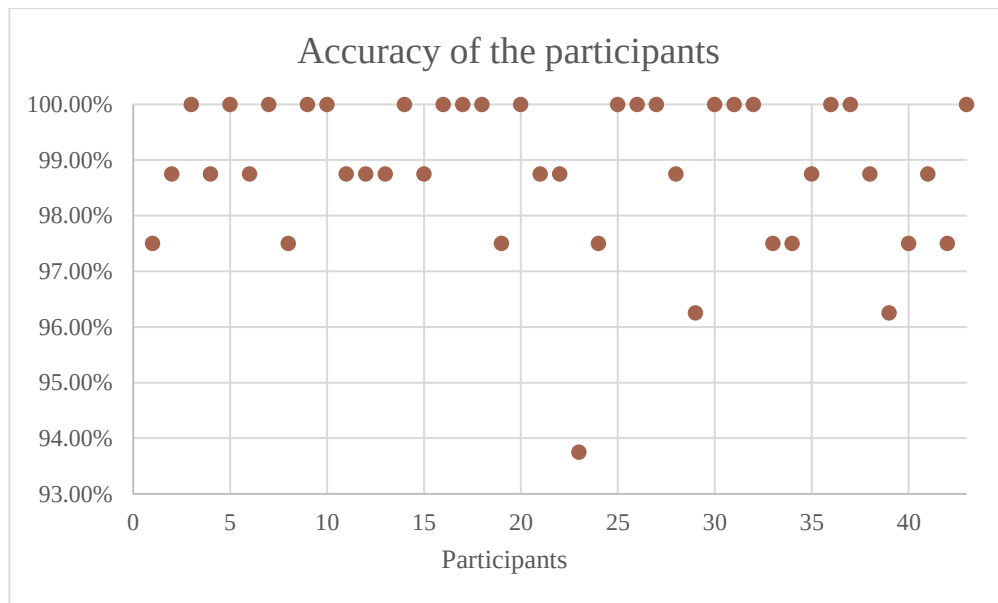


Table 6. Accuracy of the participants

Other factors were compared to the accuracy of the participants, such as their gender and language dominance. No significant difference was found in the accuracy between female ($M = .989$, $SD = .012$) and male participants ($M = .987$, $SD = .015$), $t(39) = .42$, $p = .67$. However, there was a non-significant, weak, negative correlation found between the accuracy and dominance score, $r(41) = -.28$, $p = .06$. This implies that more balanced participants made fewer mistakes (lower dominance score - higher accuracy).

Another potentially influential factor is the relationship between accuracy and reaction time, since participants might have concentrated on being accurate or providing an answer fast. However, the analysis showed that there is only a weak, non-significant correlation between accuracy and reaction time, $r(41) = .18$, $p = .24$.

Having presented the accuracy of the participants, the mistakes behind the calculations can also be mentioned. As Figure 20 reports, 25% ($N = 40$) of errors were cases when participants did not respond to the stimulus. Another 15% ($N = 25$) of the errors were responses in the non-target language; and 2% ($N = 3$) cases included responses in the non-target language that were other than Hungarian and English, such as German. These three types were not accepted during the analysis.

Besides not being able to respond (in the target language), other types of errors were also noted. These errors, or rather, acceptable variants were considered right answers; however, it might be beneficial to analyse them for further insights into the bilingual behaviour. The acceptable variant types included answers which started in the non-

target language, but the participant realised it and switched in the middle of the utterance. Examples include “f...hal”, “áá...bed”, “stair” (from “szék” and “chair” assimilating to the closest existing word). This type accounted for 12% ($N = 20$) of errors.

In many cases, participants responded with a semantically related non-target word. These acceptable variants were grouped into three categories. The first one was when they said a related, but different word, which happened in 17% ($N = 28$) of the cases. This type included answers such as “tiger” for the target word “lion”, “guitar” instead of violin”, or “rat” for “mouse”. Next, synonyms of the target word were also noted, accounting for 25% ($N = 41$) of the cases. Examples of such responses were “cica” (kitty) for “macska” (cat), “szamóca” for “eper”, “campfire” instead of “fire”, or “necktie” for “tie”. Lastly, in a few instances the words were produced in plural form, even though there was only one object in the picture, accounting for 3% ($N = 5$) of the cases. The words put into plural were shoe and map.

