UiA University of Agder

Master

Tip-of-the-Tongue (TOT) States in Norwegian-English Bilinguals

Effects of Word Frequency, Cognate Status, Noun Type, and Bilingual Profiles

YVONNE MØTTEBERG KARLSEN

SUPERVISORS
Linda Ruth Wheeldon
Allison Louise Wetterlin

University of Agder, 2021
Faculty of Humanities and Education
Department of Foreign Languages and Translation

Table of Contents

Abstract

This study investigates the effects of language, word frequency, cognate status, noun type, and different bilingual profiles on tip-of-the-tongue (TOT) states in Norwegian-English bilinguals. Furthermore, the study aimed to establish whether the weaker links hypothesis or the competition hypothesis could better account for the TOT phenomenon. TOTs were induced by using a word-finding experiment in which the participants were asked to read a definition and then report whether they knew the target word. According to the results, the participants knew more words in Norwegian and reported more TOTs in English. Frequency effects revealed that the participants knew more high-frequency than low-frequency words and that more TOTs were reported for low-frequency words. In addition, the participants who were more proficient in English knew more words and reported fewer TOTs. Surprisingly, more TOTs were reported for cognates and there was a significant correlation between the participants' increased age of English acquisition and increased vocabulary knowledge. Although the competition hypothesis cannot account for the frequency effects, both hypotheses predict more TOTs and lower vocabulary scores in the non-dominant language, in addition to lower TOT rates and higher vocabulary scores due to higher language proficiency. The results suggest that the weaker links hypothesis and the competition hypothesis are not mutually exclusive and that TOTs might occur due to a combination of the two.

Acknowledgments

I would first like to thank my supervisors Professor Linda R. Wheeldon and Professor Allison L. Wetterlin. In addition to helping me structuring my thesis, you also planned well-structured, highly informative, and frequent supervisor meetings. Also, thank you for always being quick to reply to my emails whenever I ran into a problem or had a question about my research or writing.

Helene and Heidi, my co-experimenters, I could not have done this without you. Thank you for all the hours we spent designing the experiment, discussing relevant theory, and generally for all our good conversations and many laughs. Thank you also to Jan who helped us with the experiment set up and all the technical issues we experienced before we could start testing, and to Eunice who helped us retrieving the TOT data.

I must also express my very profound gratitude to my parents, my grandparents, my friends, and my boyfriend for providing me with unfailing support and continuous encouragement throughout my six years of studying at UiA and through the writing process of this thesis.

Finally, I want to express some extra gratitude to Helene, who has been my rock and main motivator throughout these past 6 years. Thank you for having that waste container-conversation with me during one of our classes in 2015, thank you for becoming one of my best friends during this journey, and thank you for all the good memories (such as the York trip) and the less good memories (preparing for all the exams we have taken). My study years would not have been this good without you.

Introduction

Every time we speak, we go through a comprehensive speech production process in order to plan an utterance in our head and then articulate that utterance. This includes a word retrieval process to find the right word for the semantic representation to be articulated. However, word retrieval appears to differ between different types of speakers. For instance, a person who speaks two languages (a bilingual) has a mental lexicon containing more words for the same concept compared to that of a monolingual. Consequently, word retrieval in bilinguals is a much more complex process than in monolinguals, since bilinguals must manage a bigger and more complex mental lexicon and select the right word for the right language. However, bilinguals also differ among themselves, and some bilinguals might manage this process differently than others. Furthermore, sometimes when planning an utterance, we struggle to retrieve specific words that we are sure we know but cannot remember at the moment. We know the meaning of the words, and sometimes we even remember some of the sounds, letters, or even the number of syllables. We have them on the tip of our tongue (TOT, Brown & McNeill, 1966). Bilinguals experience more TOTs than monolinguals (e.g. Gollan & Acenas, 2004; Pyers, Gollan, & Emmorey, 2009), however, TOT rates might also vary among bilinguals depending on individual differences such as language history, proficiency, and use. Although TOTs have become a common field of linguistic research, it is still debated how and why TOTs occur (e.g., Gollan, Ferreira, Cera, & Flett, 2014; Gollan, Montoya, Cera, & Sandoval, 2008). This study aimed to investigate word retrieval in Norwegian-English bilinguals and whether TOT rates could be related to different bilingual profiles. Furthermore, the goal was to investigate the underlying mechanism for TOTs and whether factors such as language, word frequency, cognate status, and noun type could have an effect on TOT rates. In the following introduction, I will first review the differences between monolingual and bilingual speech production before turning to different speech production models. I will then review bilingual advantages and disadvantages, TOTs, and the different hypotheses for why TOTs occur. Furthermore, I will discuss the differences in bilingual profiles and language proficiency before turning to the present study, which includes the study motivation and predictions.

Monolingual Speech Production

The focus of this study was on word production processes. According to Levelt's (1989) speech production model, speech production includes conceptualization, formulation, and articulation (see Figure 1). First, conceptualization involves determining what to say. During these processes, speakers conceive an intention and select relevant information from memory or the environment in preparation for the construction of the intended utterance. Next, formulation involves translating the conceptual representation into a linguistic form. During these processes, speakers have to select individual target words (i.e., lexicalization) and then put them together to form a sentence (i.e., syntactic planning). Finally, articulation involves phonological encoding. These processes include detailed phonetic and articulatory planning, such as turning words into sounds in the right order, spoken at the correct speed, with the appropriate prosody (e.g., pitch, intonation, and loudness).

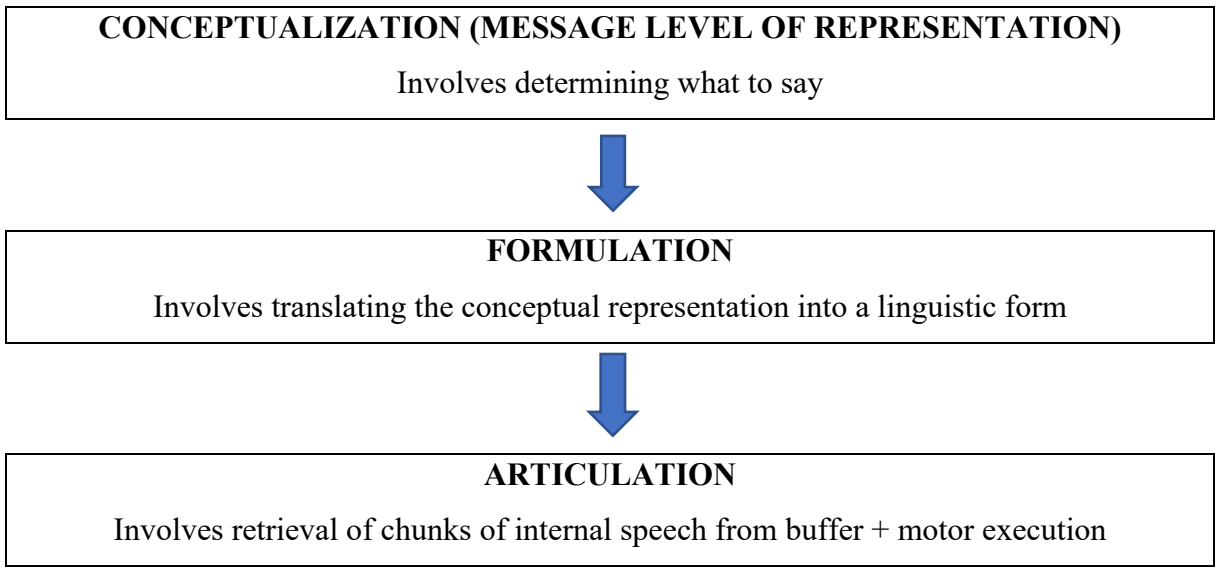

Figure 1: Speech production processes (Levelt, 1989)

There is a widespread consensus among researchers that word retrieval is a two-staged process, including a meaning-based (semantic) stage and a phonologically-based stage. However, there is still disagreement about what is presented at the level of lexical representation (Rapp & Goldrick, 2000). According to Levelt's (1989) speech production model, each word is represented by a lemma. A lemma is a level of representation of a word between its semantic and phonological representations. Due to lemmas being the intermediate stage of the two stage-model, they are syntactically specified but they do not contain phonological information yet.

During this intermediate stage, also known as lemma selection, speakers specify the target word in a pre-phonological and abstract way. Then, in the second stage of speech processing, the actual concrete phonological word is specified and the phonological form (i.e., lexeme) is selected (see Figure 1).

According to most speech production models, both the intended concept but also semantically related concepts are to some degree activated during conceptual processing (Costa, 2005). For instance, if *dog* is the target word, semantically related words such as *cat* and *bark* will also be activated. In turn, the activation of the semantic representations spreads to the lexical system, and the corresponding lexical nodes or words are proportionally activated. In other words, activation flows from an activated semantic representation to the corresponding lexical node (see Figure 2, Costa, 2005).

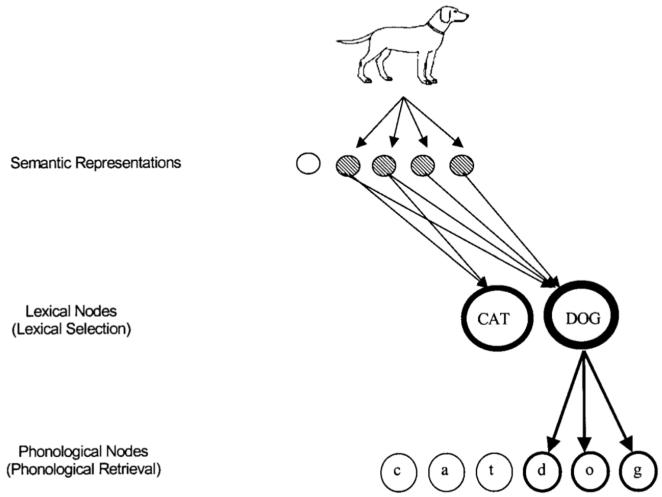

Figure 2: Monolingual speech processing (based on Levelt's model), adapted from Costa (2005, p. 309). The arrows represent the flow of activation, while the level of activation of the representations is indicated by the thickness of the circles.

Bilingual Speech Production

The main difference between monolingual and bilingual speech production is that bilinguals usually have two similarly adequate words for almost every concept (e.g., *table* in English and *bord* in Norwegian), which makes the lexical selection process more complex in bilinguals than in monolinguals (e.g., Gollan & Kroll, 2001; Kroll & Stewart, 1994). According to most bilingual lexical access models, the semantic system in bilinguals activates both languages although the bilingual is only planning to speak in one of the languages (see Figure 3) (e.g., Colomé, 2001; Costa, Caramazza, & Sebastián-Gallés, 2000; Costa & Santesteban,

2004; Gollan & Kroll, 2001). Furthermore, it is a controversial topic whether bilinguals have two separated lexicons or an integrated lexicon for their two languages (De Groot, 2011). The language-nonspecific hypothesis assumes that bilinguals have an integrated lexicon and that there is activation flow to both languages. In this case, the connections between the semantic representations and the lexical nodes, as well as the connections between the lexical nodes and the phonological nodes in the unintended language, will be functional. However, according to the language-specific hypothesis, which assumes two separate lexicons, these connections will only be functional in the intended language (see Figure 3, Costa, 2005). Recently, much compelling evidence suggests that bilinguals have an integrated lexicon and that lexical access is language non-selective (e.g., De Groot, 2011; van Assche, Duyck, & Hartsuiker, 2012). Otherwise, if only the representations in the intended language were activated during bilingual speech processing, then bilingual speech processing would be the same as that of a monolingual speaker.

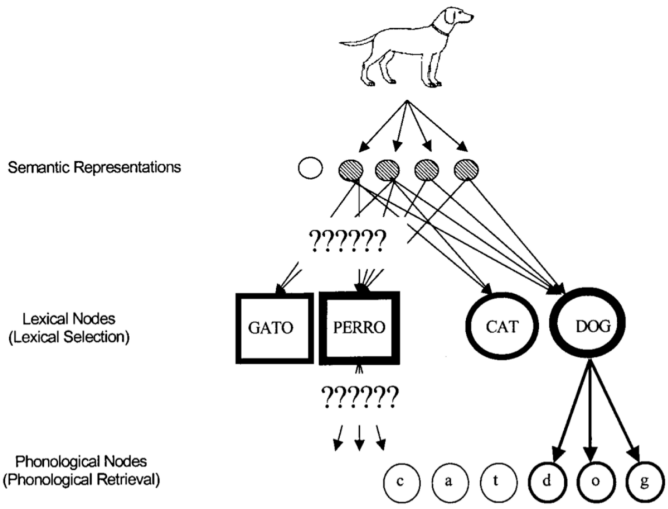

Figure 3: Bilingual speech processing, adapted from Costa (2005, p. 311). The circles represent the lexical nodes of the intended language and the squares represent the lexical nodes of the unintended language. The arrows represent the flow of activation, the thickness of the circles indicates the level of activation of the representations, and the question marks represent the language-specific and nonspecific activation flow hypotheses.

Although researchers agree that the speech production process is a two staged-process, it is still debated whether the activated lexical nodes of the language(s) not in use activate the corresponding phonological representations and whether this activation could affect the

phonological encoding of the intended word. Three models that address these issues are the cascaded, the discrete, and the feedback model of spoken word production. According to the cascaded model (e.g., Caramazza, 1997; Costa et al., 2000), there is a continuous activation flow from the lexical to the phonological stage, meaning that all activated lemmas spread some activation to their corresponding phonological features although they have not been selected. In other words, the activation is cascaded forward before processing is completed in the lexical stage. In contrast, the discrete model (e.g., Levelt, Roelofs, & Meyer, 1999) assumes phonological activation to be restricted to the lemma selected in the lexical stage. In other words, activation flows discreetly. Finally, the feedback model (e.g., Dell, 1986) assumes that activation flows in a fully interactive manner by feeding both forward to the phonological stage and backward to the lexical stage.

Simultaneous language activation has frequently been investigated by testing how cognates are processed relative to non-cognates. In purely linguistic terms, cognates refer only to words of common language ancestry (e.g., *hand* in English and *hånd* in Norwegian, as these two languages are both Germanic languages and related in their origins, Myers-Scotton, 2005). However, in psycholinguistics, cognates are typically defined as a broader category of words, including loanwords that share form and meaning across languages (e.g., *film* in English and Norwegian) (Comesaña et al., 2015; Costa, Santesteban, & Caño, 2005; Dijkstra, Grainger, & van Heuven, 1999). If a bilingual processes words that share form or meaning across languages differently from words that are language-specific (i.e., non-cognates) in a given experimental task, then this would indicate that both the bilingual's languages were activated during the task (Lijewska, 2020). As explained above, bilinguals activate information about words in both languages simultaneously, regardless of their intention to function within one language alone. Previous research has consistently demonstrated that bilinguals are faster at recognizing cognates than to non-cognates (e.g., Dijkstra, Van Jaarsveld, & Ten Brinke, 1998; Van Hell & Dijkstra, 2002). These results show that the overlap of form and meaning between two languages speeds the retrieval process in bilinguals. In addition to speech recognition, similar effects have also been found in speech production. For instance, bilinguals seem to be faster at naming pictures with cross-language cognate names than pictures with non-cognate names (e.g., Christoffels, Firk, & Schiller, 2007; Costa et al., 2000; Hoshino & Kroll, 2008; Strijkers, Costa, & Thierry, 2010).

Costa et al. (2000) tested whether non-selected lemmas activate their phonological information. They based their study on Peterson and Savoy (1998), which argued that phonological activation of non-selected lexical items can only occur in situations where both

the target word and the non-selected lexical item are highly activated at the lemma level. For instance, in near-synonym pairs (e.g., *couch* and *sofa*), the lemmas of both words would be highly activated as such pairs consist of two words that are highly semantically similar. However, translation pairs share the same meaning and are therefore predicted to have an even larger overlap between the semantic representations of lemmas. In this case, the cascaded activation model predicts activation of the phonological properties of the translation words in the non-selected language. Costa and colleagues (2000) investigated to what extent picture naming could be affected by picture names that are cognates. They predicted that if non-selected words spread some activation to their phonological segments (as proposed by the cascaded activation model), pictures with cognate names should be named faster than pictures with non-cognate names. The participants included both highly proficient Catalan-Spanish bilinguals and Spanish monolinguals, and the stimuli included 40 pictures from different semantic categories divided into four categories of low-frequency pictures with cognate names, low-frequency pictures with non-cognate names, high-frequency pictures with cognate names, and high-frequency pictures with non-cognate names. The participants were instructed to name the pictures as fast and accurately as possible in Spanish and the results revealed that the bilinguals named the pictures with cognate names faster than those with non-cognate names. However, the monolinguals named pictures with both cognate and non-cognate names equally fast. These results support the cascaded activation model as the phonological properties of non-selected lexical items were activated, causing the bilinguals to be faster at naming pictures with cognate names.

Costa's Language Production Model

If both languages are activated simultaneously, then bilinguals need some sort of mechanism to select the target word in the intended language (Roelofs, 1998). Although evidence supports the idea that both languages of bilinguals are simultaneously activated during the process of lexical access, it is still debated whether the two languages compete for selection. In two picture-word interference experiments (i.e., a distractor word in the unintended language is presented during picture naming), Hermans, Bongaerts, De Bot, & Schreuder (1998) found that bilinguals cannot suppress activation from their first language (L1) while naming pictures in their second language (L2). This evidence suggests that there is competition between bilinguals' two languages. However, Costa and colleagues have provided compelling evidence against this claim. In their picture-word interference experiments, they found that Catalan-Spanish bilinguals named pictures faster when they were exposed to a distractor word that

corresponded to the target's translation compared to when they were exposed to an unrelated word. For instance, a picture of a table appeared with the related distractor words *taula* (Catalan, 'table') and *mesa* (Spanish, 'table') and the unrelated distractor words *peril* (Catalan, 'ham') and *jamon* (Spanish, 'ham') (Costa & Caramazza, 1999; Costa, Miozzo, & Caramazza, 1999). In the case of cross-language competition, the lexical nodes corresponding to a target word's translation equivalent should be the most powerful competitor due to their semantic overlap with the target word. Consequently, translation word distractors should lead to slower picture naming rather than facilitation if semantically and phonologically similar lexical candidates from both languages compete for selection. Based on this, Costa and colleagues proposed a language-specific selection model in which bilinguals' two languages are both activated during lexical access. However, the lexical representations of the unintended language do not compete for selection (see Figure 3) (Costa et al., 1999; Costa & Caramazza, 1999). According to this model, the lexical selection mechanism in bilinguals ignores the activation of the words in the unintended language without the need to suppress their activation. Alternatively, the Inhibitory Control model (Green, 1998), which is a language-non-specific selection model, suggests that a bilingual's two languages compete for selection and that inhibitory mechanisms are used to suppress the activation of the unintended language.

The Inhibitory Control Model

Green's (1998) *Inhibitory Control (IC) model* (see Figure 4) is a production model that modulates competition and controls performance in non-selective lexical access. According to the model, language task schemas provide sustained control by directing the system toward a goal-relevant task, such as speaking in a specific language. Additionally, potential responses that could conflict with the current goal, such as an unintended language, are inhibited to prevent errors. The model suggests that the process starts with a conceptual representation that activates the lexico-semantic system and the supervisory attentional system (SAS). Different language tasks require different task schemas, and the SAS controls the activation of task schemas for the different goals of language processing. Additionally, the task schemas activate lemmas in the intended language while inhibiting lemmas in the unintended language. The IC model assumes that the degree of inhibitory control required for a bilingual to perform a particular language task depends on the number of activated lemmas in each of the bilingual's languages. For instance, due to the activation of lexical candidates in L1 during the performance of a task in the L2, more inhibitory control is required when bilinguals perform language tasks

involving both languages (e.g., translating between L1 and L2) compared to when they perform language tasks using only the L1. The IC model assumes non-selective language activation in bilinguals by arguing that the conceptual system activates lemmas of both languages and that the lemmas of the unintended language are suppressed later.