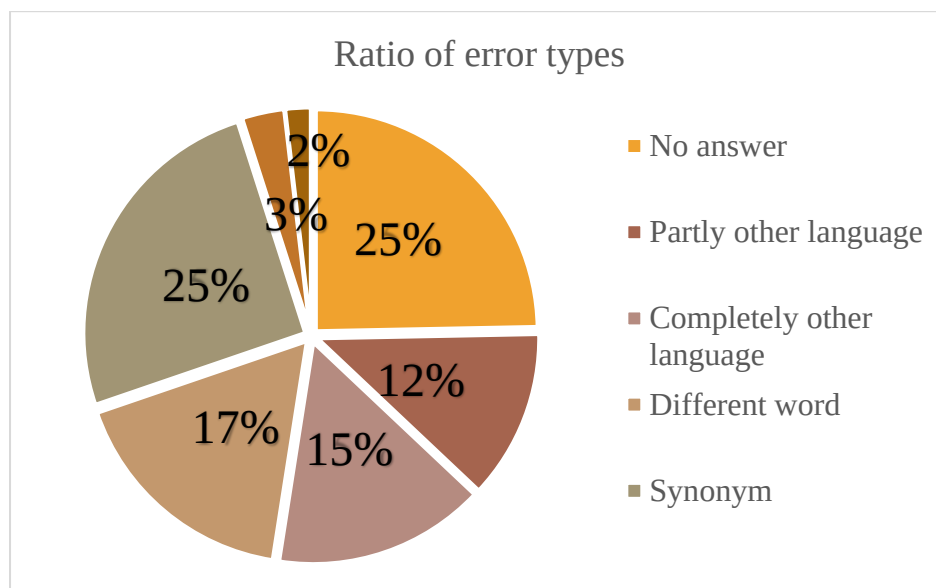


Figure 20. Ratio of error types

CHAPTER 4: DISCUSSION

The aim of the present study was to conduct an experiment focusing on the relationship of bilingual speech production and language dominance. The main question around which the thesis revolves is how language dominance and speech production are interconnected, whether switching to the stronger language is more difficult to the bilinguals than switching to the weaker language, or the opposite way. The hypothesis was that the results will support the former case, thus support the Inhibitory Control Model (Green, 1986). However, empirical studies have reported contradictory results, some concluding that switching to L1 is easier for bilinguals than to L2 (e.g.: Christoffels et al., 2007; Mosca & De Bot, 2017), and other findings supporting the ICM (e.g.: Linck et al, 2012) (for a more thorough overview see Section 1.4). For this reason, in this thesis, not only the proficiency or nativeness of the bilinguals were taken into consideration, but also the extent of language dominance. The investigation was done through a picture naming task, the results of which were analysed together with the language dominance of the participants. In this section, the results presented in Chapter 3 will be discussed, focusing on answering to what extent language dominance and other factors influence the language switching of Hungarian-English bilinguals.

The investigation of the extent of language dominance provided interesting results. Based on the results of the Bilingual Language Profile (Birdsong et al., 2012) self-report questionnaire, participants were divided into different dominance categories (Table 1.). There were altogether 3 participants who were more dominant in English than in Hungarian, 5 who can be considered balanced bilinguals; and the vast majority of 36 participants were more dominant in Hungarian to a certain extent.

The next pieces of information to discuss should be the differences between the reaction times in the two languages, and in the two types of trial. The expected results were that participants would respond faster to English stimulus than to Hungarian, and to repetition trials than to switch trials. As figures show, however, there was no considerable difference between reactions to Hungarian and English stimulus. Similarly, there was also no significant difference between the reaction times for the Hungarian and English versions of each word. This might imply that the proficiency of the participants was relatively high; their temporary dominance might have shifted to a more balanced state, and they were functioning in bilingual mode (Grosjean, 2001).

Next, repetition and switch trials were analysed. In this case, as expected, repetition trials were faster than trials where participants had to switch to another language; however, the difference was non-significant. Similar results have been reported in the literature as well (e.g.: Mosca and De Bot in 2017). Focusing on the two languages individually, it was the Hungarian stimulus that showed significant difference between the two trial types; it was much faster for participants to provide the target responses when L1 followed L1 than when they had to switch from L2 to L1. This in itself might indicate asymmetric production, since it took more time for participants to reactivate Hungarian than to suppress English during the repetition trials. In cases of English, there was no substantial difference between repetition and switch trials; it took approximately the same time for participants to provide answers in English after English as after Hungarian stimuli.

Interestingly, the averages of the switch trial reaction times show that it was faster for participants to switch to English than to Hungarian, even if by a non-significant difference. This also suggests that it is easier for participants to switch to L2 than to L1; however, this cannot be concluded based on the mean values only, individual differences and language dominance should be taken into consideration.

Another issue considered while designing the experiment was whether it influences switching cost if the participants “stay” in one of the languages. The assumption based on the observations during the pilot experiment was that it will take more time for the participant to respond if they have to switch the language after the pause. For this purpose, a 3000ms pause was added after every 4th trial, and the reaction times after the pause to switch and repetition trials were analysed. Surprisingly, in this setting the switch trials were significantly faster than repetition trials; and among these, switches to L1 seemed to be faster than switches to L2. This could suggest that during the pause, participants switched to their mothertongue to a certain extent, so it was easier for them to produce the next response in L1.

As an attempt to answer the research question of this thesis, the correlation between the difference of switches to L1 and L2 and the dominance score of participants were calculated. As hypothesised, according to the ICM (Green, 1986), switching to the more dominant language should be slower than switching to the weaker language. However, the results showed a strong negative correlation, indicating that it took participants less time to produce their stronger language than the weaker one. Thus, data from the picture

naming experiment and Bilingual Language Profile instrument strongly suggest that performance on the languages is dominance-related, symmetrical, as participants switched more effectively to their more dominant language. The non-significant differences between the switching cost to L1 and L2 also support this argument, indicating that it did not take more effort for the participants to switch to Hungarian than to English compared to the repetition trials in the languages, contrary to the expectations based on the ICM (Green, 1986).

Looking at the results of other pieces of research, this paper is in line with the findings of various other experiments, such as Mosca and De Bot (2017), Christoffels et al. (2007), Macizo et al. (2012), or Hernandez et al. (2013). Even though the design of these experiments is different from that of this thesis to some extent, the results in all these cases show a symmetrical switching cost between the two languages of the bilingual. This was observed in experiments with predictable (Mosca & De Bot, 2017) and unpredictable order of codeswitching (Christoffels et al., 2007), in picture naming (Hernandez et al., 2013) and tasks with other stimuli such as words (Macizo et al., 2012) or numerals (Declerck et al., 2012) and with two languages as well as with trilingual participants (Linck et al., 2012).

In broader context besides focusing on the connection of the results and the bilingual speech production model, the results also show how influential language dominance is on performance. Even though all participants were native speakers of Hungarian and learnt English as a foreign language, through their individual differences in connection with history, use, proficiency and attitude to English and Hungarian, the mental representation of their mothertongue were drastically different. The use of English as a foreign language in certain domains proved to have an influence on the L1 performance of the participants, so much so that for many of them it took more time to produce instances in their mothertongue in the foreign language. In addition, the present case is in the seemingly monolingual country, Hungary, where English-speaking communities are rather difficult to find, and the language is radically different from English. This effect of bilingualism is similar to the findings of Bice and Kroll (2015), which concluded that a new language has influence on the native language even at a very early stage of learning, which the participants of this thesis have long surpassed.

As part of answering the other research question of the present thesis, other potentially influential factors were considered as well during the analysis, such as gender, word frequency, and accommodation to the task. It can be concluded that

gender did not have a considerable influence on the results; none of the data analysed showed significant differences when gender was the focus of the analysis.