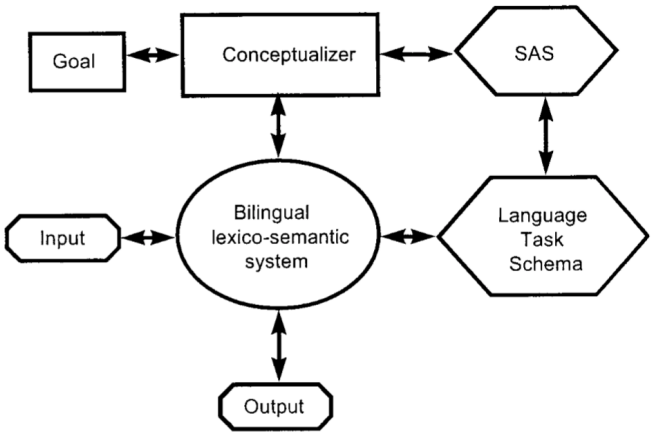

Figure 4: The Inhibitory Control Model, adapted from Green (1998).

The Adaptive Control Hypothesis

Green and Abutalebi (2013) proposed the *Adaptive Control Hypothesis* (ACH) as a revised version of the IC model. According to the ACH, language control processes adapt to the recurrent demands placed on them by the interactional context. Adapting a control process (i.e., conflict monitoring, goal maintenance, interference suppression, selective response inhibition, task engagement, task disengagement, and opportunistic planning) requires changing the parameters about the way it works or the way it works in coordination with other control processes. The demands on these processes are imposed by three interactional contexts. These contexts include single language (i.e., one language is used in one environment, and the other in a second environment), dual-language (i.e., both languages are used but typically with different speakers), and dense code-switching (i.e., speakers regularly mix both languages in single utterances). By distinguishing proactive control processes (which establish a task goal) from reactive control processes (which limit interference with the task goal), it is possible to recognize the interplay of control processes (Braver, 2012). This contrast is implicitly present in Green's (1998) IC model, in which language selection requires the activation of the task schema for that language. The activation increases when an intended language is specified in the conceptual representation. Language task schemas are selected through competition, but

they are potentially also selected through the reactive inhibition of representations triggering the selection of the competing task schemas. Green and Abutalebi (2013) argue that the language task schemas compete for selection in the single language and dual-language contexts but cooperate in the dense code-switching context. The ACH assumes that non-verbal skills require the type of control processes that are relevant to language control, such as maintaining action goals and resisting interference from other competing actions that may be generated by the situational context. According to the hypothesis, the language use of bilinguals increases the demand for the processes involved in utterance selection to a greater extent compared to monolingual language use.

Non-selective Language Activation and Language Switching

Santesteban & Schwieter (2020) suggested that some bilingual effects, such as language switching costs, indicate that non-target language activation affects bilinguals' performance and that some sort of control mechanism is needed to regulate this cross-language activation. Language switching costs are calculated by comparing a bilingual's response times in a blocked language context (i.e., a context in which they only use one of their languages) versus a language switching context (i.e., a context in which they use both languages interchangeably). Such switching costs have been used as evidence to support bilinguals' effort of dealing with cross-language competition. According to the main pattern of results, switching costs are larger in the dominant language than in the non-dominant language, supporting bilinguals' use of global inhibitory mechanisms (i.e., sustained inhibition in which the language as a whole is inhibited) to manage the competition of the unintended language. In other words, in line with the IC model, a larger switching cost in the L1 reflects the need to inhibit the dominant L1 to a greater extent when speaking in the non-dominant L2 (Kroll et al., 2008; Philipp & Koch, 2009).

Assuming that lexical selection is non-selective, Costa & Santesteban (2004) examined the imbalance in the activation between bilinguals' two languages. By studying asymmetrical switching costs (i.e., when the cost is greater when switching to the L1 than switching to the L2), they investigated whether inhibitory control could explain lexical access in highly proficient bilinguals and predicted that the more a language had been inhibited, the harder it would be to overcome the inhibition on the following trial. According to previous evidence (e.g., Poulisse & Bongaerts, 1994), proficiency correlates negatively with language intrusions. In other words, increased proficiency could lead to better inhibitory control and enhanced

control for managing the number of activations. Costa and Santesteban tried to replicate the results reported by Meuter and Allport (1999) who demonstrated asymmetrical switching costs in low-proficient bilinguals. In one of their experiments, Costa and Santesteban (2004) included L2 learners divided into two groups: One group consisted of native Spanish speakers who were learning Catalan, while the other group consisted of native Korean speakers who were learning Spanish. The materials included pictures with non-cognate names and the participants were instructed to name the pictures as fast and accurately as possible in the language signified by the color of the picture. Half of the participants were told that red signified their L1 and that blue signified their L2, while the other half got the opposite instructions. The types of trials switched between non-switch-trials (i.e., trials where the response language was the same as that in the preceding trial) and switch-trials (i.e., trials where the response language was different from that in the preceding one). The results revealed that the magnitude of the switching cost was larger when switching into L1 than when switching into L2 (i.e., an asymmetrical switching cost). In a second experiment, Costa and Santesteban (2004) investigated the link between language inhibition and L2 proficiency level. The participants consisted of native Spanish speakers who were highly proficient in Catalan, while the materials and procedure were the same as in the first experiment. In contrast to the participants in the first experiment (who found it harder to switch into L1 than L2), the highly proficient bilinguals in the second experiment experienced the same switching cost for both languages (i.e., symmetrical switching cost). In conclusion, all bilinguals showed switching costs, although L2 learners showed asymmetrical switching costs while the proficient bilinguals showed symmetrical switching costs. These results support the IC model and that language activation is non-selective.

Bilingual Advantages and Disadvantages

In addition to obvious linguistic advantages, such as the ability to communicate with people in different languages, previous research (e.g., Carlson & Meltzoff, 2008; Duncan et al., 2018) reveals that bilinguals also seem to show cognitive advantages compared to monolinguals. As explained above, bilinguals develop certain mechanisms to manage non-selective language activation, however, these mechanisms also seem to confer benefits to non-linguistic cognitive functioning. For instance, earlier research has found evidence for bilingual advantages in executive functioning, which includes the cognitive processes used in situations that require selection and conflict resolution (Bialystok, 2011). For instance, bilinguals tend to

outperform monolinguals in tasks such as the Stroop task (i.e., a task in which participants look at color names in conflicting font colors and are instructed to name the font color as quickly as possible) (Bialystok, Craik, & Luk, 2008) and the flanker task (i.e., a task in which participants are instructed to specify whether a central arrow points to the left or right while ignoring two flanker arrows pointing to either the same or the opposite direction) (Costa, Hernández, & Sebastián-Gallés, 2008). As mentioned, research suggests that language activation in bilinguals is non-selective and that both languages are active even when they are planning to use only one of them. In other words, bilinguals have to select the right language. This selection introduces a problem in bilinguals' attention since both languages sometimes satisfy great parts of the criteria for the intended utterance (Bialystok, 2011). When bilinguals decide to use one of their languages, Bialystok (2011) argues that the unintended language needs to be suppressed. Furthermore, if the executive control system is involved in situations that require selection and conflict resolution, then it would make sense that the same system also involves the managing of simultaneous activation of two languages. Consequently, the system is proposed to be strengthened through both planning the utterance itself but also through managing the simultaneous language activation (including language competition and language selection) that occurs during speech production. This way of managing the attention to the target language enhances the network and makes it more robust, which in turn seems to enhance executive functioning in bilinguals (Bialystok, 2011). Direct evidence of bilinguals' enhanced executive function is supported by data from neuroimaging studies (e.g., Bialystok et al., 2005) and studies involving language-switching and task-switching (e.g., Prior & Gollan, 2011; Timmer, Calabria, & Costa, 2019). In addition to enhanced executive functioning, research has also revealed bilingual advantages in terms of cognitive reserve in unhealthy aging (such as Alzheimer's Disease), which is the relation between a person's brain integrity and cognitive level, functioning as the mind's resistance to brain damage (Bialystok, Anderson, & Grundy, 2018). The mental activity of suppressing one language to use the other (i.e., causing pressure to the executive control system) may contribute to cognitive reserve in bilinguals. In turn, cognitive reserve could make it possible for bilinguals to cope more effectively with early symptoms of dementia and Alzheimer's Disease than monolinguals (Bialystok, 2011).

Although bilingualism seems to confer cognitive advantages, research has also provided evidence for certain bilingual disadvantages. According to Kroll & Gollan (2014), bilinguals differ in several aspects, including how proficient they are in their L2, whether their two languages are typologically similar (i.e., including similar properties and structural features) or different to each other, and to what extent the bilingual is exposed to an L1 or L2 context.

However, a surprising observation in bilingual production research reveals that it is not the speaking in an L2 that is more difficult than speaking in the L1, but that the L1 itself changes as a response of actively using the L2. Consequently, bilingual speech production differs from monolingual speech production even in the L1. As explained above, bilinguals tend to be more proficient than monolinguals on non-linguistic tasks that require cognitive control. However, bilinguals seem to be relatively less proficient on verbal tasks that reflect vocabulary knowledge and rapid lexical access compared to monolinguals. For instance, according to studies of vocabulary knowledge, bilinguals of all ages consistently achieve lower scores in each language compared to monolinguals' scores in their one language (e.g., Bialystok et al., 2008; Bialystok, Luk, Peets, & Yang, 2010; Portocarrero, Burright, & Donovick, 2007). Additionally, previous research reveals slower language development in bilingual as compared to monolingual children in terms of both vocabulary (e.g., Hoff et al., 2012) and grammar (e.g., Bedore & Peña, 2008). In terms of verbal fluency, bilinguals also tend to report slower reaction times in picture naming tasks, which also reflects smaller vocabularies in bilinguals in comparison to monolinguals (e.g., Gollan, Montoya, Fennema-Notestine, & Morris, 2005). Taken together, these disadvantages illustrate that two language systems can have a negative impact on linguistic performance (Bialystok, Poarch, Luo, & Craik, 2014). Additionally, bilinguals also tend to experience more word-finding difficulties than monolinguals. More specifically, they tend to fall into tip-of-the-tongue (TOT) states more often.

The Tip-of-the-Tongue Phenomenon

TOT states occur when speakers temporarily get stuck retrieving a known word. This is a universal phenomenon that occurs in both bilinguals and monolinguals (Brown & McNeill, 1966). For instance, TOTs are experienced by people of all languages and cultures, including American Sign Language speakers (i.e., tip-of-the-fingers) (Thompson, Emmorey, & Gollan, 2005) and synesthetes (Simner & Ward, 2006), as well as by children (Hanly & Vandenberg, 2010), young adults (Schwartz, 2006), and older adults (Brown & Nix, 1996; Schwartz & Frazier, 2005). TOTs have also been detected in a number of neurological conditions, such as Alzheimer's Disease, anomic aphasia (i.e. a language disorder that causes troubles with naming objects during speaking and writing), and temporal-lobe epilepsy (Brown, 2012). According to earlier research, TOTs seem to occur about once a week for younger adults and increase to about once a day for older adults (Dahlgren, 1998; Heine, Ober, & Shenaut, 1999), although TOT frequencies will differ between individuals. However, according to the studies mentioned

above, TOTs seem to generally occur more frequently with increased age and when the number of languages increases.

There are different theories as to why TOTs arise. For instance, Gollan and Acenas (2004) suggested that TOTs reflect failed lexical selection, based on TOTs being affected by semantic and phonological relationships between targets and competitors. Other research has suggested that TOTs reflect intact lexical selection, but failed word-form selection (Bock & Levelt, 1994; Levelt, Roelofs, & Meyer, 1999) or that TOTs arise after completed lexical selection and reflect insufficient activation of phonology as a result of infrequent use (MacKay & Burke, 1990).

Hanley and Chapman (2008) found that during a TOT state, people do have access to partial information about the target word, at least some of the time. For instance, it is common to remember some information about the word, such as some of the sounds, letters, or the number of syllables. According to their results, the participants could remember whether famous people are known by three names (e.g., Sarah Jessica Parker) rather than two (e.g. Cameron Diaz). This partial information was accessed even when they could not recall the actual names. Furthermore, people who experience TOTs often retrieve semantically related alternative words (e.g., astrology and horoscope), but also form-related alternatives (e.g., astrology and astronomy) as well, which supports the idea of separate access stages for meaning and form in language production (e.g., Bock & Levelt, 1994).

As mentioned, TOTs are experienced by speakers of all languages. However, bilinguals tend to experience more TOTs than monolinguals, particularly in their non-dominant language (Ecke, 2004). Additionally, bilinguals tend to experience more TOTs than monolinguals when speaking in their dominant language than monolinguals speaking in their one language (Gollan & Acenas, 2004). Although researchers seem to agree that bilinguals experience more TOTs because they speak two languages, earlier research has provided evidence for different loci of cross-language activation in bilinguals by using different tasks. For instance, findings from simple picture-naming tasks (e.g., Costa et al., 2000; Hoshino & Kroll, 2008; Poarch & van Hell, 2012) suggested that the phonology of the non-target translation equivalents was available. In Christoffels et al.'s (2007) ERP study (i.e., a study in which the brain response to a specific cognitive or sensory event is measured), the results also suggested that phonological information about the non-target language was activated during a picture-naming task. However, results from the picture-word interference paradigm suggested that lexical, but not phonological, alternatives might have been active (e.g., Costa et al., 1999; Hermans et al., 1998). Taken together, these results, indicate that the locus of TOTs might not be fixed, but

rather depends on different factors. Such factors could be the tasks themselves or individual differences, such as the bilingual's proficiency level and language dominance (Kroll, Bobb, & Wodniecka, 2006).

The Underlying Mechanism: Weaker Links or Competition for Lexical Selection?

The weaker links hypothesis (Gollan et al., 2008; also called the frequency lag hypothesis, Gollan, Slattery, Van Assche, Duyck, & Rayner, 2011) and the competition hypothesis (e.g., Green, 1998; Kroll et al., 2006) are the two main theories that have been proposed to explain the underlying mechanism for TOTs and the reason why these word retrieval errors occur more often in bilinguals compared to monolinguals.

The Weaker Links Hypothesis

According to the weaker links hypothesis (Gollan et al., 2008), bilinguals speak each of their languages only some of the time, meaning that they are likely to use each language less frequently than monolinguals use their one language. Over time, bilingual patterns of language use should lead to weaker links between the semantic and phonological representation in each of the bilingual's lexical systems. This hypothesis assumes a *ceiling effect* on performance, in which low-frequency words catch up with high-frequency words in their level of activation as a result of increased language use. In turn, this will reduce frequency effects, and could explain why words that are used more often tend to be easier to produce. In other words, increased use should lead to improved lexical accessibility in bilinguals. Additionally, the weaker links hypothesis could explain why bilinguals exhibit larger frequency effects than monolinguals in studies that include tasks such as picture naming tasks, both in and out of context (Gollan et al., 2008, 2011; Ivanova & Costa, 2008). According to these studies, bilinguals named pictures more slowly and experienced more difficulty producing low-frequency names relative to monolinguals. Generally, the hypothesis predicts smaller frequency effects in monolinguals than bilinguals when tested in their dominant language, but also smaller frequency effects in bilinguals when tested in their dominant language versus their non-dominant language. Additionally, the weaker links hypothesis predicts speakers to experience fewer TOTs for high-frequency words. Therefore, bilinguals should experience fewer TOTs for cognates since these are the same in both languages (i.e., they should be more high-frequent than non-cognates).

Pureza, Soares, and Comesaña (2016) investigated the role of cognate status, syllable position, and word length in TOT states in European Portuguese (EP)-English bilinguals. The

experiment included a picture naming task in L1 and L2 and then a lexical decision task for each target picture. The bilinguals reported more TOTs in L2 compared to L1, and they also experienced more TOTs for non-cognate than for cognate words. Additionally, more TOTs were reported for longer than for shorter words when performing the task in EP (L1), but there was no word length effect when the task was performed in English (L2). However, longer cognates elicited more TOT resolutions than shorter cognates in both languages. These findings might be explained by longer words having a higher baseline level of activation because of the higher number of nodes activated in comparison to shorter words (Pitt & Samuel, 2006; Pureza et al., 2013). This characteristic in combination with the higher activation of cognate words due to the shared connection between the languages could explain why cognate longer words elicited more TOT resolutions.

Although some proper nouns are non-cognates (such as cartoon characters and movie titles), proper nouns are often cognates (e.g., *Fidel Castro* and *Marilyn Monroe*), which means that they should not be subject to a frequency lag effect. Therefore, cognate proper nouns should be experienced about equally in both bilinguals and monolinguals (Gollan, Montoya, & Bonanni, 2005). Gollan et al. (2005) conducted a similar study as Gollan and Acenas (2004), in which Spanish-English bilinguals and monolinguals produced the names of picture objects and people's names after being given their descriptions. According to the results, bilinguals did not show an increased TOT rate when proper nouns were the targets of retrieval. These results are interesting since it is normal to know many things about specific individuals, however, very few aspects of meaning are consistently associated with particular names (Cohen, 1990; Semenza, 1997). Proper nouns are unique in that they refer to single individuals or places rather than several instances of a kind (Semenza & Zettin, 1989). In some models, this uniqueness is represented by a special proper noun phrase node that is processed after distributed semantic representations but before whole word lexical level representations (Burke, Locantore, Austin, & Chae, 2004). These proper noun nodes could be prone to retrieval difficulty since only one single connection within the semantic system links proper noun phrasal nodes to the necessary lexical representations (i.e., there is no strong activation from multiple converging links within the semantic system; Burke, MacKay, Worthley, & Wade, 1991). The results in Gollan et al. (2005) indicate that the bilingual cognitive system manages to maintain control of both languages without disrupting even the most difficult of production tasks, such as proper noun production. The results also revealed cognates to produce similar findings as proper nouns in that both conditions elicited fewer TOTs, which indicates that both results were caused by the same mechanism. This is interesting as one might think that proper noun representations would

differ from cognates since proper nouns are believed to share a single lexical representation, whereas cognates are believed to require separate representations to support cross-linguistic syntactic differences.

The Competition Hypothesis

The competition hypothesis, on the other hand, assumes that increased TOT rates in bilinguals are caused by competition between lexical candidates both within the same language and across languages (e.g., Green, 1998; Kroll et al., 2006). As explained above, the bilingual lexicon is full of translation equivalent word pairs (i.e., words that are semantically overlapping), and according to non-selective language activation, when bilinguals produce words in one of their languages, they activate information about that word in the other language as well. Consequently, the translation equivalents may compete with one another across the bilingual's languages (Hermans et al., 1998). Bilinguals would then need to recruit executive functions to resolve competition, which makes linguistic processing effortful (e.g., Green, 1998; Kroll et al., 2006). Both monolinguals and bilinguals might experience interference from semantically and phonologically similar words. However, the competition hypothesis assumes that bilinguals should also experience interference from activated translation equivalents. This in turn could increase TOT rates when bilinguals try to retrieve the intended words. In terms of frequency effects, the competition hypothesis assumes either no frequency effects or that frequency could affect lexical selection at the point in speech production where multiple semantically related candidates are active (e.g., Alario, Costa, & Caramazza, 2002; Bates et al., 2003; Caramazza, Costa, Miozzo, & Bi, 2001; Dell, 1990). The hypothesis further assumes that low-frequency words in the less dominant language are unlikely to compete with dominant language production. Therefore, the competition between the languages should affect high-frequency word retrieval more than low-frequency word retrieval. Critically, according to TOT research in monolinguals, TOTs seem to arise during phonological encoding (i.e., after the competition between semantically related lexical candidates have been resolved), which rejects the competition hypothesis as a possible underlying mechanism for TOTs (e.g., James & Burke, 2000; Meyer & Bock, 1992). In addition, evidence against the competition hypothesis has also been found in TOT research that includes bilinguals.

Pyers, Gollan, and Emmorey (2009) tried to replicate previous reports of increased TOT rates in bilinguals. However, their study also included bimodal bilinguals (i.e., bilinguals who are fluent in both a signed and a spoken language). Results revealed that both types of bilinguals reported more TOTs compared to monolinguals, meaning that bilinguals with no possibility of

competition between languages at the phonological level (i.e., bimodal bilinguals) also experience more TOTs than monolinguals. These results are problematic for the competition hypothesis, as they provide clear evidence that the increased TOT rates associated with bilingualism cannot be attributed exclusively to competition between phonological forms. Instead, the results support the weaker links hypothesis which predicts TOTs to reflect incomplete activation of target lexical representation caused by reduced frequency of use.