Surprisingly, accommodation to the task was not an influential factor either, which had been assumed to make language switching faster by the end of the session. The two types of switch trials did not result in visible differences; it did not matter if codeswitches came after a period of repetition trials or after a series of other codeswitches. Reaction times for switch trials were not faster by the end of the experiment either. This contradicts the feedback of the participants, which reported that they felt more confident in language-switching by the finish. Naturally, it is possible that even though participants felt more confident with code-switching, the experiment was a tiring challenge, so confidence was not enough to counterbalance the exhausting nature of the task.

Lastly, the effect of word frequency was also considered, and expected to influence the reaction times so that high frequency would result in low reaction time. Data showed that there is a correlation between the frequency of the target word and the reaction time, indicating that the more frequent a word is, the less time it takes for the participants to produce it. Word frequency was also in correlation with accuracy, suggesting that the retrieval of less frequent words was more challenging for participants. This is in line with the expected results, supporting the hypotheses that word frequency has an influence on reaction time. Accuracy also showed a correlation with dominance, indicating that the more balanced a bilingual is, the easier it is to produce the target words.

The accuracy of participants is also worth mentioning. Since it was less than half of the participants that had 100% accuracy, it can be concluded that the task was rather difficult. Half of the mistakes made were cases of providing no answer, or providing answer in the wrong language, which is also an indicator of the difficulty of the picture naming task. Other than that, in many instances the speech monitoring and error correction mechanism could be observed, providing a great insight into speech production. There was also one example of creating a cross-linguistic mixture of words, “stair” from “szék” and “chair”, assimilating to the closest existing word form. The relationship of accuracy and reaction time showed a weak correlation, indicating that in some cases participants who tried to respond quickly did so on the expense of being accurate, but it was not a significant factor in general.

As other mistakes included saying a semantically related, but different word than the target lexeme, it can be also an indicator of the quality of the stimulus. For example, one picture with the least accuracy in the results was “violin”, which, in retrospect, did resemble a guitar (the most common response). The use of synonyms showed the differences in individual speech behaviour, such as responding with nicknames for the animals, or with dialectal versions of the target word.

CHAPTER 5: CONCLUSIONS

In the previous chapters a picture naming experiment conducted amongst Hungarian-English bilinguals was presented, which was designed to expand our knowledge on the mental process of bilingual speech production, codeswitching and language dominance. The research question in focus was to what extent language dominance and non-linguistic factors influence codeswitching for Hungarian-English bilinguals, and in order to answer it, two instruments were used during the experiment.

First, participants ($N = 43$) fulfilled a questionnaire (Bilingual Language Profile by Birdsong et al. (2012) focusing on their language history, use, proficiency, and attitude in Hungarian and English. This questionnaire provided data about the language dominance of the participants, which was then used during the analysis of the results. On average, participants were dominant in Hungarian; however, some participants were dominant in English, and some of them were balanced bilinguals.

As the second phase of the experiment, participants completed a picture-naming task. In this task they were asked to name the presented picture as quickly and accurately as possible. The pictures presented were of everyday objects, animals, body parts etc. Participants had to face altogether 80 trials, during which the order of the target language was not predictable; there were trials where the required answer was in different language than the previous one (switch trials), and where the answer was the same language as the previous stimulus (repetition trials). Participants saw each picture twice, once in Hungarian and once in English.

The results showed that there was no considerable difference between their performance in Hungarian and in English, nor between switch and repetition trials. The data also showed a strong correlation between the differences in switching to the languages and language dominance, indicating that participants produced their stronger language easier. This suggests that there is a symmetric relationship between language dominance and language inhibition; the more dominant a language is, the easier it was for the participants produce that language.

As for non-linguistic factors, neither gender nor the potential accommodation to the task had a considerable influence on codeswitching. However, there was also a medium correlation between the frequency of the target words and the reaction time, suggesting that more frequent words were accessed faster.

This is in line with numerous other findings as well. Symmetric switching cost during a picture naming experiment with unpredictable order of the required language has been reported by Christoffels et al., (2007), Costa and Santesteban (2004), Declerck et al. (2012) and Hernandez et al. (2013) among many others.