In terms of cognate and translatability effects, Gollan and Acenas (2004) compared TOTs for cognate and non-cognate picture names in Spanish-English bilinguals, Tagalog-English bilinguals, and age and education-matched monolinguals. In two experiments, participants named pictures of objects with low-frequency names in English and then attempted to translate the target words into another language. The results revealed both cognate facilitation effects and translatability facilitation effects. Relative to frequency-matched non-cognates, bilinguals had fewer TOTs for the cognates they could translate, while monolinguals did not show any cognate effects. In both experiments, the results revealed an interaction in which translatability reduced TOTs in bilinguals. These results are difficult to explain in terms of the competition hypothesis, which predicts that bilinguals should be negatively affected by target translatability due to increased competition between lexical candidates.

Gollan et al. (2008), on the other hand, investigated younger and older monolinguals' and bilinguals' ability to name pictures with high- and low-frequency names. Based on the weaker links hypothesis, Gollan and colleagues predicted that the bilinguals should be slower at naming pictures with low-frequency names than pictures with high-frequency names. However, based on the competition hypothesis, Gollan and colleagues predicted that picture naming times would either not be modulated by word frequency (if frequency effects arise after lexical selection) or that the participants would be slower for producing high-frequency names. Also based on the competition hypothesis, they predicted that older age should be related to slower naming times, believing that older bilinguals would be less able to manage competition between languages compared to younger bilinguals. The results of Experiment 1 support the predictions of the weaker links hypothesis, as the bilinguals were slower at naming pictures in the non-dominant language and slower at naming low-frequency names. The results of Experiment 2 also support the weaker links hypothesis, as older adults experienced a smaller frequency effect in the non-dominant language compared to younger adults. These results are problematic for the competition hypothesis, which predicts the opposite frequency effects where low-frequency names in the non-dominant language would not be sufficiently active to compete for selection in time to affect dominant language production. Although this was not a

TOT study, the results could still be used to support the weaker links hypothesis as a better account for TOTs.

Combining the Hypotheses

The weaker links hypothesis and the competition hypothesis are not necessarily mutually exclusive (Gollan et al., 2008), meaning that TOTs could be caused by a mix of the two hypotheses. In two translation priming experiments (i.e., the participants were exposed to stimuli that could influence their responses to subsequent stimuli without their awareness of the connection), Gollan et al. (2014) investigated whether activation of translation equivalents could be a possible source of bilinguals' increased TOT rates in their dominant language. Results revealed that prior processing of a translation equivalent significantly increased the probability of a TOT response even though the primes were in the bilinguals' non-dominant language while the target words were in their dominant language. These findings support the idea that dual-language activation contributes to bilinguals experiencing more TOTs than monolinguals. This does not necessarily mean that dual-language activation increases TOTs via interference between languages, as it can also be compatible with the weaker links hypothesis, which in turn supports the idea that the increased TOT rate can be caused by more than one reason. Regarding the locus of TOTs, Gollan and colleagues further suggested that some TOTs may reflect the failure of lexical selection, while others may reflect the failure of phonological encoding. This indicates that there could be different types of TOTs. Overall, the results suggest that in addition to a frequency lag (i.e., supporting the weaker links hypothesis), the increased TOT rates associated with bilinguals could also be caused by dual-language activation (i.e., supporting the competition hypothesis).

Bilingual Profiles and Language Proficiency

As explained above, factors such as word frequency, cognate status, and noun type have been found to affect TOT rates in bilinguals. However, TOT frequencies differ between individuals, meaning that individual differences in terms of language history, proficiency, and use could also reveal effects on word retrieval and TOT rates in bilinguals.

Bilinguals are typically defined as speakers who are fluent in two languages. However, this definition is a bit vague as it depends on what is meant by being fluent in a language. As argued in Cutler, Mehler, Norris, & Segui (1992), bilingualism is not absolute, meaning that it is highly unlikely that bilinguals use both their languages in exactly the same way. Consequently, bilingualism does not necessarily mean equal and perfect performance in two

languages. Instead, language use in bilinguals tends to be specific to certain tasks or situations. Language competency also varies depending on different tasks and situations (e.g., reading, writing, listening, etc.). This makes it difficult to define whether someone is a "perfect" bilingual, which is why researchers started to write in terms of degrees of bilingualism (e.g., Baetens Beardsmore, 1982). For this reason, instead of thinking of bilingualism as something that is either-or, it might be better to think of proficiency in multiple languages as lying on a continuum. Additionally, there are different types of bilinguals. For instance, some researchers (e.g., Bialystok, 2001) distinguish between productive bilinguals (i.e., speakers who can produce and understand both languages) and receptive bilinguals (i.e., speakers who can understand both languages but have more limited production abilities). We can also distinguish between simultaneous bilinguals (i.e., speakers who learned both languages about the same time), early sequential bilinguals (i.e., speakers who learned their L1 first but then learned their L2 also during childhood), and late bilinguals (i.e., speakers who learned their L2 in adolescence or even later; Bialystok & Hakuta, 1994).

As explained above, speech production is similar for all bilinguals and more importantly, the production processes differ from those in monolinguals. However, bilinguals clearly differ among themselves as well, particularly in terms of language proficiency. Researchers seem to agree that associations between word forms and their concepts are stronger in L1 than in L2 (e.g., Gollan et al., 2008). Comparable to the weaker links hypothesis, Kroll & Stewart (1994) proposed a model that attempts to account for the relative "strength of the links between words and concepts in each of the bilingual's languages" (Kroll, Van Hell, Tokowicz, & Green, 2010, p. 373), which further assumes that these links are strengthened through increased language proficiency.

The Revised Hierarchical Model

According to Kroll & Stewart's (1994) *Revised Hierarchical Model* (RHM), L1 words are more strongly connected to concepts than L2 words, while L2 words are more strongly connected to their L1 translation equivalents than vice versa (see Figure 5). The model suggests that the lexical connection between L2 and L1 will strengthen as bilinguals become more proficient in L2. Additionally, increased L2 proficiency will also strengthen the ability to conceptually process L2 words directly. However, most bilinguals will still find the connection between words and concepts to be stronger for L1. The RHM also predicts asymmetry in translation as a translation from L2 to L1 is assumed to proceed directly via the lexical link, while a translation from L1 to L2 is conceptually mediated and is therefore assumed to take

longer to perform. However, increased L2 proficiency and strengthened connection between L2 words and concepts can decrease translation asymmetry and also increase the degree of conceptual mediation in L2 to L1 translation. In other words, the RHM could explain why bilinguals tend to experience more TOTs in their non-dominant language. In addition, the model would predict more proficient bilinguals to experience fewer TOTs.

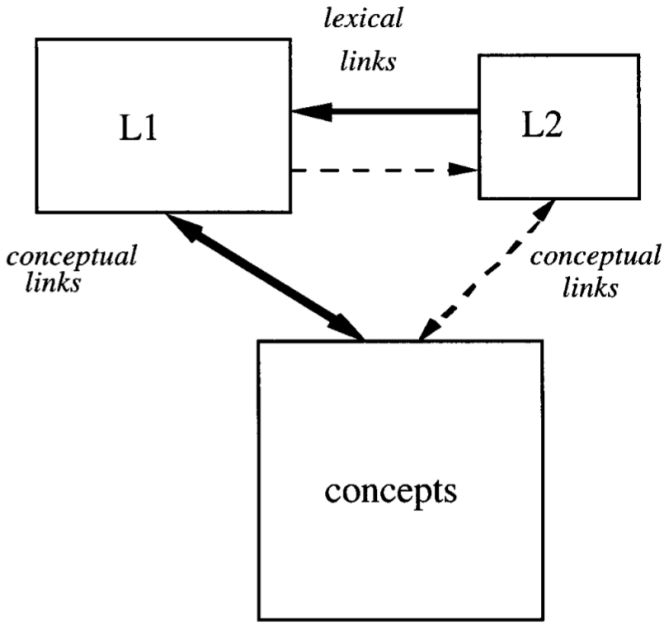

Figure 5: The Revised Hierarchical Model, adapted from Kroll & Stewart (1994, p. 545).

Kroll and Stewart (1994) examined whether semantic category interference (i.e., including categories such as clothing, body parts, musical instruments, etc.) would occur in translation, and predicted that category interference should occur for fluent bilinguals only during translation from L1 to L2 due to conceptual mediation and influence of semantic context. The participants consisted of fluent Dutch-English bilinguals and the stimuli consisted of nouns that were divided into either same-category lists or randomized lists with different categories. The experiment included both a naming task where the participants were instructed to pronounce the words on the computer screen in the language in which they appeared (i.e., English or Dutch) and a translation task in which they were instructed to translate the words on the screen. According to their findings, translation from L1 to L2 took longer to perform than vice versa, which was interpreted as a result of concept mediation and the influence of semantic context. Translation from L2 to L1, on the other hand, seemed to be lexically mediated and also uninfluenced by semantic context. These results support the predictions of the RHM and the hypothesis that the cross-language connection between lexical representation, and between

lexical representation and concepts, is asymmetric (i.e., the bilinguals were able to translate faster from L2 to L1 than vice versa).

The Language Experience and Proficiency Questionnaire

In order to relate bilingual profiles to performances on different language tasks, Marian et al. (2007) introduced a self-assessment tool that combines participants' relevant language proficiency and language experience variables into a single instrument. Research with bilinguals has revealed inconsistencies in findings such as how lexical processing (e.g., Kroll & de Groot, 1997) and phonological and orthographic processing (e.g., Doctor & Klein, 1992) can differ depending on what age the participants started acquiring a language, how they acquired the language, their history of language use, and their degree of language proficiency and dominance. These inconsistencies increased further by the absence of valid and uniformly used assessment instruments in bilingualism research. Bilingual profiles could be recorded by assessing language experience and proficiency across multiple linguistic domains, however, the absence of such assessment measures has made it difficult to interpret existing findings and to make generalizations across studies and populations. Instead of relying exclusively on self-assessed information, usually collected with improvised questionnaires, research involving bilinguals needed a language self-assessment tool that is comprehensive, valid, and reliable across bilingual populations and settings. Therefore, Marian et al. introduced the *Language Experience and Proficiency Questionnaire* (LEAP-Q).

The LEAP-Q was constructed to assess bilingual experience and proficiency profiles in first and second languages. Furthermore, the questionnaire aims to capture factors that have been identified as important contributors to the bilingual status, such as the participant's language competence (including dominance, proficiency, and preference ratings), age of language acquisition, modes of language acquisition, prior language exposure, and current language use. This reliable and valid questionnaire for efficient assessment of bilinguals' linguistic profiles is based on question types used in earlier self-assessment questionnaires for bilinguals (e.g., Jia, Aaronson, & Wu, 2002; Marian & Spivey, 2003; Vaid & Menon, 2000).

According to earlier studies, the age of acquisition (AoA) tightly connects to language learning, to the influence of bilinguals' ratings of language dominance, and the predictions of their performance on behavioral tasks (e.g., Hyltenstam & Abrahamsson, 2003; Johnson & Newport, 1989). Therefore, Marian and colleagues (2007) included four AoA measures in the LEAP-Q, including the age of initial language learning, age of attained fluency, age at which the participants started to read in each language, and age of attained reading fluency.

Additionally, the environment in which a language is learned, such as the number of years of education received in an L2 country and years of residence in an L2 country (Flege, Yeni-Komishian, & Liu, 1999) could also influence attained proficiency. Therefore, the LEAP-Q includes questions about the participants' language acquisition modes in terms of the learning environments and in terms of the extent to which these learning environments contributed to language acquisition.

Earlier research has also found that the degree of prior exposure to a language has been shown to influence bilingual performance (e.g., Birdsong, 2005; McDonald, 2000; Weber-Fox & Neville, 1999), which is why the LEAP-Q assessed exposure to a language in four different environments, including in a country, at school, at work, and at home. Finally, seeing that bilinguals who used L2 more often than L1 had better pronunciation and higher grammar performance in L2 than bilinguals who used L1 more often than L2 (Flege, MacKay, & Piske, 2002), Marian and colleagues (2007) included questions regarding bilinguals' current exposure to their languages across settings. These settings included interaction with family and friends, exposure during reading, watching TV, and listening to the radio, as well as exposure through self-instruction.

The Present Study

In the present study, the aim was to investigate word retrieval and TOTs in Norwegian-English bilinguals and any relationships between TOT rates and the participants' individual differences. Specifically, the goal was to replicate earlier findings including effects of language, word frequency, cognate status, and noun type. In addition, the study included bilingual profiles (i.e., the participants' language history, proficiency, and use) and experiment conditions combining cognate status and noun type as novel manipulations. Furthermore, the goal was to test whether the weaker links hypothesis or the competition hypothesis provided the best account for the underlying mechanism for TOTs.

The participants only included Norwegian-English bilinguals, meaning that there will be no comparison with monolinguals. Instead, there will be a comparison between the different bilingual profiles. The study aimed to investigate whether the participants' individual differences could have a significant impact on TOT induction. Therefore, the participants completed an amended version of the LEAP-Q (Marian et al., 2007) before completing the experiment, to establish their language experience, history, proficiency, and habits of intentional and accidental language mixing and switching.

In terms of manipulations, the experiment included both an English and a Norwegian stimuli set to look for language effects. Additionally, word frequency, cognate status, and noun type were manipulated to investigate any frequency lag and any differences in word retrieval for cognates versus non-cognates and proper nouns versus common nouns. Conditions manipulating both cognate status and noun type combined were also included to investigate any differences between cognate common nouns, cognate proper nouns, non-cognate common nouns, and non-cognate proper nouns.

In contrast to most other TOT studies, definitions were used instead of pictures to elicit TOTs. Pictures could be limiting in comparison to definitions, as they make it more difficult to illustrate abstract words and clearly specify the low-frequency target words. The aim was for the participants to report more *GOTs* (i.e., reporting the correct target word) and TOTs than *don't knows* (i.e., reporting the wrong target word or reporting not knowing the word). However, pictures could make it more difficult for the participants to report the correct target word.

English vs. Norwegian

As mentioned, the participants were tested in both Norwegian and English to look for language effects. Both English and Norwegian are Germanic languages (i.e., a branch of the Indo-European language family), which means that they share origin as well as a great number of linguistic features, such as vocabulary, verb conjugation, sentence and word structure, word order, and phonology. For instance, both languages are SVO languages (i.e., languages that follow the subject-verb-object syntax structure) and both languages distinguish between regular and irregular verbs. However, although English and Norwegian evolved from the same root, there are also some significant differences between the two languages. For instance, the two languages differ in word stress patterns. The first syllables of Norwegian words are usually stressed (e.g. ***ep****le* 'apple', ***bil****de* 'picture'), except if the word is a loan word from for instance German (e.g., be**tale** 'to pay', fort**elle** 'to tell') or from Romance languages (e.g., *kon**tor*** 'office', *bi**llett*** 'ticket') (Vikør, 2009). However, in English, the main stress may occur in all syllable positions (e.g., ***pa****rrot, a**spa**ragus, arma**di**llo, ra**ccoon***) and can also be used to distinguish between words (e.g., *an **in**sult vs. to in**sult***) (Davenport & Hannahs, 2020).

The experimental stimuli of the present study consist of English and Norwegian nouns. However, nouns tend to be structured and behave differently across the two languages. For instance, compound nouns in English can either be written as one word (e.g., *housekeeper*), as hyphenated words (e.g., *mother-in-law*), or as separate words (e.g., *peanut butter*). However,

compound nouns are rarely written as separate words in Norwegian. They are usually written as one word (e.g., *peanøttsmør*), but can in some cases also be written as hyphenated words (e.g., *tur-retur-billett*). Furthermore, Norwegian nouns are specified for gender by using the articles *en*, *ei*, or *et*, and can be either masculine (e.g., *en stol*, 'a chair'), feminine (e.g., *ei bok*, 'a book'), or neuter (e.g., *et tre*, 'a tree'). However, nouns are not gender-specific in English. Additionally, nouns in English and Norwegian are specified for definiteness in different ways. In Norwegian, nouns change form depending on whether they are singular indefinite, singular definite, plural indefinite, or plural definite (e.g., *en katt* 'a cat' - *katten* 'the cat' - *katter* 'cats' - *kattene* 'the cats'). In English, however, indefinite and definite forms are expressed by using determiners such as the indefinite article *a* or definite article *the*. Furthermore, English nouns are normally specified for plural by adding the plural suffix -s (e.g., *one cat, two cats*), although some nouns are irregular (e.g., *one child, two children*).

There is also a long list of phonological differences between English and Norwegian. As reviewed in Nilsen (2010), the two languages do have a great number of phonemes in common, however, both languages also include phonemes that do not occur in the other language. For instance, most varieties of English do not have any front rounded vowels. Furthermore, Standard British English has 23 consonants, 12 vowels, and 8 diphthongs as compared to 21 consonants, 19 vowels, and 7 diphthongs in Norwegian (see Table 1).

Table 1. An overview of the phonemes in Norwegian and English.

	Norwegian	**English**	**In common**
Consonants	/ʊ, ɾ, ɽ, ʂ, ç,/	/θ, ð, ʃ, ʒ, z, ɹ, w/	/p, b, t, d, k, g, m, n, ŋ, f, v, s, z, h, j, l/
Vowels	/æː, eː, ʏ, œ, yː, øː, ʉ, ʉː, ɔ, ɑ, oː/	/ɜː, ʌ, ɔː, ɒ/	/ɪ, iː, ɛ, æ, ə, ʊ, uː, ɑː/
Diphthongs	/œʏ, æɪ, æʉ, ʉɪ, ɛɪ, ɔʏ, ɑɪ/	/eɪ, aɪ, ɔɪ, ɪə, eə, ʊə, əʊ, aʊ/	

Predictions

The present study aimed to investigate whether the weaker links hypothesis or competition hypothesis could better account for TOTs. Therefore, the predictions listed underneath are based on these hypotheses. However, as explained above, the weaker links hypothesis and competition hypothesis are not mutually exclusive (Gollan et al., 2008; Gollan et al., 2014), meaning that although the hypotheses predict some opposite effects, they also predict some similar effects.

Predictions Based on the Weaker Links Hypothesis

1. **Language:** Since the hypothesis assumes that the links between semantic concepts and phonological forms are stronger in Norwegian than English, the participants who use English less often than Norwegian should experience larger frequency effects in English than in Norwegian (i.e., they should report more TOTs and know fewer words in English than in Norwegian).
2. **Frequency:** The participants should report more TOTs and achieve lower vocabulary scores (i.e., number of known words) for low-frequency words than high-frequency words since the links between the semantic concepts and phonological information are stronger for words that are used more frequently.
3. **Cognate status:** The participants should experience a cognate facilitation effect, meaning that they should report fewer TOTs and achieve higher vocabulary scores for cognates since these overlap in both form and meaning across the two languages. Consequently, they should report more TOTs for non-cognates compared to cognates.
4. **Noun type:** The participants should also experience a facilitation effect for cognate proper nouns, meaning that they should report more TOTs and achieve lower vocabulary scores for non-cognate proper nouns. Since non-cognate proper nouns do not overlap in form, these should be used less frequently than cognate proper nouns. In addition, proper nouns could be difficult to retrieve since only one single connection within the semantic system links proper noun phrasal nodes to the necessary lexical representations (Burke et al., 1991). Therefore, due to the absence of strong activation from multiple converging links within the semantic system, proper nouns could elicit more TOTs than common nouns.
5. **Bilingual profiles:** In terms of bilingual profile effects, increased use of a language should increase lexical accessibility (e.g., Dell et al., 1997; Griffin & Bock, 1998), which is why the more proficient bilinguals should report fewer TOTs and score higher on vocabulary than those who are less proficient. In addition, the participants who started acquiring their languages at a younger age might have become more proficient in their languages due to more frequent use for a longer time. In this case, participants' younger AoA could also be related to fewer TOTs and higher vocabulary scores.