All things considered, this piece of research supports the theory that during bilingual language production language inhibition is symmetrical. The more dominant a bilingual is in one of their languages, the easier, faster it is for them produce the stronger language, and the more effort it takes to switch to the non-dominant language. However, the frequency of words can also be an influential factor during codeswitching. The experiment did not support the main hypothesis, namely that participants will switch to their stronger language slower; the results show the exact opposite of this assumption. As of the other hypotheses, the reaction time of participants did not get faster with accommodation to the test either; however, it was confirmed that the frequency of a word influences how quickly one produces it.

5.1 Limitations of the study

As any other piece of scientific research, this thesis is also subject to potential limitations and further questions which only arose having acquired and analysed the final data. The most influential shortcoming of this thesis lies in the fact that the questionnaire on language dominance focuses on an overall score for the two languages in the life of the participants but does not give any information about the language mode the participants are in during the experiment. The temporary shift in dominance or language mode might influence the results, even if there was a strong indication of the relationship between language dominance and switching difference being symmetrical.

Another factor that might have influenced the speech behaviour of the participants was the instrument itself. As the instrument presented the stimulus in fixed intervals, some participants seemed to have settled into a rhythm, and were not prioritising reacting to the stimulus as quickly as possible. Based on this observation, the instrument for picture naming should be revised, should the study be repeated in the future.

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Appendix 1 – Bilingual Language Profile questionnaire

Bilingual Language Profile: English Hungarian

Dear Participant,

I would like to ask you to help me by answering the following questions concerning your language history, use, attitudes and proficiency. The survey consists of 19 questions and will take less than 10 minutes to complete. This is not a test, so there are no right or wrong answers. Please answer every question and give your answers sincerely. Please read the instructions carefully.

All data collected will be dealt with as confidential and will be analysed and used for my thesis and publication.

This survey consists of two parts. In the first part, I will ask you to fill this questionnaire. In the second part, an experiment will be conducted. For this purpose, I will ask you to add your email address to contact you later.

Thank you very much for your help.

Should you have any questions, feel free to contact me:

Réka Hajner

University of Pannonia

reka.hajner@gmail.com

***Kötelező**

1. E-mail *

2. I read the description and accept the terms *

Soronként csak egy oválist jelöljön be.

☐

Agree

☐

Disagree

I. Biographical information

3. 2. Age *

4. 3. Sex *

Soronként csak egy oválist jelöljön be.

☐

Male

☐

Female

5. 4. Current place of residence (country) *

6. 5. Country of origin *

7. 6. Highest level of formal education *

Soronként csak egy oválist jelöljön be.

☐

Elementary school

☐

Vocational school (=szakközépiskola)

☐

Secondary (grammar) school (=érettségi)

☐

National Qualification Registry (= OKJ)

☐

Short-Cycle Higher Education (=FOSZK)

☐

Currently studying at a university (BA)

☐

BA

☐

MA

☐☐

PhD

Egyéb:

In this section, I would like you to answer some factual questions about your language history by placing a check in the appropriate box.

II.

Language history

8. 1. At what age did you start learning the following languages? *

Soronként csak egy oválist jelöljön be.

	Since birth	1	2	3	4	5	6	7	8
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐

9. 2. At what age did you start to feel comfortable using the following languages? *

Soronként csak egy oválist jelöljön be.

	As early as I can remember	Not yet	1	2	3	4	5	6	7
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐

10. 3. How many years of classes (grammar, history, math, etc.) have you had in the following languages (primary school through university) (including English as a foreign language classes)? *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	8
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐

11. 4. How many years have you spent in a country/region where the following languages are spoken? *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	8
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐

12. 5. How many years have you spent in a family where the following languages are spoken?

*

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	8
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐

13. 6. How many years have you spent in a work environment where the following languages are spoken? *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6	7	8
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐

Language use

In this section, I would like you to answer some questions about your language use by placing a check in the appropriate box. Total use for all languages in a given question should equal 100%.

14. 7. In an average week, what percentage of the time do you use the following languages with friends? !!!The total use for all languages should equal 100% (E.g. 60% Hungarian + 40% English)!!! *

Soranként csak egy oválist jelöljön be.

	0%	10%	20%	30%	40%	50%	60%	70%	80%
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other languages	☐	☐	☐	☐	☐	☐	☐	☐	☐

15. 8. In an average week, what percentage of the time do you use the following languages with family? !!!The total use for all languages should equal 100% (E.g. 60% Hungarian + 40% English)!!! *

Soranként csak egy oválist jelöljön be.

	0%	10%	20%	30%	40%	50%	60%	70%	80%
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other languages	☐	☐	☐	☐	☐	☐	☐	☐	☐

16. 9. In an average week, what percentage of the time do you use the following languages at school/work? !!!The total use for all languages should equal 100% (E.g. 60% Hungarian + 40% English)!!! *

Soranként csak egy oválist jelöljön be.

	0%	10%	20%	30%	40%	50%	60%	70%	80%
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other languages	☐	☐	☐	☐	☐	☐	☐	☐	☐

17. 10. When you talk to yourself, how often do you talk to yourself in the following languages? !!!The total use for all languages should equal 100% (E.g. 60% Hungarian + 40% English)!!! *

Soranként csak egy oválist jelöljön be.

	0%	10%	20%	30%	40%	50%	60%	70%	80%
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other languages	☐	☐	☐	☐	☐	☐	☐	☐	☐

18. 11. When you count, how often do you count in the following languages? !!!The total use for all languages should equal 100% (E.g. 60% Hungarian + 40% English)!!! *

Soranként csak egy oválist jelöljön be.

	0%	10%	20%	30%	40%	50%	60%	70%	80%
Hungarian	☐	☐	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐	☐	☐
Other languages	☐	☐	☐	☐	☐	☐	☐	☐	☐

19. If you opted for using other languages in the previous questions: Which language(s) do you use besides English and Hungarian?

IV. Language proficiency

In this section, I would like you to rate your language proficiency by giving marks from 0 to 6. (0=not well at all 6=very well)

20. 12. How well do you speak... *
- Soroként csak egy oválist jelöljön be.*

	0	1	2	3	4	5	6
Hungarian	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐

21. 13. How well do you understand... *
- Soroként csak egy oválist jelöljön be.*

	0	1	2	3	4	5	6
Hungarian	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐

22. 14. How well do you read... *
- Soroként csak egy oválist jelöljön be.*

	0	1	2	3	4	5	6
Hungarian	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐

23. 15. How well do you write... *

V.

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6
Hungarian	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐

Language
attitudes

In this section, I would like you to respond to the statements about language attitudes by giving marks from 0-6. (0=disagree, 6=agree)

24. 16. I feel like myself when I speak... *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6
Hungarian	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐

25. 17. The culture I identify with is.... *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6
Hungarian-speaking	☐	☐	☐	☐	☐	☐	☐
English-speaking	☐	☐	☐	☐	☐	☐	☐

26. 18. It is important to me to use (or eventually use) this language like a native speaker: *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6
Hungarian	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐

27. 19. I want others to think I am a native speaker of *

Soronként csak egy oválist jelöljön be.

	0	1	2	3	4	5	6
Hungarian	☐	☐	☐	☐	☐	☐	☐
English	☐	☐	☐	☐	☐	☐	☐

Feedback

28. I want to get my language dominance score in email *

Soronként csak egy oválist jelöljön be.

☐ Yes

☐ No

Appendix 2. - Picture naming experiment instrument

The instrument for the picture naming part of the experiment can be found in the following links:

1. Single-language practice session 1. (Hungarian): https://youtu.be/yr9zANtBG_o
2. Single-language practice session 2. (English): <https://youtu.be/PwjzPb1cHsI>
3. Mixed-language session, list no. 1.: <https://youtu.be/n7McJEFWbYA>
4. Mixed-language session, list no. 2.: <https://youtu.be/RbVs8nkiRN0>

Alternatively, the following QR codes can be scanned to access the instruments. The numbering of the codes corresponds to the numbers of the list above.