Predictions Based on the Competition Hypothesis

1. **Language:** According to the competition hypothesis and the IC model, more inhibitory control is required when bilinguals perform language tasks in the less dominant L2 (i.e., due to the strong activation of lexical candidates from the more dominant L1). Consequently, participants should report more TOTs and know fewer words in the non-dominant language (English).
2. **Frequency:** The participants should not experience any frequency effects. Alternatively, since low-frequency words in the less dominant language would be unlikely to compete with dominant language production, the competition between the languages should affect high-frequency word retrieval more than low-frequency word retrieval (i.e., the participants should report more TOTs for high-frequency words).
3. **Cognate status:** The competition hypothesis assumes that increased TOT rates in bilinguals are caused by competition between lexical candidates in the intended language and translation equivalents from the unintended language. Consequently, the participants should experience fewer TOTs for cognates since these are the same in both languages (i.e., there is no competing translation equivalent). In addition, they should also know more cognate words.
4. **Noun type:** Due to cross-language competition between lexical candidates, the participants should report more TOTs and achieve lower vocabulary scores for non-cognate proper nouns. However, the participants could also report more TOTs and achieve lower vocabulary scores for cognate proper nouns if the target words compete with other semantically or phonologically similar words within the same language (i.e., not cross-language competition).
5. **Bilingual profiles:** In terms of bilingual profile effects, the more proficient participants and the participants who frequently switch between their languages should have attained better inhibitory control. They should be better at managing the competition between lexical candidates during simultaneous language activation. Therefore, they should experience fewer TOTs and achieve higher vocabulary scores than the less proficient participants, those who rarely switch between their languages, and those who frequently experience language intrusions. Likewise, the participants who acquired their L2 at a younger age could also be more trained and thereby better at suppressing the competing unintended language. In turn, they are expected to report fewer TOTs and achieve higher vocabulary scores.

Method

Participants

Fifty-one (15 male and 36 female) Norwegian-English bilinguals between the age of 18 and 34 years were recruited from the University of Agder, friends, and family to participate in the study. All participants completed the LEAP-Q, although only 49 participants completed the TOT experiment. None of the participants reported any significant hearing or writing impairments, such as hearing loss or dyslexia. Depending on whether the participants only participated in this TOT study, or if they participated in all the experimental master studies (three experiments in total) at UiA this semester, all participants received either a 150 NOK or 300 NOK voucher as a reward for their participation. Three experimenters designed the TOT experiment together, and each experimenter tested about 16 participants each.

Materials

The following section includes descriptions of the materials used in the present study. It starts with information about the LEAP-Q components, followed by a description of the content differences between the original LEAP-Q (Marian et al., 2017) and the amended version used in the current study. Furthermore, the section includes information about the stimuli used in the TOT experiment, information about the stimuli criteria, and finally a description of how the stimuli were matched on frequency and length.

The LEAP-Q

An amended version of Marian et al.'s (2007) LEAP-Q (see Appendix A) was used to collect information about the participants' language history, proficiency, and use. The first part of the amended LEAP-Q consists of screening questions such as questions about age, gender, country of birth, education level, and so on. The second part includes questions about language background, such as questions about language dominance, language acquisition, and language exposure. Lastly, the third part includes questions about Norwegian and English proficiency, such as questions about contributing factors to learning both languages, current exposure to each language, level of proficiency in different aspects, and so on.

Comparison Between the Amended Version and the Original LEAP-Q

Certain questions in the LEAP-Q were added, removed, or changed to make the questionnaire more relevant to the present study. For instance, questions about whether Norwegian is the participant's native language, whether Norwegian is the only language spoken at home aside from English, and whether the participant is a reasonably good speaker of English, were added. The amended version also included questions about country of birth, current country of residence, the time spent speaking in each language, and the time spent reading in each language. Questions were also added to establish whether the participants had become less fluent in any of their languages and in which language they usually do tasks such as simple math and dreaming. Furthermore, some of the questions in the amended version included added exposure alternatives (e.g., talking, listening to music, reading, and watching TV) and added contribution alternatives (e.g., school and education). Questions about the participant's level of proficiency in language switching and mixing, including a question about the participants' habit of accidentally and intentionally mixing words across Norwegian and English, were also included in the amended version. These questions were not included in the original LEAP-Q, but are particularly relevant to the current study, as language switching and mixing proficiency effects could support the competition hypothesis. All the added elements can be found in the amended version in Appendix A.

In terms of changed elements, in a question where the participants were asked to rate their level of proficiency, the alternative "understand spoken language" was replaced with alternatives such as "pronunciation (accent)", "listening (understanding spoken language)", "vocabulary", and so on. Furthermore, changes were made to adapt the questionnaire to Norwegian participants. For instance, changes were made due to the different educational systems in the U.S. and Norway (e.g., "some college" was changed to "current bachelor student"). Some of the language environment alternatives were also changed. For instance, both English and Norwegian are used in Norwegian schools, which is why it was important to distinguish between a school where one of the languages is spoken *all* of the time and a school where the language is spoken *some* of the time. The amended version also included changed alternatives in terms of cultural identification (e.g., Norwegian, British, and American instead of US-American, Chinese, and Jewish-Orthodox). In comparison to the original LEAP-Q, which asks about general language proficiency, all of part 3 in the amended version focuses on Norwegian and English proficiency.

In terms of removed elements, the question about the participant's date of immigration to the United States was removed since the current study only included Norwegian-English

bilinguals living in Norway. Additionally, questions about accents were removed, since accents are not relevant in terms of TOTs.

Stimuli

The stimuli consisted of 80 target words and matching definitions in English and 80 target words and matching definitions in Norwegian. Both language sets were divided into two different sets of 40 words and matching definitions each, which were counterbalanced across participants. Each set consisted of four conditions: 10 non-cognate common nouns (NCN), 10 cognate common nouns (CCN), 10 non-cognate proper nouns (NPN), and 10 cognate proper nouns (CPN). See examples of the stimulus conditions in Table 2.

Table 2. Examples of stimulus conditions

Condition	**Example**
NCN	*Ginger, Ingefær* (Norwegian)
CCN	*Astrology/astrologi*
NPN	*Goofy, Langbein* (Norwegian)
CPN	*Fidel Castro*

Corpora

For the experiment, a range of different frequencies was necessary to look for frequency effects and to match all the stimuli. The Norwegian Web as Corpus (NoWaC, Guevara, 2010) and the British English version of Subtlex (Subtlex-UK, Van Heuven, Mandera, Keuleers, & Brysbaert, 2014), were used to gather information about the number of hits, frequency per million (fpm), and length of each target word. Subtlex-UK is a corpus with subtitle-based word frequencies for British English that consists of 201.3 million words from 45,099 BBC broadcasts. The words were collected from nine channels (BBC1-BBC4, BBC News, BBC parliament, BBC HD, CBeebies, and CBBC) broadcasted between January 2010 and December 2012 (Van Heuven et al., 2014). NoWaC, on the other hand, is the first version of a large web-based corpus for Norwegian (Bokmål) words that consist of approximately 700 million words. The corpus was made by automatically going through all documents on the .no-domain in the period between November 2009 and January 2010, downloading them, and then processing them (Guevara, 2010).

The fpm was found by dividing the number of hits by the total number of words (in millions) in the corpus (e.g., x/201,3 in Subtlex-UK and x/700 in NoWaC). Furthermore, the number of hits and fpm was based on lemmas (i.e., the dictionary forms), although some lemmas (particularly in NoWaC) could be categorized as several parts of speech. For instance, *cast* could either be the cast on a broken foot (i.e., a noun) or to *cast* a movie (i.e., a verb). Additionally, some of the words in NoWaC were classified as both nouns and 'unknown'. For instance, *stomi* ('ostomy') gave 36 hits as a noun and 6 hits as 'unknown'. In such cases, the numbers were added together as long as there were more hits for the words categorized as nouns and the lemmas were the same. For instance, if *May* was the target word (as in *Theresa May*) this word would also represent the month of *May* and the auxiliary verb *may*. Regardless of what a word represents in a particular case, the word would still be activated if one of its representations is the target word, as long as the lemma is the same.

Target Words Criteria

The target words criteria were to include a) words the participants were likely to know to increase the likelihood of eliciting TOTs, b) a range of frequencies to look for frequency effects, c) words that were not too long, since they had to be matched on length across the sets, and d) words that would be easy to uniquely define to make it easier for the participants to retrieve the correct target words. The goal was to find target words with clear, specific definitions. Therefore, it was important to avoid using words with many common synonyms, high-frequency homophones (to avoid any low-frequency homophones inheriting the frequency of the target words), and words that could be translated literally (to avoid the participants guessing the target words, e.g., *snøhvit* and *snow white*).

The target words were based on the stimuli in Avila (2019). To increase the likelihood of word retrieval and TOTs, typical trivia target words were removed (e.g., less known character names from the universe of *Harry Potter* and *The Lord of the Rings*). The Norwegian culture was also kept in mind. For instance, target words including members of the British royal family were removed from the stimuli sets as this is not necessarily common knowledge to Norwegians.

Due to corpora limitations, it was only possible to create stimuli sets with a smaller frequency range (see Tables 3 and 4). For instance, the frequency of common words, such as *stol* ('chair') were categorized in NoWaC as relatively low (e.g., 8.88 fpm). Words such as *table*, *chair*, and *girl* were too common and would likely not elicit any TOTs. Additionally, proper nouns consisting of two or more words were not included in the corpora (e.g., the

combination of the first name and last name of celebrities or movie titles consisting of more than one word). Instead, either the first or the last name of famous people and titles consisting of only one word were used as target words.

Three foils for each target word were also included in the stimuli sets. These foils included a semantically similar word, a phonologically similar word, and a random unrelated word. For instance, for the target word *lacrosse*, the semantically similar word was *rugby*, the phonologically similar word was *lactose,* and the unrelated word was *carousel.*

When matching the stimuli, the averages of fpm, syllables, phonemes, and letters for all the target words were matched across all the conditions. The number of phonemes in the Norwegian words was based on East Norwegian phonology, while the number of phonemes in the English words was based on Standard British (RP) English phonology. An overview of the matched numbers for the stimuli can be found in Table 3 (Norwegian stimuli) and Table 4 (English stimuli). For the full stimuli list, see Appendix B.

Table 3. Norwegian matched stimuli. M = means, R = range.

Target word type (set 1)	Frequency per million (NoWaC)		No. of syllables		No. of phonemes		No. of letters	
	M	R	M	R	M	R	M	R
CCN	2.37	0.06-8.58	3.4	2-4	8.2	6-11	8.6	6-12
NCN	1.51	0.01-6.9	2.2	1-3	5.8	3-9	6.5	4-10
CPN	1.99	0.08-8.39	2.6	2-4	6.4	4-9	7.6	5-12
NPN	1.54	0.07-7.42	2.6	2-4	6.7	4-10	7.4	5-11
Target word type (set 2)								
CCN	2.42	0.04-7.82	3.2	2-4	7.8	5-10	8.4	6-11
NCN	1.54	0.04-8.32	2.3	1-4	6.1	4-9	6.4	4-9
CPN	1.62	0.04-4.76	2.3	1-4	6.4	4-8	7.1	4-10
NPN	1.52	0.02-6.36	3.2	2-6	8.5	4-17	9.1	5-17

Table 4. English matched stimuli. M = means, R = range.

Target word type (set 1)	Frequency per million (Subtlex-UK)		No. of syllables		No. of phonemes		No. of letters	
	M	R	M	R	M	R	M	R
CCN	1.87	0.18-6.77	3	2.4	7	5-12	7.4	5-11
NCN	2.13	0.03-7.99	2.7	1-6	6.4	3-13	7.2	3-12
CPN	2.38	0.02-8.86	2.2	1-3	6	4-11	7.1	4-10
NPN	1.87	0.27-6.38	2.4	1-4	6.2	3-9	6.9	4-10
Target word type (set 2)								
CCN	2.13	0.23-8.77	2.8	1-5	7.1	4-12	8.1	5-13
NCN	2.03	0.08-4.14	3	2-4	6.6	5-10	7.6	6-10
CPN	2.46	0.14-5.04	2.1	2-3	5.8	4-7	6.5	4-9
NPN	2.04	0.12-9.76	2.3	1-4	6.2	3-11	7	4-12

Definitions Criteria

Clear, short, and concise definitions were made for each target word. Only the most specific and necessary information about the target words was included. In some definitions, examples were added to make it easier for the participants to understand the intended target word. To avoid any priming effects, no parts of any target words or phonologically similar words were mentioned in the definitions within the same stimuli set. Online dictionaries such as *Merriam-webster* and *Oxford languages*, but also encyclopedias such as *Store Norske Leksikon* and *Wikipedia,* were used to find inspiration and ideas on how to define the target words. The stimuli were tested on people who did not participate in the experiment to ensure the quality of the target words and definitions. Furthermore, the feedback was used to reconsider some target words and revise some of the definitions.

Procedure

All conversation took place in English when doing the English part of the experiment, and in Norwegian when doing the Norwegian part. All participants read the study description, signed the consent form (see Appendix C), and completed the LEAP-Q before being tested. After completing the LEAP-Q, the experimenter went through the questionnaire together with the participant to make sure all the questions were correctly interpreted and answered. The participants completed the first and second parts of the experiment on different days to avoid any unwanted language mixing effects. The LEAP-Q and the Norwegian set were completed the first day, and the English set on the second day of testing. A protocol was made to ensure that all three experimenters tested the participants in the same way and gave the same instructions to make sure valid data were collected (i.e., to ensure that the participants reported real TOTs).

The experiment started with the participants reading the experiment instructions on a computer screen. The participants were told the definition of TOTs and that they would read definitions on the screen and then be asked whether they knew the word. They were instructed to say the word if they knew it or say “no” if they did not know it. If they knew the word but could not remember it at the moment, they were instructed to say “TOT”. If the participants reported a TOT, they were asked if they could guess any letters or sounds, the positions of these letters or sounds, and the number of syllables in the target word. Finally, four options in a random order appeared on the screen, including the target word and the three foils. The participants were then asked whether one of these words was the one they were thinking of.

The experimenter pressed keys on the keyboard to continue the experiment and to register the participants' answers. A log was also written in case any data got lost. Additionally, the experimenters wrote down whenever the participants thought they knew the target word, but then produced the wrong word. On average, the experiment took approximately 1.5 hours in total to perform. Full experiment instructions and procedure can be found in Appendix D.

Results

LEAP-Q Data

Participants

The participants consisted of 51 people (36 females and 15 males). The age of the participants ranged between 18 and 34 years, and the average age was 25 years. All but three were right-handed. Additionally, all participants lived in Norway and all but one were born in Norway. Twenty participants were current BA (bachelor) students, 15 had completed a BA, 8 were current MA (master) students, 4 had completed an MA, 3 participants reported "other", and 1 participant reported completed high school. All but three reported Norwegian as their L1 and English as their L2. Additionally, 18 participants reported an L3, including German, French, Spanish, Japanese, Swedish, and Danish, and one participant reported Norwegian Sign Language (NSL) as their L4. No participants reported speaking an L5.

Language Background and Use

Table 5. Participants' self-reported language behavior.

	L1 behavior		L2 behavior	
Language behavior measures	**Mean**	**Range**	**Mean**	**Range**
Language exposure (%)	59.6	25-95	39.2	5-75
Speaking (%)	77.8	20-100	21.2	0-80
Reading (%)	52.6	10-99	46.7	1-90
Spoken language choice (%)	82.2	10-100	17.4	0-90

The numerical averages for the participants' self-reported language behavior are shown in Table 5. Furthermore, all but four reported Norwegian as their dominant language and English as their second dominant language. All but one acquired Norwegian as their L1 and

English as their L2. Additionally, 18 participants listed an L3 as their third acquired and third dominant language, and 1 participant listed NSL as their fourth acquired and fourth dominant language.

All but 2 participants reported Norwegian as their main culture. Twenty also identified with American culture, 13 identified with British culture, and 13 identified with other cultures, including Canadian, German, Australian, Sámi, French, Danish, Korean, and Swiss. Identification with Norwegian culture was rated between 7-10 (on a scale from 1-10), where the majority rated 10, while identification with the other cultures was rated between 0 and 8.

Thirty-two were once better in one of their languages and had become less fluent. Fifteen reported this language to be English, 6 reported Norwegian, and 11 reported either French, German, Japanese, Danish, or Spanish. The age of when the participants became less fluent in one of their languages ranged between 10 and 30 years, and the average age was 20 years. All but 3 reported that they do simple math tasks in Norwegian, 42 reported that they usually dream in Norwegian, 34 reported that they usually express anger or affection in Norwegian, and 33 reported that they usually talk to themselves in Norwegian.

Table 6. Participants' self-reported language proficiency.

	Norwegian		English	
Language proficiency measures	**Mean**	**Range**	**Mean**	**Range**
Immersion duration (years)				
In a country	24.5	17.75-32.58	1.5	0-17.25
In a family	25.2	18.66-34.91	1.9	0-34.91
In a school (language is used all of the time)	14.3	0-27	0.7	0-13
In a school (language is used some of the time)	5.3	0-27	6.7	0-18.08
In a workplace (language is used all of the time)	5.1	0-14	0.1	0-3
In a workplace (language is used some of the time)	1.9	0-12.91	1.4	0-10
Contribution to language learning[a]				
From friends/colleagues	7.7	0-10	6.1	0-10
From family	9.3	5-10	2.5	0-10
From reading	6.8	0-10	7.2	2-10
From school	7.5	2-10	7.6	0-10
From self-instruction	1.3	0-10	2.7	0-10
From TV	3.9	0-10	7.5	2-10
From music	3.3	0-10	6.4	0-10
Extent of language exposure[b]				
Friends	9.1	4-10	3.8	0-10
Family	9.4	0-10	1.1	0-9
Reading	5.3	0-10	6.9	1-10
Self-instruction	1.1	0-10	1.7	0-10
TV	3.4	0-10	8.1	4-10
Music	3.3	0-10	8.0	4-10
Self-reported proficiency[c]				
Speaking	9.5	5-10	7.8	4-10
Pronunciation	9.5	6-10	7.0	2-10
Listening	9.8	6-10	8.5	6-10
Reading	9.5	3-10	8.3	3-10
Writing	9.1	5-10	7.8	4-10
Grammar	8.4	4-10	6.9	3-10
Vocabulary	8.7	6-10	7.2	4-10
Spelling	8.7	4-10	7.0	3-10
Age milestones (years)				
Started hearing	0.1	0-3	7.1	0-14
Became fluent in speaking	4.3	0-16	13.9	6-23
Started reading	5.2	3-8	7.8	5-13
Became fluent in reading	8.1	5-19	13.2	7-22
Language intrusion[d]				
Accidental	3.7	0-8	1.7	0-7
Intentional	4.4	0-10	2.1	0-9

Note. [a]Range: 0 (not a contributor) to 10 (most important contributor). [b]Range: 0 (never) to 10 (almost always). [c]Range: 0 (none) to 10 (perfect). [d]Range: 0 (never) to 10 (all of the time).

The numerical averages for the participants' self-reported language proficiency are shown in Table 6. Furthermore, the average score of self-rated language switching proficiency was 8.1 (ranging between 4 and 10). Forty-four participants reported that they tend to

accidentally mix words or sentences from Norwegian and English, and 46 reported that they tend to intentionally mix words and sentences.

Factor Analysis

A factor analysis was conducted of the LEAP-Q data to capture covariance and see how the variables that varied in a similar or different direction grouped statistically. First, variables of written answers with minimal variation or those for which there were too few participants answering were removed. The remaining 46 numerical variables were used further in the analysis. To check the degree of covariance, a correlation matrix in which everything was correlated was produced. The variables needed to have a correlation of at least 0.3 with one other variable to be included in the data set. Therefore, question 8b (intentional use of Norwegian in English) was removed from the data set. One variable from variable pairs with correlations above 0.8 was also removed from the set. For instance, percentage variables regarding L1 exposure, L1 speaking, L1 reading, and choice of L1 speaking generally explain both sides of one measure (e.g., more exposure to the L1 indicates less exposure to the L2 and vice versa, see list of removed variables in Appendix E). The present study mainly focuses on second language English, which is why the L1 (Norwegian) variables of the questions mentioned above were removed. Additionally, three other variables from pairs with a high correlation above 0.8 (English spelling proficiency, contribution of Norwegian music, and exposure to Norwegian music) were removed. After removing all the high-correlation and no-correlation variables, 38 remaining variables were submitted to a factor analysis.

Table 7. Factors yielded in the study

Factor 1: English proficiency	Loading values	Factor 2: Spoken English proficiency	Loading values
Q4n. Proficiency English grammar	0.84	Q4b. Time spent speaking L2	0.68
Q4m. Proficiency English writing	0.82	Q5b. Fluent speaking age Norwegian	0.60
Q4l. Proficiency reading English	0.82	Q5d. Fluent reading age Norwegian	0.59
Q4o. Proficiency English vocabulary	0.78	Q6b. Choice of speaking L2	0.59
Q4k. Proficiency listening English	0.74	Q3b. Exposure to L2	0.57
Q4i. Proficiency speaking English	0.71	Q2i. Contribution interacting with family English	0.44
Q4j. Proficiency English pronunciation	0.69	Q3g. Exposure interacting with friends English	0.41
Q3i. Exposure reading in English	0.65	Q7a. Accidental use of English in Norwegian	0.37
Q6. Switching proficiency	0.60	Q4o. Proficiency English vocabulary	0.33
Q2j. Contribution reading English	0.59	Q4j. Proficiency English pronunciation	0.33
Q2d.Contribution school Norwegian	0.43	Q5b. Time spent reading in L2	0.33
Q7a. Accidental use of English in Norwegian	0.41	Q2c. Contribution reading Norwegian	-0.37
Q2c. Contribution reading Norwegian	0.41	Q2d. Contribution school Norwegian	-0.40
Q5b. Time spent reading in L2	0.38	Q3c. Exposure reading Norwegian	-0.44
Q5b. Fluent speaking age Norwegian	0.36	Q3e. Exposure TV Norwegian	-0.71
Q5d. Fluent reading age Norwegian	0.35		
Q3g. Exposure interacting with friends English	0.35		
Q3l. Exposure music English	0.35		
Q2k. Contribution school English	0.33		
Q6b. Choice of speaking L2	0.31		
Q2i. Contribution interacting with family English	0.31		
Q3k. Exposure TV English	0.31		
Proportion variance	**0.19**	**Proportion variance**	**0.11**
Cumulative variance	**0.19**	**Cumulative variance**	**0.30**

Factor 3: Informal learning of English	Loading values	Factor 4: Age of English acquistion	Loading values
Q2m. Contribution TV English	0.74	Q5h. Fluent reading age English	0.69
Q2n. Contribution music English	0.65	Q5e. Started hearing English age	0.65
Q3k. Exposure TV English	0.61	Q5f. Fluent speaking age English	0.62
Q3l. Exposure music English	0.56	Q5g. Started reading in English age	0.61
Q2j. Contribution reading English	0.49	Q2h. Contribution interacting with friends English	0.51
Q3b. Exposure to L2	0.46	Q2c. Contribution reading Norwegian	0.48
Q6. Switching proficiency	0.44	Q2f. Contribution TV Norwegian	0.47
Q3g. Exposure interacting with friends English	0.35	Q7b. Accidental use of Norwegian in English	-0.37
Q2l. Contribution self-instruction English	0.35	Q8a. Intentional use of English in Norwegian	-0.58
Q5b. Time spent reading in L2	0.31		
Q5b. Fluent speaking age Norwegian	-0.30		
Q5h. Fluent reading age English	-0.40		
Proportion variance	**0.09**	**Proportion variance**	**0.09**
Cumulative variance	**0.39**	**Cumulative variance**	**0.47**

Four factors were extracted from the data set by means of factor analysis. The factors have been assigned construct names that indicate their components and are listed in order of variance accounted for. Table 7 shows which variables are loaded on the different factors and in which direction they are loaded (i.e., either positively or negatively). The variables load on the different factors with different weights and the weights indicate how much contribution to the factors the different variables have.

The first factor included only positively loaded variables which related mostly to English proficiency. The seven most highly loaded were the proficiency variables (e.g., grammar, writing, reading, vocabulary, etc.). However, the factor also contained variables such as exposure (e.g, exposure to reading, music, and TV), switching proficiency, and contributions to learning (e.g., reading and school). Additionally, most of the variables were English. The only Norwegian variables included the contribution of school and reading, and the fluent speaking and reading age. According to this factor, as proficiency goes up, so does the accidental use of English in Norwegian. Additionally, when the Norwegian variables go up, the English variables in the factor also go up. In other words, the older the participants were when becoming proficient in Norwegian, the more proficient they seem to be in English. This factor is therefore named *English proficiency*.

In the second factor, the highest loading variables were those of speaking and interaction (e.g., the time spent speaking in the L2, the choice of speaking the L2, and interacting with family and friends in English). Other positively loaded variables included accidental use of English in Norwegian, fluent speaking and reading age in Norwegian, English vocabulary and pronunciation proficiency, and time spent reading in the L2. The negatively loaded variables included the contributions of reading and school in Norwegian, and exposure to reading and watching TV in Norwegian. This factor indicates that as the fluent reading and speaking age in Norwegian go up, so do the speaking in L2, the contribution of interactions with family, and the exposure to interactions with friends in English. In other words, less formal learning of Norwegian and less exposure to Norwegian TV and music seem to be related to improved speaking and interaction in English (and vice versa). For this reason, this factor seems to capture *Spoken English proficiency*.

The most highly loaded variables in the third factor included contributing elements to learning English (e.g., watching TV, listening to music, and reading in English), exposure to English (e.g., watching TV, listening to music, interacting with friends, self-instruction, and reading in English), and switching proficiency. The only negative variables in this factor were the fluent speaking age in Norwegian and fluent reading age in English. Additionally, the fluent speaking age was the only Norwegian variable in this factor. All the positive variables related to the contribution of informal learning of English, which means that when the variables of informal learning of English go up, the fluent speaking age in Norwegian and fluent reading age in English go down. In other words, the younger age of Norwegian and English fluency indicates more *Informal learning of English*.

For the fourth factor, the highest loading variables were all based on the age of English acquisition, such as fluent reading age, the age of when the participants started hearing English, fluent speaking age, and the age of when they started to read in English. Other variables included the contribution of interacting with friends in English, reading in Norwegian, and watching TV in Norwegian. The negatively loaded variables included accidental use of Norwegian in English and intentional use of English in Norwegian. According to this factor, as the fluent reading age and speaking age of English go up, the accidental use of Norwegian in English and intentional use of English in Norwegian go down. This is interesting as one would believe the late learners of English to be less fluent than the early learners of English. Furthermore, the factor indicates that the participants who acquired English later interact more with friends in English, but that they also read and watch more TV in Norwegian. Generally, this factor seems to describe the *Age of English acquisition*.

Experimental Results

The dependent variables for the analysis relate to the extent of the participants' vocabulary (i.e., how many words they knew in each language) and TOT states. The Vocabulary scores and TOT rates were analyzed using a linear mixed effects model including the experiment manipulations (i.e., language, frequency, Cognate status, and Type of noun).

Vocabulary Scores

The Vocabulary scores include the reported *knows* and TOTs against the *don't knows* to see how many words the participants knew. Successful access to meaning is indexed by positive TOTs (i.e., excluding TOTs that occurred for words that were not target words) plus GOTs, relative to all trials. Responses were *TOTs*, *GOTs*, and *don't knows*. There were 357 TOTs (9.3%), but only 235 (65.3% of these or 6.2% of the data) of these were true TOTs. The true TOTs were coded as positive TOT and the other as negative TOT.

GOTs and positive TOTs were coded as 1, and all other responses as 0. Cognate status (Cognate, -0.5 vs. Non-cognate, 0.5), Type of noun (Common, -0.5 vs. Proper, 0.5) and language (English, -0.5 vs. Norwegian, 0.5) were fixed effects (centered), as well as frequency (zip, continuous). Logistic regression was fitted to assess the likelihood of knowing words. There was not sufficient variability introduced by the list manipulation to include it as a factor in the model. The model output is shown in Table 8 with significant effects in bold.

Table 8. The measure of participants' Vocabulary scores

Probability of GOT and +TOT relative to all trials				
	Estimate	Std. Error	z value	p value
(Intercept)	1.02	0.13	7.62	0.00
language [en, -0.5; no, 0.5]	**0.58**	**0.16**	**3.57**	**0.00**
typeName [common, -0.5; proper, 0.5]	**0.31**	**0.16**	**1.90**	**0.06**
Cognate [cognate, -0.5; proper, 0.5]	-0.01	0.16	-0.09	0.93
frequency [continuous from -1.89 to 0.23]	**0.30**	**0.12**	**2.45**	**0.01**
language:frequency	-0.09	0.25	-0.35	0.73
typeName:frequency	-0.23	0.25	-0.93	0.35
Cognate:frequency	0.21	0.25	0.84	0.40
language:typeName	-0.33	0.32	-1.01	0.31
language:Cognate	0.02	0.32	0.05	0.96
typeName:Cognate	0.48	0.32	1.49	0.14
language:typeName:frequency	0.84	0.50	1.69	0.09
language:Cognate:frequency	0.44	0.50	0.88	0.38
typeName:Cognate:frequency	0.12	0.50	0.23	0.82
language:typeName:Cognate	-0.26	0.65	-0.40	0.69
language:typeName:Cognate:frequency	-0.77	0.99	-0.77	0.44

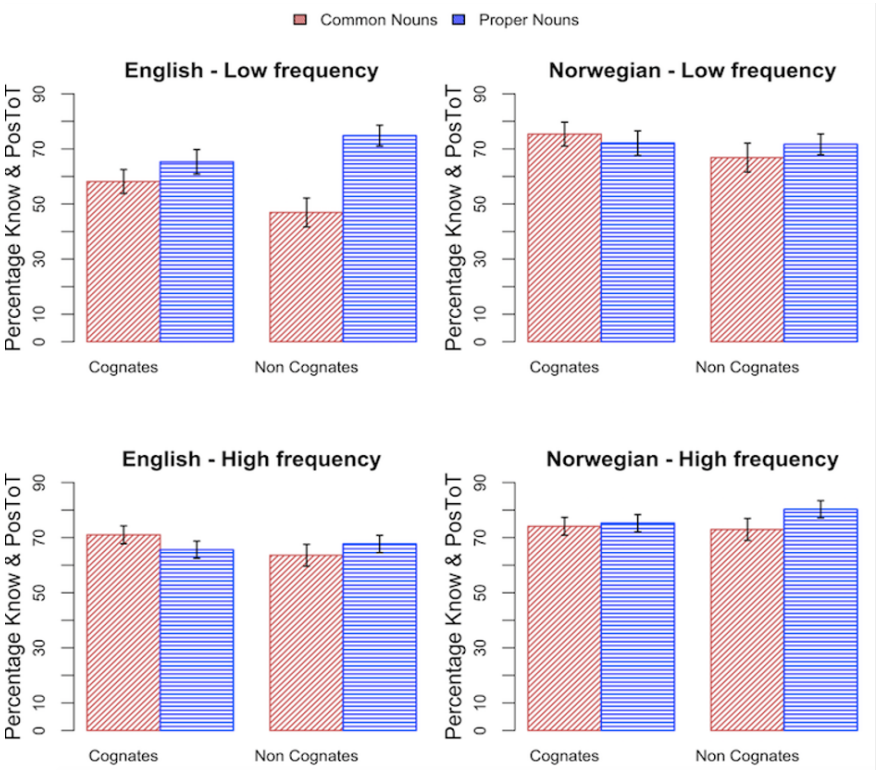

Figure 6. Participants' Vocabulary scores. Know = GOT.

There was a significant effect of language and frequency and a borderline effect of Type of nouns. The language effect indicates that the participants knew more words in Norwegian than in English and the frequency effect indicates that they knew more high-frequency than low-frequency words. The means per condition by word frequency are shown in Figure 6. Interestingly, the borderline effect of Type of noun indicates that Proper nouns and Common nouns behaved differently. As seen in Figure 6, the English low-frequency graph reveals a slightly higher percentage of Non-cognate Proper nouns compared to the percentage of Non-cognate Proper nouns in the English high-frequency graph. Additionally, the difference between the Cognates and Non-cognates is generally larger and the percentage of Cognates is lower in the English high-frequency graph compared to the results presented in the other graphs. However, there were no significant differences in those patterns overall.

TOT Rates

The following represents the proportion of responses that reflect a failed form retrieval: positive TOT/(positive TOTs + GOTS). First, don't know trials (28%) and negative TOTs (3.27%) were discarded. Non-positive TOTs (i.e., when participants experienced TOTs for non-target words) were not included in the number of TOTs, but rather in the number of don't knows. Then, TOTs were coded as 1, and GOTs as 0. The model output is shown in Table 9.

Table 9. The measure of participants' TOT rates

Probability of positive TOT relative to GOT				
	Estimate	Std. Error	z value	p value
(Intercept)	-2.69	0.16	-17.01	<
language	**-0.43**	**0.19**	**-2.24**	**0.03**
typeName	0.20	0.19	1.06	0.29
Cognate	**-0.42**	**0.19**	**-2.22**	**0.03**
frequency	**-0.33**	**0.15**	**-2.27**	**0.02**
language:frequency	0.08	0.30	0.26	0.80
typeName:frequency	0.09	0.29	0.31	0.76
Cognate:frequency	0.06	0.29	0.20	0.84
language:typeName	0.14	0.38	0.36	0.72
language:Cognate	0.30	0.38	0.79	0.43
typeName:Cognate	**-1.05**	**0.38**	**-2.75**	**0.01**
language:typeName:frequency	0.60	0.59	1.00	0.32
language:Cognate:frequency	0.24	0.59	0.41	0.68
typeName:Cognate:frequency	-0.67	0.59	-1.14	0.25
language:typeName:Cognate	-0.13	0.76	-0.18	0.86
language:typeName:Cognate:frequency	1.71	1.20	1.43	0.15

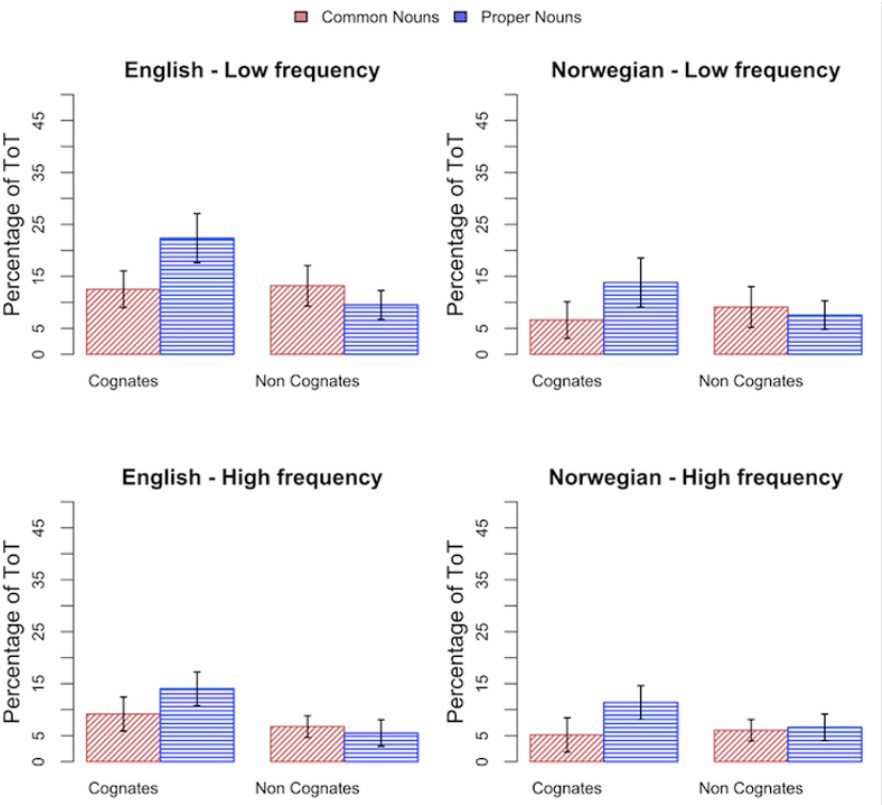

Figure 7. The means for the participants' TOT rates.

The TOT rates showed significant effects of language, frequency, and Cognate status. As shown in Figure 7, there was a significant difference between the averages across English and the averages across Norwegian. For instance, The TOT rates are generally higher in the English graphs than in the Norwegian graphs, and the rates are also higher in the low-frequency graphs compared to the high-frequency graphs. There is a significant difference between the Cognates and Non-cognates in all four graphs. However, this difference seems to be mainly due to the Proper nouns, as the TOT rates for Cognate Proper nouns are significantly higher than for Cognate Common nouns. Interestingly, there is also a slight difference between the Non-cognates in the English low-frequency graph. However, there was no significant Non-cognate effect overall.

Effects of Access to Phonology

A linear mixed effects model was also used in an analysis of phonology access (including language, Type of noun, Cognate status, and NoWaC & Subtlex Zipf) to see whether there were any effects of Cognate status or language. During TOT states, the participants were asked whether they could remember any sounds, letters, letter positions, or the number of syllables in the target words. First, each of the answers was given a rating, and then analysis

was run to see whether the amount of phonology the participants got right was affected by any of the conditions. However, there were no effects (see raw counts, result table, and graph in Appendix F).

Interactions Between Factors and Vocabulary Scores

The final analysis investigated the effects of individual differences in the Factors from the LEAP-Q analysis on the Vocabulary scores and TOT rates. The participants' values for each factor were added to the linear mixed effect model. Responses were *TOT, GOT*, and *I don't know*. There were 179 TOTs (9.3%), but only 124 of these were true TOTs. True TOTs were coded as TOT and the other as 'I don't know'. GOTs and TOTs were coded as 1, and the 'I don't know' responses as 0. Cognate status (Cognate, -0.5 vs. Non-Cognate, 0.5) was fixed effect (centered).

Logistic regression was fitted to assess the likelihood of knowing (GOT + TOT) words. To assess individual differences, the four Factors associated with each subject were added as covariates: EngProficiency, SpokenEngProficiency, InfEngLearning, and AoAEng. The resulting model for the Vocabulary scores is shown in Table 10 and the relationship between Vocabulary scores and each Factor is shown in Figure 8.

Table 10. The model output for the Vocabulary scores including the Factors, GOTs, and positive TOTs

Probability of GOT and +TOT relative to I don't Know				
	Estimate	Std. Error	z value	p value
(Intercept)	0.87	0.17	5.04	<0.01
EngProficiency	**0.50**	**0.13**	**3.92**	**<0.01**
SpokenEngProficiency	**0.39**	**0.13**	**2.96**	**<0.01**
InfEngLearning	-0.15	0.12	-1.25	0.21
AoAEng	**0.27**	**0.12**	**2.23**	**0.03**
Cognate	0.01	0.26	0.00	1.00
EngProficiency:Cognate	**0.25**	**0.12**	**2.19**	**0.03**
SpokenEngProficiency:Cognate	0.13	0.13	1.03	0.30
InfEngLearning:Cognate	-0.15	0.11	-1.36	0.17
AoAEng:Cognate	-0.19	0.11	-1.68	0.09

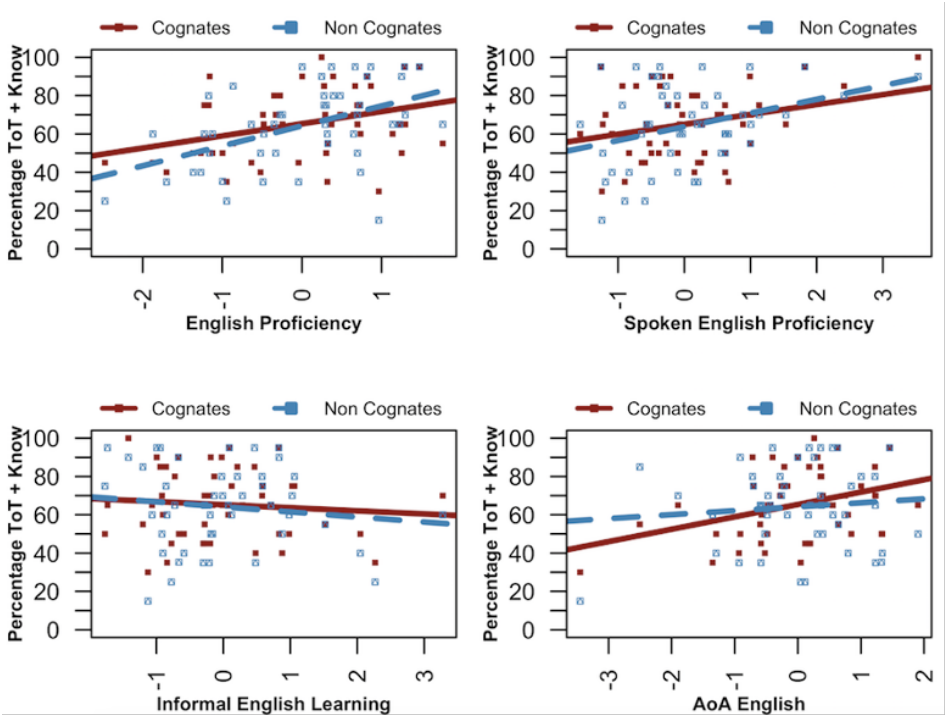

Figure 8. Interactions between the Factors and Vocabulary scores. Know = GOT.

There were significant interactions between TOT rates and Factors English proficiency, Spoken English proficiency, and Age of English acquisition. Additionally, there was a significant interaction between the English proficiency Factor and Cognates. As shown in Figure 8, as the participants' proficiency goes up, so do their Vocabulary scores. The same graph also illustrates an interaction between English proficiency and Cognate status, in which the dotted Non-cognates line goes up more steeply with increased English proficiency. The second graph illustrates the interaction between Spoken English Proficiency and Vocabulary scores. As spoken English proficiency goes up, so do the Vocabulary scores. The third graph illustrates an interaction between Informal English learning and Vocabulary scores in which increased Informal learning of English correlates with lower Vocabulary scores. However, this effect was not significant. In the fourth graph, Age of English acquisition increases with Vocabulary scores. Interestingly, this interaction seems to be particularly stronger for Cognates than for Non-cognates, although this effect was not significant.

Interactions Between Factors and TOT Rates

For this part of the analysis, the 'I don't know' trials (32%) and negative TOTs (2.81%) were first discarded. Then, TOTs were coded as 1, and GOTs as 0. The model output is shown in Table 11.

Table 11. The model output for the TOT rates including the Factors

Probability of TOT relative to GOT				
	Estimate	Std. Error	z value	p value
(Intercept)	-2.71	0.22	-12.41	< 2e-16
EngProficiency	**-0.48**	**0.17**	**-2.75**	**0.01**
SpokenEngProficiency	0.01	0.16	0.06	0.95
InfEngLearning	-0.08	0.16	-0.48	0.63
AoAEng	0.13	0.18	0.72	0.47
Cognate	**-0.59**	**0.30**	**-1.98**	**0.05**
EngProficiency:Cognate	-0.31	0.23	-1.32	0.19
SpokenEngProficiency:Cognate	0.00	0.20	0.00	1.00
InfEngLearning:Cognate	-0.02	0.22	-0.07	0.94
AoAEng:Cognate	-0.11	0.24	-0.45	0.65

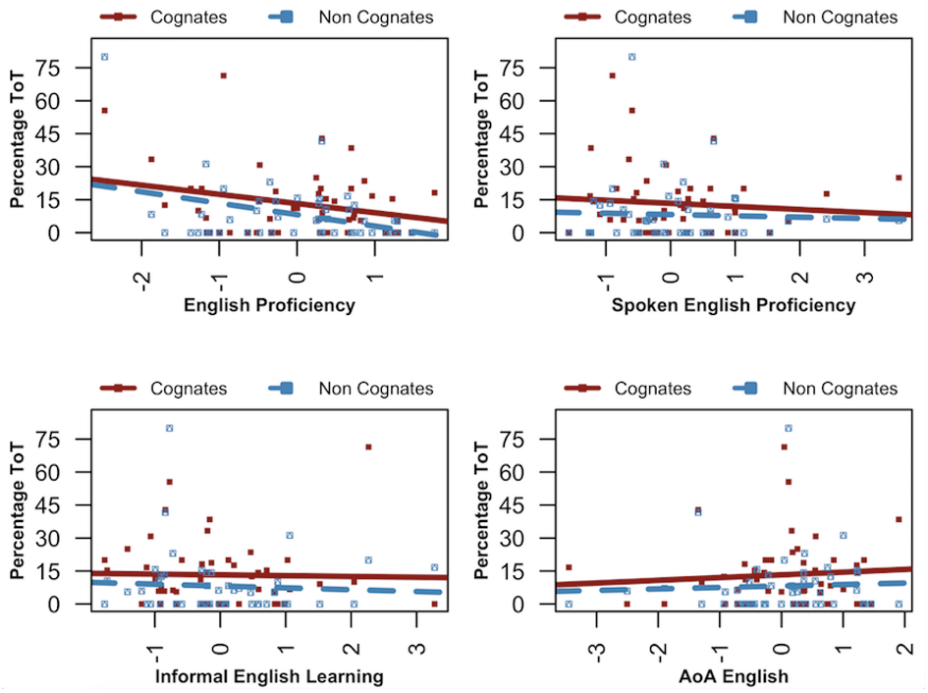

Figure 9. Interactions between the Factors and the participant's TOT rates

There was a significant Factor effect of English proficiency on TOT rates and a significant effect of Cognate. As shown in Figure 9, the TOT rates decreased with higher English proficiency. Additionally, the TOTs rates were higher for Cognates than Non-cognates

in all four graphs. The Spoken English proficiency graph and AoA English graph also reveal slight interactions between the Factors and TOT rates, however, these interactions were not significant. Finally, the graph of Informal English learning illustrates the least effect for both Cognate and Non-cognate TOTs with the smallest slope.

Discussion

This study aimed to investigate word retrieval in Norwegian-English bilinguals, particularly by investigating whether TOT rates would be affected by language, word frequency, cognate status, noun type, and different bilingual profiles. The study further aimed to investigate whether the weaker links hypothesis or the competition hypothesis could better account for the TOT phenomenon. A word-finding experiment including a Norwegian stimuli set and an English stimuli set was conducted. According to the results, the participants knew more words in Norwegian than English and more high-frequency words than low-frequency words. More TOTs were reported in English than in Norwegian, and the TOT rates were generally higher for cognates and low-frequency words. Additionally, proper noun cognates elicited more TOTs than common noun cognates. Moreover, the participants who were more proficient in English scored higher on vocabulary (particularly for non-cognates) and reported fewer TOTs than the less proficient participants. Interestingly, those who acquired English at an older age also scored higher on vocabulary.

Vocabulary scores

As predicted by both the weaker links hypothesis (i.e., in terms of stronger links between semantic concepts and phonological information in the L1) and the competition hypothesis (i.e., in terms less inhibitory control required for L1 tasks), the participants knew more words in Norwegian (the dominant language) than in English. This makes sense since all but two participants acquired Norwegian as their L1 and since most of the participants tend to use Norwegian more than English. Furthermore, the participants knew more high-frequency words than low-frequency words, which was predicted by the weaker links hypothesis. As explained in the introduction, the weaker links hypothesis assumes that more frequent use should reduce frequency lag (Gollan et al. 2008).

TOT rates

Language and Word Frequency Effects

As predicted by both hypotheses, the participants reported more TOTs in English than Norwegian, which replicates earlier findings that also showed higher TOT rates in the L2 (e.g. Gollan et al., 2005; Pureza et al., 2016). This finding could be explained by less frequent use of the L2 but also by the strong activation of lexical candidates from the L1 when performing the task in the L2 (i.e., more inhibitory control is required). Further supporting the weaker links hypothesis, more TOTs were reported for low-frequency words. This finding is problematic for the competition hypothesis. As explained in the introduction, the competition hypothesis predicts high-frequency translation equivalents to be highly active because the larger number of stored lexical nodes should lead to increased competition for selection. Consequently, high-frequency words should compete for selection more strongly and elicit more TOTs than low-frequency words. Alternatively, the competition hypothesis would predict no frequency effects.

No Cognate Facilitation Effects

The present study did not replicate the cognate facilitation effect found in other word-finding studies (e.g. Colomé & Miozzo, 2010; Costa et al., 2000; Gollan & Acenas, 2004; Pureza et al., 2016). Interestingly, the participants reported more TOTs for cognates than non-cognates, which is difficult to interpret in terms of both hypotheses. As explained in the introduction, the weaker links hypothesis predicts cognates to facilitate retrieval because they overlap semantically and phonologically, meaning that they should also be used more frequently than non-cognates. Furthermore, since cognates are the same in both languages, they should be activated irrespective of the intended language. In other words, the competition hypothesis would also predict fewer TOTs for cognates since there is no competing translation equivalent from the unintended language.

Interestingly, the cognate effect was mainly driven by proper nouns (i.e., more TOTs were elicited for cognate proper nouns than cognate common nouns). These results do not replicate those of Gollan et al. (2005), where bilinguals experienced an equal number of TOTs for proper nouns and common nouns. However, as explained in the introduction, although people might know many things about specific individuals, few aspects of meaning are consistently associated with particular names (Cohen, 1990; Semenza, 1997). A proper noun refers to a single individual, place, or title, rather than to several instances of a kind (Semenza & Zettin, 1989), which means that only one single connection within the semantic system links

proper noun phrasal nodes to the necessary lexical representations (Burke et al., 1991). Therefore, proper nouns could be more difficult to retrieve due to the absence of strong activation from multiple converging links within the semantic system. However, proper nouns could also be difficult to retrieve if there is competition between semantically or phonologically similar words at the lexical level (within the same language, i.e., not cross-language competition). For instance, when asked about the last name of the famous talk show host James Corden, one of the participants answered "Gordon" (which is the first name of a famous chef and TV personality). Moreover, when asked about the first name of the chancellor of Germany, a participant answered "Merkela" (i.e., a mix between Angela and Merkel).

A third theory is that the lack of cognate facilitation effect could be due to the bilingual profiles being uniform. Larger individual differences could have provided more variability in the data set. For instance, the effect could be a question of language use and interests. Participants who tend to watch more TV and movies would be more likely to retrieve names of different actors and movie titles, those who tend to read more would be more likely to retrieve names of different books and characters, and those who are more interested in geography would be more likely to retrieve the names of different capital cities, and so on.

Taken together, these theories could explain why the participants experienced more TOTs for proper nouns in the present study, and also why they experienced more TOTs for cognates than for non-cognates. However, none of the theories discussed above can be confirmed without further research. In conclusion, the reason why cognates, and particularly proper noun cognates, elicited more TOTs is unclear.

No Effects of Access to Phonology

Interestingly, there was no effect of access to phonology. Whenever the participants experienced a TOT, they were asked whether they could remember any target word phonology, such as sounds, letters, and the number of syllables. Correct access to phonology could be affected by any of the conditions, such as cognate status or language. For instance, phonology could have been easier to access during cognate TOTs because the phonology is similar in both languages. However, there were no such effects.

English Proficiency Effects on Vocabulary Scores and TOT Rates

The participants who were more proficient in English knew more words and reported fewer TOTs than those who were less proficient. These findings support both the weaker links hypothesis and the competition hypothesis. As explained above, the weaker links hypothesis assumes that increased use of a language can increase lexical accessibility, which could explain why the more proficient participants knew more words and reported fewer TOTs. However, participants who are proficient language switchers should also report fewer TOTs because they are better at managing dual-language activation and possible competition between lexical candidates from both languages. Consequently, these participants should have been better at suppressing the unintended language, which supports the competition hypothesis. Alternatively, these findings could be explained by combining the two hypotheses. As explained in the introduction, reduced frequency of use could increase TOT rates for bilinguals at the same time that simultaneous language activation does so as well (Gollan et al., 2014).

There was also a significant interaction between English proficiency and cognate status in which the more proficient participants retrieved more non-cognates, than the less proficient participants. This finding could be due to non-cognates being more difficult to learn and remember in the L2 (since they overlap semantically but not in form) and could also be explained by both hypotheses (i.e., in terms of more frequent use and increased inhibitory control).

Age of English Acquisition Effects on Vocabulary Scores

There was an interesting correlation between the Age of English acquisition factor and the vocabulary scores. The later the participants started to be exposed to and became proficient in English, the more words they knew. This finding is problematic for both hypotheses. The participants who started to acquire their L2 at an earlier age have likely been using both of their languages for a longer time (i.e., consistently improved their inhibitory control skills) and perhaps also more frequently than the late learners. Consequently, one would believe that younger AoA should be related to better performance. It is not clear what is defined as a late learner of L2. However, Norwegian children usually start to acquire English in school at the age of 8, meaning that to start L2 acquisition at age 12 could be considered late. According to a closer look at the LEAP-Q results, the participants who started hearing English at an older age (i.e., 12-14 years) or became fluent in English at an older age (i.e. 21-23 years), had also

lived in an English-speaking environment (i.e., where English was spoken all of the time) continuously for at least 1 year. In line with the predictions mentioned in Marian et al. (2007), the environment in which a language is learned could influence attained proficiency. Therefore, there could have been an interaction between increased English AoA (and fluency) and increased vocabulary scores because these participants lived in an English-speaking environment and used their L2 more than their L1 continuously for a longer time (i.e., 1-2.5 years).

There was also an interesting and similar type of correlation in the Age of English acquisition factor from the factor analysis. According to this factor, as the fluent reading age and speaking age of English go up, the accidental use of Norwegian in English goes down. Again, this is interesting as one would believe the late learners of English to be less fluent than the early learners of English. This could also be due to the increased use of L2 during participants' time living in an English-speaking environment. Furthermore, it is also possible to speculate that late learners of English might be more aware, more motivated, and more focused when speaking their L2 because of their desire to perform well when speaking English, whereas early learners might act more inattentively when speaking in their L2. However, further research is required to provide evidence for these theories. In conclusion, the reason for these unpredicted findings is also unclear.

Future Research

For future research, it could be recommended to use more recently updated corpora, as the corpora used for stimuli in this study were not optimal. For instance, NoWaC has not been updated in over ten years, meaning that it is not completely reliable in terms of frequency. For instance, some words did not score as high in frequency as they would have if the corpus was recently updated (e.g., *Bieber* and *pandemi* ('pandemic') were listed as low-frequency words). Additionally, there is a big difference in the total amount of words in the two corpora. While NoWaC contains 700 million words, Subtlex-UK only contains 201.3 million words. Furthermore, although NoWaC contained mostly Norwegian words, a certain number of English words were also included in the corpus. Consequently, it was difficult to find words of similar frequency in both corpora to be able to match for frequency. Additionally, it was difficult to find a wide range of frequencies, since most of the words in the corpora were of very low-frequency. As mentioned in the introduction, examples of high-frequency words would be *table*, *chair*, and *girl*, however, these words would not be likely to elicit TOTs. An

alternative option for future TOT studies could be to conduct a pretest with a different set of participants in which they are asked to rate different words in terms of frequency (i.e., based on approximately how often they use or hear the different words).

As explained above, the present study included a relatively uniform batch of participants. For future research, it could be interesting to include participants who vary more in language history, proficiency, and use. Consequently, a wider variety in the data set could perhaps provide the predicted cognate facilitation effect, interesting language switching effects, a different pattern of proper nouns, or a different interaction between English AoA and vocabulary scores. In a future study, further research of cognate status, proper nouns, and AoA would be interesting to investigate. For instance, by manipulating different types of proper nouns (e.g., celebrity names, capital cities, movie titles, product names, etc.), it could be possible to further investigate the cognate proper noun effect and also see what particular types of proper nouns would likely elicit more TOTs. Additionally, a comparison between bilingual participants who have only lived in one country and bilingual participants who have lived abroad for a certain amount of time could reveal significant differences in terms of vocabulary and TOTs. Furthermore, such research might be able to provide supporting results for the interaction between increased AoA and higher vocabulary scores (and fewer L1 intrusions in the L2) in the present study.

Conclusion

The present word-finding study aimed to investigate TOTs in Norwegian-English bilinguals and the underlying mechanism for the TOT phenomenon. The experiment included manipulations to look for effects of language, word frequency, cognate status, and noun type. Additionally, an amended version of Marian et al.'s (2007) LEAP-Q was used to gather information about the participants' language history, proficiency, and use. This information was further used to look for effects of the different bilingual profiles on the participants' vocabulary scores and TOT rates.

As predicted, the participants knew more words and reported fewer TOTs in Norwegian. They also knew more high-frequency words and reported more TOTs for low-frequency words. Those who were more proficient in English knew more words and reported fewer TOTs. Most of these findings support both the weaker links hypothesis and the competition hypothesis. For instance, it is unclear whether the participants' English proficiency was due to a strengthened connection between words' semantic concepts and phonological information (i.e., as predicted

by the weaker links hypothesis) or whether it was due to them being competent language switchers and thereby also competent at managing dual-language activation and competition between lexical candidates (i.e., as predicted by the competition hypothesis). The participants' proficiency level could even be a result of a combination of the two hypotheses. However, the effects of word frequency are problematic for the competition hypothesis. Furthermore, there were no cognate facilitation effects. Instead, the participants reported more TOTs for cognates, particularly for proper noun cognates. These findings are problematic for both hypotheses. However, this could be a matter of competition between semantically and phonologically similar words within the same language. In addition, some researchers believe that proper nouns are more vulnerable to retrieval failures. In other words, the reason for these findings is still unclear and would require further research. Another finding that is difficult to explain is that the participants who acquired English at an older age knew more words than those who acquired English at a younger age. A closer investigation of the LEAP-Q results revealed that several of the late learners had spent at least 1 year in an environment where English was spoken all of the time. However, this did not reveal any significant effects in the factor analysis, meaning that the reason for this finding is also unclear. In future research, participants who vary more in terms of language history, proficiency, and use could be included to provide more variation in the data set, which would perhaps also provide different findings in terms of both cognate effects and the interaction between higher English AoA and higher vocabulary scores.

In conclusion, the present study replicated significant effects of language and word frequency. In addition, results revealed predicted effects of language proficiency on both vocabulary and TOTs. While the weaker links hypothesis can account for all of these findings, the competition hypothesis cannot account for the frequency effects. Furthermore, unpredicted effects of cognate status and English AoA were also found. However, these findings are problematic for both hypotheses, and although different theories can be used to try to explain these findings, further research is needed to establish any clear reasons. Taken together, both hypotheses could be used to explain most of the predicted findings. This indicates that the weaker links hypothesis and the competition hypothesis are not mutually exclusive and that TOTs might occur due to a combination of both hypotheses.

References

- Alario, F. X., Costa, A., & Caramazza, A. (2002). Frequency effects in noun phrase production: Implications for models of lexical access. *Language and Cognitive Processes, 17*(3), 299–319. DOI: https://doi.org/10.1080/01690960143000236
- Avila, S. M. (2019). *Tip-of-the-tongue states among Norwegian-English bilinguals: Investigating the bilingual disadvantage in word finding and its relationship to the bilingual language profile* (Master's thesis). University of Agder, Kristiansand.
- Baetens Beardsmore, H. (1982). *Bilingualism: Basic Principles*. Clevedon: Tieto.
- Bates, E., D'Amico, S., Jacobsen, T., Sze ́kely, A., Andonova, E., Devescovi, A., et al. (2003). Timed picture naming in seven languages. *Psychonomic Bulletin & Review, 10,* 344–380. DOI: https://doi.org/10.3758/BF03196494
- Bedore, L. M., & Pena, E. D. (2008). Assessment of bilingual children for identification of language impairment: Current findings and implications for practice. *International Journal of Bilingual Education and Bilingualism*, *11*(1), 1-29. DOI: https://doi.org/10.2167/beb392.0
- Bialystok, E. (2001). Metalinguistic aspects of bilingual processing. *Annual Review of Applied Linguistics, 21*(1), 169-181. DOI: 10.1017/S0267190501000101
- Bialystok, E. (2011). Reshaping the mind: The benefits of bilingualism. *Can J Exp Psychol. 64(4)*, 229-235. DOI: 10.1037/a0025406
- Bialystok, E., Anderson, J. A. E., & Grundy, J. G. (2018). Interpreting cognitive decline in the face of cognitive reserve: Does bilingualism affect cognitive aging? *Linguistic Approaches to Bilingualism,* 1-20. DOI: https://doi.org/10.1075/lab.18040.bia
- Bialystok, E., Craik, F. I. M., Grady, C., Chau, W., Ishii, R., Gunji, A., & Pantev, C. (2005). Effect of bilingualism on cognitive control in the Simon task: evidence from MEG. *NeuroImage, 24*(1), 40-49. DOI: https://doi.org/10.1016/j.neuroimage.2004.09.044
- Bialystok, E., Craik, F. I. M., & Luk, G. (2008) Cognitive control and lexical access in younger and older bilinguals. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 34*(4), 859– 873. DOI: https://doi.org/10.1037/0278-7393.34.4.859
- Bialystok, E. & Hakuta, K. (1994). *In other words: The science and psychology of second-language acquisition.* New York: Basic Books.
- Bialystok, E., Luk, G., Peets, K. F., & Yang, S. (2010). Receptive vocabulary differences in monolingual and bilingual children. *Bilingualism: Language and Cognition, 13*(4), 525–531. DOI: 10.1017/S1366728909990423
- Bialystok, E., Poarch, G., Luo, L., & Craik, F. I. M. (2014). Effects of bilingualism and aging on executive function and working memory. *Psychology and Aging, 29*(3), 696–705. DOI: https://doi.org/10.1037/a0037254

- Birdsong, D. (2005). Interpreting age effects in 2nd language acquisition. In J. Kroll & A. de Groot (Eds.), *Handbook of bilingualism* (pp. 109–127). New York: Oxford University Press.
- Bock, K., & Levelt, W. (1994). Language production: Grammatical encoding. *Handbook of psycholinguistics* (pp. 945–984). San Diego, CA, USA: Academic Press.
- Braver, T.S. (2012). The Variable Nature of Cognitive Control: a Dual Mechanisms Framework. *Trends in Cognitive Sciences,* 16(2), 106-113. https://doi.org/10.1016/j.tics.2011.12.010
- Brown R. & McNeill D. (1966) The "tip of the tongue" phenomenon. *Journal of Verbal Learning and Verbal Behavior, 5*(4), 325–337. DOI: https://doi.org/10.1016/S0022-5371(66)80040-3
- Brown, A. S. (2012). *The tip of the tongue state.* Hove: Psychology Press.
- Brown, A. S., & Nix, L. A. (1996). Age differences in the tip-of-the- tongue experience. *The American Journal of Psychology, 109*(1), 79–91.
- Burke, D. M., Locantore, J. K., Austin, A. A., & Chae, B. (2004). Cherry pit primes Brad Pitt: Homophone priming effects on young and older adults' production of proper names. *Psychological Science, 15*(3), 164-170. DOI: https://doi.org/10.1111/j.0956-7976.2004.01503004.x
- Burke, D. M., MacKay, D. G., Worthley, J. S., & Wade, E. (1991). On the tip of the tongue: What causes word finding failures in young and older adults. *Journal of Memory and Language, 30,* 542–579. DOI: https://doi.org/10.1016/0749-596X(91)90026-G
- Caramazza, A. (1997). How many levels of processing are there in lexical access? *Cognitive Neuropsychology, 14*(1), 177–208. DOI: https://doi.org/10.1080/026432997381664
- Caramazza, A., Costa, A., Miozzo, M., & Bi, Y. C. (2001). The specific-word frequency effect: Implications for the repre- sentation of homophones in speech production. *Journal of Experimental Psychology: Learning Memory and Cognition, 27*(6), 1430–1450. DOI: https://doi.org/10.1037/0278-7393.27.6.1430
- Carlson, S. M. & Meltzoff, A. N. (2008). Bilingual experience and executive functioning in young children. *Dev Sci. 11(2)*, 282-298. DOI: 10.1111/j.1467-7687.2008.00675.x
- Christoffels, I., Firk, C., Schiller, N. (2007). Bilingual language control: An event-related brain potential study. Brain Research, 1147, 192–208. DOI: https://doi.org/10.1016/j.brainres.2007.01.137
- Cohen, G. (1990). Why is it difficult to put names to faces? *British Journal of Psychology, 81,* 287–297. DOI: https://doi.org/10.1111/j.2044-8295.1990.tb02362.x
- Colomé, Á. (2001). Lexical activation in bilinguals' speech production: Language-specific or language-independent. *Journal of Memory and Language, 45*(4), 721–736. DOI: https://doi.org/10.1006/jmla.2001.2793
- Colomé, A., & Miozzo, M. (2010). Which words are activated during bilingual word production? *Journal of Experimental Psychology: Learning, Memory, and Cognition, 36*(1), 96–109. doi:10.1037/a0017677

- Comesaña, M., Ferré, P., Romero, J., Guasch, M., Soares, A. P., & García-Chico, T. (2015). Facilitative effect of cognate words vanishes when reducing the orthographic overlap: The role of stimuli list composition. Journal of Experimental Psychology: *Learning, Memory, and Cognition, 41*(3), 614–635. DOI: https://doi.org/10.1037/xlm0000065
- Costa, A. (2005). Lexical Access in Bilingual Production. In J. F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (p. 308–325). Oxford University Press.
- Costa, A., & Caramazza, A. (1999). Is lexical selection in bilingual speech production language-specific? Further evidence from Spanish-English and English-Spanish bilinguals. *Bilingualism: Language and Cognition, 2*(3), 231–244. DOI: https://doi.org/10.1017/S1366728999000334
- Costa, A., Caramazza, A., & Sebastián-Gallés, N. (2000). The cognate facilitation effect: Implications for models of lexical access. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*(5), 1283–1296. DOI: https://doi.org/10.1037/0278-7393.26.5.1283
- Costa, A., Colomé, A., & Caramazza, A. (2000). Lexical access in speech production: the bilingual case. *Psicológica, 21*(2), 403–437.
- Costa, A., Hernández, M., & Sebastián-Gallés, N. (2008). Bilingualism aids conflict resolution: Evidence from the ANT task. *Cognition, 106*(1), 59-86. DOI: https://doi.org/10.1016/j.cognition.2006.12.013
- Costa A., Miozzo M., & Caramazza A. (1999). Lexical selection in bilinguals: Do words in the bilingual's two lexicons compete for selection? *Journal of Memory and Language, 41*(3), 365–397. DOI: https://doi.org/10.1006/jmla.1999.2651
- Costa, A., & Santesteban, M. (2004). Lexical access in bilingual speech production: Evidence from language switching in highly proficient bilinguals and L2 learners. *Journal of Memory and Language, 50*(4), 491–511. DOI: https://doi.org/10.1016/j.jml.2004.02.002
- Costa, A., Santesteban, M., & Caño, A. (2005). On the facilitatory effects of cognate words in bilingual speech production. *Brain and Language, 94*(1), 94–103. DOI: https://doi.org/10.1016/j.bandl.2004.12.002
- Cutler, A., Mehler, J., Norris, D., & Segui, J. (1992). The monolingual nature of speech segmentation by bilinguals. *Cognitive psychology*, *24*(3), 381-410. DOI: https://doi.org/10.1016/0010-0285(92)90012-Q
- Cutting, J. C., & Ferreira, V. S. (1999). Semantic and phonological information flow in the production lexicon. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 25*(2), 318–344. DOI: https://doi.org/10.1037/0278-7393.25.2.318
- Dahlgren, D. J. (1998). Impact of knowledge and age on tip-of-the-tongue rates. *Experimental Aging Research, 24*(2), 139–153. DOI: https://doi.org/10.1080/036107398244283
- Davenport, M., & Hannahs, S. (2020). *Introducing phonetics and phonology* (4th ed.). Abingdon, Oxon: Routledge.
- De Groot, A. M. B. (2011). *Language and cognition in bilinguals and multilinguals: An introduction.* New York: Psychology Press.

- Dell, G. S. (1986). A spreading-activation theory of retrieval in sentence production. *Psychological Review, 93*(3), 283–321. DOI: https://doi.org/10.1037/0033-295X.93.3.283
- Dell, G. S. (1990). Effects of frequency and vocabulary type on phonological speech errors. *Language and Cognitive Processes, 5*(4), 313–349. DOI: https://doi.org/10.1080/01690969008407066
- Dell, G. S., Schwartz, M. F., Martin, N., Saffran, E. M., & Gagnon, D. A. (1997). Lexical access in aphasic and nonaphasic speakers. *Psychological Review, 104*(4), 801–838. DOI: https://doi.org/10.1037/0033-295X.104.4.801
- Dijkstra, A., & Van Heuven, W. J. B. (1998). The BIA model and bilingual word recognition. In J. Grainger & A. M. Jacobs (Eds.), *Localist connectionist approaches to human cognition* (pp. 189–225). Mahwah, NJ: Erlbaum.
- Dijkstra, A., & Van Heuven, W. J. B. (2002). The architecture of the bilingual word recognition system: From identification to decision. *Bilingualism: Language and Cognition, 5*(3)*,* 175–197.
- Dijkstra, T. (2005). Bilingual Visual Word Recognition and Lexical Access. In J. F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (p. 179–201). Oxford University Press.
- Dijkstra, T., Grainger, J., & van Heuven, W. J. B. (1999). Recognition of cognates and interlingual homographs: The neglected role of phonology. *Journal of Memory and Language, 41*(4), 496–518. DOI: https://doi.org/10.1017/S1366728902003012
- Dijkstra, T., Van Jaarsveld, H., & Ten Brinke, S. (1998). Interlingual homograph recognition: Effects of task demands and language intermixing. *Bilingualism: Language and Cognition, 1*(1), 51–66. DOI: 10.1017/S1366728998000121
- Doctor, E., & Klein, D. (1992). Phonological processing in bilingual word recognition. In R. Harris (Ed.), *Cognitive processing in bilinguals* (pp. 237–252). Amsterdam: Elsevier.
- Duncan, H. D., Nikelski, J., Pilon, R., Steffener, J., Chertkow, H., & Phillips, N. A. (2018). Structural brain differences between monolingual and multilingual patients with mild cognitive impairment and Alzheimer disease: Evidence for cognitive reserve. *Neuropsychologia, 109*, 270–282. DOI: https://doi.org/10.1016/j.neuropsychologia.2017.12.036
- Ecke, P. (2004). Words on the tip of the tongue: A study of lexical retrieval failures in Spanish speakers of the southwestern US and northern Mexico. *Southwest Journal of Psycholinguistics, 23*(2), 33–63.
- Ferreira, V. S., & Griffin, Z. M. (2003). Phonological influences on lexical (MIS) selection. *Psychological Science, 14*(1), 86–90. DOI: https://doi.org/10.1111/1467-9280.01424
- Flege, J. E., MacKay, I. A., & Piske, T. (2002). Assessing bilingual dominance. *Applied Psycholinguistics, 23*, 567–598. DOI: 10.1017.S0142716402004046
- Flege, J. E., Yeni-Komishian, G. H., & Liu, S. (1999). Age constraints on second-language acquisition. *Journal of Memory and Language, 41*, 78–104.
- Gollan, T. H., & Acenas, L. A. (2004). What is a TOT? Cognate and translation effects on tip-of-the-tongue states in Spanish-English and Tagalog-English bilinguals.

Journal of Experimental Psychology: Learning, Memory, & Cognition, 30(1), 246–269. https://doi.org/10.1037/0278-7393.30.1.246

- Gollan, T. H., Ferreira, V. S., Cera, C., Flett, S. (2014). Translation-priming effects on tip-of-the-tongue states. *Language, Cognition and Neuroscience, 29*(3), 274-288. DOI: https://doi.org/10.1080/01690965.2012.762457
- Gollan, T. H., & Kroll, J. (2001). Bilingual lexical access. In B. Rapp (Ed.), *The handbook of cognitive neuropsychology: What deficits reveal about the human mind* (pp. 321–345). Philadelphia, PA: Psychology Press.
- Gollan, T. H., Montoya, R. I., & Bonanni, M. P. (2005). Proper names get stuck on bilingual and monolingual speakers' tip of the tongue equally often. *Neuropsychology, 19*(3), 278-287. DOI: 10.1037/0894-4105.19.3.278
- Gollan, T. H., Montoya, R. I., Cera, C., & Sandoval, T. C. (2008). More use almost always means a smaller frequency effect: Aging, bilingualism, and the weaker links hypothesis. *Journal of Memory and Language, 58*, 787-814. DOI: 10.1016/j.jml.2007.07.001
- Gollan, T. H., Montoya, R. I., Fennema-Notestine, C., & Morris, S. K. (2005). Bilingualism affects picture naming but not picture classification. *Memory & Cognition, 33*(7), 1220–1234. DOI: https://doi.org/10.3758/BF03193224
- Gollan T. H., Slattery T. J., Goldenberg D., van Assche E., Duyck W., & Rayner K. (2011). Frequency drives lexical access in reading but not in speaking: The frequency-lag hypothesis. *Journal of Experimental Psychology: General, 140*(2), 186–209. DOI: https://doi.org/10.1037/a0022256
- Green, D. W. (1998). Mental control of the bilingual lexico-semantic system. Bilingualism: Language and Cognition, 1, 67-81.
- Green, D. W. & Abutalebi, J. (2013). Language Control in Bilinguals: The Adaptive Control Hypothesis. *Journal of Cognitive Psychology, 25*(5), 515–530. https://doi.org/10.1080/ 20445911.2013.796377
- Griffin, Z. M. & Bock, K. (1998). Constrain, word frequency, and the relationship between lexical processing levels in spoken word production. Journal of Memory and Language, 38(3), 313-338. DOI: https://doi.org/10.1006/jmla.1997.2547
- Guevara, Emiliano Raul (2010). NoWaC: a large web-based corpus for Norwegian. In *Proceedings of the NAACL HLT 2010 Sixth Web as Corpus Workshop*, Association for Computational Linguistics, pages 1-7.
- Hanley, J. R., & Chapman, E. (2008). Partial knowledge in a tip of the tongue state about two and three word proper names. *Psychonomic Bulletin & Review, 15*(1), 156–160. DOI: https://doi.org/10.3758/PBR.15.1.156
- Hanly, S., & Vandenberg, B. (2010). Tip-of-the-tongue and word retrieval deficits in dyslexia. *Journal of Learning Disabilities, 43*(1), 15–23. DOI: https://doi.org/10.1177/0022219409338744
- Heine, M. K., Ober, B. A., & Shenaut, G. K. (1999). Naturally occurring and experimentally induced tip-of-the-tongue experiences in three adult age groups. *Psychology and Aging, 14*, 445–457.
- Hermans D., Bongaerts T., De Bot K., & Schreuder R. (1998) Producing words in a foreign language: Can speakers prevent interference from their first language?

Bilingualism: Language and Cognition, 1(3), 213–230. DOI: https://doi.org/10.1017/S1366728998000364

- Hoff, E., Core, C., Place, S., Rumiche, R., Señor, M., & Parra, M. (2012). Dual language exposure and early bilingual development. *Journal of child language*, *39*(1), 1. DOI: 10.1017/S0305000910000759
- Hoshino N., & Kroll J. (2008). Cognate effects in picture naming: Does cross-language activation survive a change of script? *Cognition, 106*(1), 501–511. DOI: https://doi.org/10.1016/j.cognition.2007.02.001
- Hyltenstam, K., & Abrahamsson, N. (2003). Maturational constraints in SLA. In C. J. Doughty & M. H. Long (Eds.), Handbook of second language acquisition (pp. 539–588). Malden, MA: Blackwell.
- Ivanova I. & Costa A. (2008) Does the bilingualism hamper lexical access in speech production? *Acta Psychologica. 127*(2), 277–288. DOI: https://doi.org/10.1016/j.actpsy.2007.06.003
- James, L. E., & Burke, D. M. (2000). Tip of the tongue, phonological priming and aging. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 26*(6), 1378–1391. DOI: https://doi.org/10.1037/0278-7393.26.6.1378
- Jia, G., Aaronson, D., & Wu, Y. (2002). Long-term language attainment of bilingual immigrants: Predictive variables and language group differences. *Applied Psycholinguistics, 23*, 599–621. DOI: 10.1017.S0142716402004058
- Johnson, J. S., & Newport, E. L. (1989). Critical period effects in second language learning: The influence of maturational state on the acquisition of English as a second language. *Cognitive Psychology, 21*(1), 60–99. DOI: https://doi.org/10.1016/0010-0285(89)90003-0
- Jones, G. V. (1989). Back to Woodworth: Role of interlopers in the tip-of-the-tongue phenomenon. *Memory and Cognition, 17(1)*, 69–76. DOI: https://doi.org/10.3758/BF03199558
- Kroll, J. F, Bobb, S. C., Misra, M., & Guo, T. (2008). Language selection in bilingual speech: Evidence for inhibitory processes. *Acta Psychologica, 128*(3), 416-430. DOI: https://doi.org/10.1016/j.actpsy.2008.02.001
- Kroll, J. F., Bobb, S. C., & Wodniecka, Z. (2006). Language selectivity is the exception, not the rule: Arguments against a fixed locus of language selection in bilingual speech. *Bilingualism: Language and Cognition 9*(2), 119-135. DOI: 10.1017/S1366728906002483
- Kroll, J. F., & de Groot, A. M. B. (1997). Lexical and conceptual memory in the bilingual: Mapping form to meaning in two languages. In A. de Groot & J. Kroll (Eds.), *Tutorials in bilingualism: Psycholinguistic perspectives* (pp. 169–199). Mahwah, NJ: Erlbaum.
- Kroll, J. F., & Gollan, T. H. (2014). Speech planning in two languages: What bilinguals tell us about language production. In M. Goldrick, V. Ferreira, & M. Miozzo (Eds.), *Oxford library of psychology. The Oxford handbook of language production* (p. 165–181). Oxford University Press.
- Kroll, J. F., & Stewart, E. (1994). Category interference in translation and picture naming: Evidence for asymmetric connections between bilingual memory

representations. *Journal of Memory and Language, 33*(2), 149–174. DOI: https://doi.org/10.1006/jmla.1994.1008

- Kroll, J. F. & Tokowicz, N. (2005). Models of Bilingual Representation and Processing. In J. F. Kroll & A. M. B. de Groot (Eds.), *Handbook of bilingualism: Psycholinguistic approaches* (p. 531–553). Oxford University Press.
- Kroll, J. F., Van hell J., Tokowicz N., & Green D. (2010). *The revised hierarchical model: a critical review and assessment. Bilingualism*, *13*, 373-381.
- Levelt, W. J. M. (1989). *Speaking: From intention to articulation.* Cambridge, MA: MIT Press.
- Levelt, W. J. M., Roelofs, A., & Meyer, A. S. (1999). A theory of lexical access in speech production. *Behavioral and Brain Sciences, 22,* 1–75. DOI: 10.1017/S0140525X99001776.
- Lijewska, A. (2020). Cognate Processing Effects in Bilingual Lexical Access. In R. Heredia & A. Cieślicka (Eds.), *Bilingual Lexical Ambiguity Resolution* (pp. 71-95). Cambridge: Cambridge University Press. DOI: https://doi.org/10.1017/9781316535967.005
- MacKay, D. G., & Burke, D. M. (1990). Cognition and aging: A theory of new learning and the use of old connections. In T. M. Hess (Ed.), *Aging and cognition: Knowledge organization and utilization* (pp. 213–263). Amsterdam: North-Holland. DOI: https://doi.org/10.1016/S0166-4115(08)60159-4
- Marian, V., Blumenfeld, H. K., & Kaushanskaya, M. (2007). The Language Experience and Proficiency Questionnaire (LEAP-Q): Assessing Language Profiles in Bilinguals and Multilinguals. *Journal of Speech, Language, and Hearing Research, 50*, 940-967. DOI: https://doi.org/10.1044/1092-4388(2007/067)
- Marian, V., & Spivey, M. (2003). Competing activation in bilingual language processing. *Bilingualism: Language and Cognition, 6*(2)*,* 97–115. DOI: 10.1017/S1366728903001068
- McDonald, J. L. (2000). Grammaticality judgments in a second language: Influences of age of acquisition and native language. *Applied Psycholinguistics, 21(3)*, 395–423. DOI: https://doi.org/10.1017/S0142716400003064
- Meuter, R. F. I., & Allport, A. (1999). Bilingual language switching in naming: Asymmetrical costs of language
- Meyer, A., & Bock, K. (1992). The tip-of-the-tongue phenomenon: Blocking or partial activation? *Memory & Cognition, 20,* 715–726. DOI: https://doi.org/10.3758/BF03202721
- Myers-Scotton, C. (2005). Multiple voices: An introduction to bilingualism (1st ed.). Oxford: Wiley-Blackwell.
- Nilsen, T. S. (2010). *English Pronunciation and Intonation: British, American and World Englishes* (3rd ed.). Universitetsforlaget.
- Peterson, R. R., & Savoy, P. (1998). Lexical selection and phonological encoding during language production: *Evidence for cascaded processing. Journal of Experimental Psychology: Learning, Memory, and Cognition, 24*(3), 539-557.
- Philipp, A., & Koch, I. (2009). Inhibition in language switching: What is inhibited when switching among languages in naming tasks? *Journal of Experimental*

Psychology: Learning, Memory, and Cognition, 35(5), 1187–1195. DOI: https://doi.org/10.1037/a0016376

- Pitt, M. A., & Samuel, A. G. (2006). Word length and lexical activation: Longer is better. *Journal of Experimental Psychology: Human Perception and Performance*, *32(5)*, 1120–1135.
- Poarch, G., & van Hell, J. (2012) Cross-language activation in children's speech production: Evi-dence from second language learners, bilinguals, and trilinguals. *Journal of Experimental Child Psychology, 111*(3), 419–438. DOI: https://doi.org/10.1016/j.jecp.2011.09.008
- Portocarrero, J. S., Burright, R. G., & Donovick, P. J. (2007). Vocabulary and verbal fluency of bilingual and monolingual college students. *Archives of Clinical Neuropsychology, 22*(3), 415–422. DOI: https://doi.org/10.1016/j.acn.2007.01.015
- Poulisse, N., & Bongaerts, T. (1994). First language use in second language production. *Applied Linguistics, 15*(1), 36–57.
- Prior, A. & Gollan, T. H. (2011). Good Language-Switchers are Good-Task-Switchers: Evidence from Spanish-English and Mandarin-English Bilinguals. *Journal of the International Neuropsychological Society, 17*, 682-691. DOI: 10.1017/S1355617711000580
- Pureza, R., Soares, A. P., & Comesaña, M. (2013). Syllabic pseudohomophone priming in tip-of-the-tongue states resolution: The role of syllabic position and number of syllables. *Quarterly Journal of Experimental Psychology*, *66(5)*, 910–26.
- Pureza, R., Soares, A. P., & Comesaña, M. (2016). Cognate status, syllable position and word length on bilingual tip-of-the-tongue states induction and resolution. *Bilingualism: Language and Cognition, 19*(3), 533-549. DOI: 10.1017/S1366728915000206
- Pyers, J. E., Gollan, T. H., & Emmorey, K. (2009). Bimodal bilinguals reveal the source of tip-of-the-tongue states. *Cognition, 112*, 323-329. DOI: 10.1016/j.cognition.2009.04.007
- Rapp, B., & Goldrick, M. (2000). Discreteness and interactivity in spoken word production. *Psychological Review, 107*(3)*,* 460-499. DOI: https://doi.org/10.1037/0033-295X.107.3.460
- Roelofs, A. (1998). Lemma selection without inhibition of languages in bilingual speakers. *Bilingualism: Language and Cognition, 1*(2), 94–95. DOI: https://doi.org/10.1017/S1366728998000194
- Santesteban, M., & Schwieter, J. (2020). Lexical Selection and Competition in Bilinguals. In R. Heredia & A. Cieślicka (Eds.), *Bilingual Lexical Ambiguity Resolution* (pp. 126-156). Cambridge: Cambridge University Press. DOI: 10.1017/9781316535967.007
- Schwartz, B. L. (2006). Tip-of-the-tongue states as metacognition. *Metacognition and Learning, 1*(2), 149–158. DOI: 10.1007/s11409-006-9583-z
- Schwartz, B. L., & Frazier, L. D. (2005). Tip-of-the-tongue states and aging: Contrasting psycholinguistic and metacognitive perspectives. *The Journal of General Psychology, 132*(4), 377–391. DOI: https://doi.org/10.3200/GENP.132.4.377-391 selection. *Journal of Memory and Language, 40*(1), 25–40.

- Semenza, C. (1997). Proper-name-specific aphasias. In H. Goodglass & A. Wingfield (Eds.), *Anomia: Neuroanatomical and cognitive correlates* (pp. 115–134). San Diego, CA: Academic Press. DOI: https://doi.org/10.1016/B978-012289685-9/50008-9
- Semenza, C. & Zettin, M. (1989). Evidence from aphasia for the role of proper names as pure referring expressions. *Nature, 342*, 678–679. DOI: https://doi.org/10.1038/342678a0
- Simner, J., & Ward, J. (2006). The taste of words on the tip of the tongue. *Nature, 444*(7118), 438–438. DOI: https://doi.org/10.1038/444438a
- Strijkers, K., Costa, A., & Thierry, G. (2010). Tracking lexical access in speech production: Electrophysiological correlates of word frequency and cognate effects. *Cerebral Cortex, 20*(4), 912–928. DOI: https://doi.org/10.1093/cercor/bhp153
- Thompson, R., Emmorey, K., & Gollan, T. (2005). Tip-of-the-fingers experiences by ASL signers: Insights into the organization of a sign-based lexicon. *Psychological Science, 16*(11), 856–860. DOI: https://doi.org/10.1111/j.1467-9280.2005.01626.x
- Timmer, K., Calabria, M., & Costa, A. (2019). Non-linguistic effects of language switching training. *Cognition, 182*, 14-24. DOI: https://doi.org/10.1016/j.cognition.2018.09.001
- Vaid, J., & Menon, R. (2000). Correlates of bilinguals' preferred language for mental computations. *Spanish Applied Linguistics, 4*, 325–342.
- Van Assche, E., Duyck, W., & Hartsuiker, R. J. (2012). Bilingual word recognition in a sentence context. *Frontiers in Psychology, 3*, 174. DOI: https://doi.org/10.3389/fpsyg.2012.00174
- Van Hell, J. G., & Dijkstra, T. (2002). Foreign language knowledge can influence native language performance in exclusively native contexts. *Psychonomic Bulletin & Review, 9*(4), 780–789. DOI: https://doi.org/10.3758/BF03196335
- Van Heuven, W.J.B., Mandera, P., Keuleers, E., & Brysbaert, M. (2014). Subtlex-UK: A new and improved word frequency database for British English. *Quarterly Journal of Experimental Psychology, 67*, 1176-1190
- Vikør, Lars S., (2009). Norsk. In *Store norske leksikon*. Retrieved from https://snl.no/norsk
- Weber-Fox, C., & Neville, H. J. (1999). Functional neural subsystems are differentially affected by delays in 2nd language immersion. In D. Birdsong (Ed.), Second language acquisition and the critical period hypothesis (pp. 23–38). Mahwah, NJ: Erlbaum.

Appendices

Appendix A: Amended Version of the LEAP-Q

1. Screening Questions

REMEMBER TO 'SAVE AS' Y + SUBJECT NUMBER (E.G., Pp_01) FIRST!!

General note: cells are locked to prevent formula being changed (you can unlock if necessary by removing the worksheet protection).

Participant number: | **Date of testing:**

SCREENING QUESTIONNAIRE

Experimenter: Ask participant the following questions and fill in the yellow boxes with their responses.

1	What is your age? (in years)		
2	What is your gender?		
3	Are you a native speaker of Norwegian?		
4	Is Norwegian the only language you speak at home (aside from English)?	*If no, please specify other home language*	
5	Are you a reasonably good speaker of English?		
6	Do you have normal vision or vision that is corrected to normal with glasses or contact lenses?		
7	Can you confirm that you have no language impairments such as dyslexia, stuttering etc.?		
8	Do you have normal hearing or hearing that is corrected to normal?		
9	Are you left or right handed?		
10	What is your country of birth?		
11	What is your current country of residence?		
12	How many years of education do you have?		
13	What is the highest education level you have? (Select from the drop-down options)	*If other, please specify*	
14	Have you participated in any experiments here before?		

2. LANGUAGE BACKGROUND

Participant: please answer these questions below about the different languages you speak.
Please fill in your responses in the appropriate yellow boxes, and ask the experimenter if you have any questions.

Q1 Please list all the languages you speak in order of DOMINANCE (up to 5).

1	
2	
3	
4	
5	

Q2 Please list all the languages you speak in order of ACQUISITION (up to 5).

1	
2	
3	
4	
5	

Q3 Please list what percentage of the time you are on average exposed to each language (e.g. exposure in terms of talking, listening, and reading, including TV, films and music).
(All your answers should add up to 100%)

	Language	%
1		
2		
3		
4		
5		
	Total:	0

Please make sure your answer adds up to 100%

Q4 Please list what percentage of the time you spend speaking each language.
(All your answers should add up to 100%)

	Language	%
1		
2		
3		
4		
5		
	Total:	0

Please make sure your answer adds up to 100%

Q5 Please list what percentage of the time you typically spend reading in each language.
(All your answers should add up to 100%)

	Language	%
1		
2		
3		
4		
5		
	Total:	0

Please make sure your answer adds up to 100%

Q6 When choosing a language to speak, with a person who is equally fluent in all your languages, what percentage of time would you choose to speak each language? Please report percentage of total time.
(All your answers should add up to 100%)

	Language	%
1		
2		
3		
4		
5		
	Total:	0

Please make sure your answer adds up to 100%

Q7 What cultures do you identify with (e.g., Norwegian, British, American, etc)? Please list each culture below (up to 5) and use the scale from 0-10 to rate the degree of identification, whereby 0 = no identification, 5 = moderate identification, 10 = complete identification.

	Culture	Identification
1		
2		
3		
4		
5		

Q8 Do you feel that you were once better in one of your languages and that you have become less fluent?

If yes, which one?

And at what age did you become less fluent?

Q9 In which language do you usually do the following tasks?

Task	Language
Simple maths (count, add)	
Dream	
Express anger or affection	
Talk to yourself	

3. NORWEGIAN AND ENGLISH PROFICIENCY

Participant: please answer these questions below about your experience with Norwegian and English.
Please fill in your responses in the appropriate yellow boxes, and ask the experimenter if you have any questions.

Q1 Please list the number of years and months you have spent in each language environment.

	Norwegian		English	
	Years	Months	Years	Months
A country where this language is spoken				
A family where this language is spoken				
A school where this language is spoken ALL of the time				
A school where this language is spoken SOME of the time				
A workplace where this language is spoken ALL of the time				
A workplace where this language is spoken SOME of the time				

Q2 Please rate how much the following factors contributed to your learning of each language on a scale of 0-10 whereby 0 = not a contributor, 5 = moderate contributor and 10 = most important contributor.

	Norwegian	English
Interacting with friends / colleagues		
Interacting with family		
Reading (e.g., books, magazines, online material)		
School and education		
Self-instruction (e.g., language learning videos or apps)		
Watching TV / streaming		
Listening to music/media		

Q3 Please rate to what extent you are currently (e.g. in the last month or so) exposed to each language on a scale of 0-10 whereby 0 = never, 5 = half of the time and 10 = almost always.

	Norwegian	English
Interacting with friends		
Interacting with family		
Reading (e.g., books, magazines, online material)		
Self-instruction (e.g., language learning videos or apps)		
Watching TV / streaming		
Listening to music/media		

Q4 Please rate your level of proficiency in the following aspects of each language on a scale of 0-10 whereby: 0 = none; 1 = very low; 2 = low; 3 = fair; 4 = slightly less than adequate; 5 = adequate; 6 = slightly more than adequate; 7 = good; 8 = very good; 9 = excellent; 10 = perfect.

	Norwegian	English
Speaking (general fluency)		
Pronunciation (accent)		
Listening (understanding spoken language)		
Reading		
Writing		
Grammar		
Vocabulary		
Spelling		

Q5 Please list the AGE (in years) you were when the following occurred for each language.

	Norwegian	English
Started hearing this language on a regular basis		
Became fluent in speaking this language		
Started learning to read in this language		
Became fluent in reading this language		

Q6 Please rate your level of proficiency in switching between your languages when you need to, on a scale of 0-10 whereby: 0 = none; 1 = very low; 2 = low; 3 = fair; 4 = slightly less than adequate; 5 = adequate; 6 = slightly more than adequate; 7 = good; 8 = very good; 9 = excellent; 10 = perfect.

Q7 When you are speaking do you ever find yourself accidentally mixing words or sentences from Norwegian and English?

(a) If yes, how often does English accidentally intrude in your Norwegian on a scale of 0-10 (whereby 0 = never, 5 = half of the time, 10 = all of the time)?

(b) And how often does Norwegian accidentally intrude into your English on a scale of 0-10 (whereby 0 = never, 5 = half of the time, 10 = all of the time)?

Q8 When you are speaking with a person who also knows both Norwegian and English do you ever find yourself intentionally mixing words or sentences from Norwegian and English?

(a) If yes, how often do you intentionally use English words when speaking Norwegian on a scale of 0-10 (whereby 0 = never, 5 = half of the time, 10 = all of the time)?

(b) And how often do you intentionally use Norwegian words when speaking English on a scale of 0-10 (whereby 0 = never, 5 = half of the time, 10 = all of the time)?

END OF QUESTIONNAIRE - THANK YOU FOR YOUR TIME!

Appendix B: Full Stimuli List

Norwegian Stimuli Set 1A

block	trial	item	Condition	List	Lang	Definition	Target	Foil1	Foil2	Foil3	None of the above	Syllables	Phonemes	Letters	NoWac	FreqPM
1	1	25	3	1	1	Etternavnet til den Amerikanske talkshow-vertinnen som sto frem som homofil i 1997 i sitt eget humor-talkshow, kjent for sitt korte blonde hår.	Degeneres	Winfrey	Degrassi	Banks	None of the above	4	9	9	1554	2,22
1	2	5	1	1	1	Læren om forestilte forbindelser mellom himmellegemene og jorden og kunsten å spå fremtidige hendelser og skjebner ut fra stjernenes stilling	astrologi	astronomi	analogi	horoskop	None of the above	4	8	8	1189	1,7
1	3	31	4	1	1	En amerikansk romantisk dramafilm basert på en roman av Nicholas Sparks med Ryan Gosling og Rachel McAdams i hovedrollene.	Dagboken	Titanic	Dagsturen	Inferno		3	8	8	53	0,07
1	4	14	2	1	1	En rot brukt som smakstilsetning i mat og drikke, ofte i frisk, tørket, malt eller syltet form. Blir også brukt til å lindre sår hals og mageproblemer	ingefær	anis	ginseng	lakris	None of the above	3	6	7	1227	1,61
1	5	15	2	1	1	Skål med spiss tut til å ha middagstilbehør av den flytende typen i.	sausenebb	mugge	Flauseredd	øse	None of the above	3	9	9	7	0,01
1	6	29	3	1	1	Den rosa sjøstjernevennen til Svampebob	Patrick	Bleke	Henrik	Sandy	None of the above	2	6	7	5876	8,39
1	7	8	1	1	1	Et dyr i kamelslekten med én pukkel	dromedar	kamel	dromund	gazelle	None of the above	3	8	8	295	0,42
1	8	21	3	1	1	Etternavnet på verdenskjente den britiske BBC naturprogramlederen spesielt kjent for dokumentarene "Our planet" og "Blue Planet".	Attenborough	Irwin	Battenburg	McGraw	None of the above	4	7	12	127	0,18
1	9	35	4	1	1	Den snakkende trefigurvennen til Lillebror i bøkene til Anne-Cath Vestly	Knerten	Karoline	Kvisten	Tretyting	None of the above	2	6	7	896	1,28
1	10	28	3	1	1	Etternavnet til den norske programlederen og komikeren kjent fra blant annet Nytt på Nytt og Side om Side.	Almaas	Tufte	Vesaas	Lyngbø	None of the above	2	5	6	835	1,19
1	11	11	2	1	1	Spredningen av stoffer til luft, vann eller jord som fører til ulempe eller skade på helse eller trivsel for mennesker, dyr og planter	forurensning	utslipp	forutsetning	tilsetning	None of the above	4	10	11	5458	7,8
1	12	34	4	1	1	Havet mellom Europa, Afrika og Asia	Middelhavet	Rødehavet	Alanterhaver	Dødehavet	None of the above	4	10	11	2243	3,49
1	13	9	1	1	1	regler for skikk og bruk i selskapslivet, særlig ved hoffet og i diplomatiet	etikette	manerer	sukett	etymologi	None of the above	4	7	8	252	0,36
1	14	19	2	1	1	Samlebetegnelse på små, buskformede planter i skogen hvor det vokser blant annet blåbær og tyttebær.	lyng	mose	lav	kvae	None of the above	1	3	4	2456	3,5
1	15	4	1	1	1	Gammel, egyptisk bildeskrift	hieroglyf	helleristninger	hiragana	sanskrit	None of the above	3	8	9	101	0,14
1	16	24	3	1	1	Fornavnet til Storbritannias statsminister under andre verdenskrig. Han var kjent for å bruke begrepet "jernteppet" for å referere til delingen av Europa under den kalde krigen	Winston	Chamberlain	Wilson	Windsor	None of the above	2	6	7	1772	2,53
1	17	18	2	1	1	Den hinnen som danner seg på varme, ofte melkeholdige væsker som får stå i ro uten å bli rørt i eller ristet på under nedkjøling	snerk	hinne	skurk	verk	None of the above	1	5	5	104	0,15
1	18	39	4	1	1	Navnet på et stjernemønster som utgjør en del av stjernebildet Store Bjørn	Karlsvogna	Orion	Kavalragnar	Lillebjørn	None of the above	3	9	10	92	0,13
1	19	38	4	1	1	Eselvennen til Ole Brum	Tussi	Kristoffer	Tassen	Tralte	None of the above	2	4	5	399	0,57
1	20	1	1	1	1	Betegnelsen på en person som er nominert av et politisk parti til å representere partiet ved valg	mandat	representant	kandidat	tjenestemann	None of the above	2	6	6	6007	8,58
2	1	10	1	1	1	En maskin som skiller væsker med forskjellig massetetthet eller skiller væske fra faste stoffer ved hjelp av rask rotasjon.	sentrifuge	sentralmål	sugekopp	fugemasse	None of the above	4	10	10	54	0,08
2	2	2	1	1	1	Navnet på luftlaget som omgir jorden	atmosfære	stratosfære	atmometer	ozonlag	None of the above	4	9	9	5385	7,69
2	3	22	3	1	1	Hovedstaden i Portugal.	Lisboa	Porto	Libya	Ankara	None of the above	3	6	6	1804	2,58
2	4	27	3	1	1	Etternavnet til den franske politiske og militære lederen som var keiser av Frankrike fra 1804 til 1814. Han var kjent for sin hvite	Bonaparte	DeGaulle	Beauport	Bernadotte	None of the above	3	8	9	891	1,27
2	5	36	4	1	1	i fuglekassa"	Solan	Mysil	Sonny	Simon	None of the above	2	5	5	450	0,64
2	6	7	1	1	1	En lærling som i religiøs sammenheng ble regnet som en religionsstifters tilhenger. Feks: Jesu 12 tilhengere.	disippel	tilhenger	disiplin	apostel	None of the above	3	7	8	489	0,7
2	7	30	3	1	1	Mowglis bjørnevenn i Jungelboken	Baloo	Shere Kahn	Balto	Kaa	None of the above	2	4	5	57	0,08
2	8	17	2	1	1	Et støtteapparat eller stativ til å holde bilder eller annet flatt materiale stødig, særlig under arbeid med malerier	staffeli	canvas	stafett	stimuli	None of the above	3	6	7	62	0,09
2	9	23	3	1	1	Etternavnet til den kanadiske skuespilleren kjent for roller i filmer som "Deadpool", "The Proposal" or "Detective Pikachu".	Reynolds	Gosling	Randalls	Harris	None of the above	2	7	8	961	1,34
2	10	16	2	1	1	En tynn treskive som en kunstmaler bruker til å blande og tynne ut malerfarger på	palett	skala	paljett	polet	None of the above	2	5	6	314	0,45
2	11	37	4	1	1	Norsk stop-motionfilm om Reodor Felgen, hans venner og byggingen av II Tempo Gigante	Flåklypa	Biler	Flokern	Rotfløyta	None of the above	3	8	8	536	0,77
2	12	40	4	1	1	Prinsessen som sov i hundre år etter å ha stukket seg i fingeren på en rokk	Tornerose	Snøhvit	Rapunzel	Ariel	None of the above	3	8	9	556	0,79
2	13	3	1	1	1	Betegnelsen på en større gruppe instrumentalmusikere (inkludert strykere, blåseinstrumenter, og slagverk), vanligvis innenfor klassisk musikk	orkester	korps	orkan	band	None of the above	3	8	8	2799	4
2	14	12	2	1	1	Stramt plagg til å bruke omkring anklene for å forhindre for eksempel å få snø i skoen.	gamasjer	anklets	masjete	pulsvanter	None of the above	3	6	7	69	0,09
2	15	26	3	1	1	Fornavnet til broren til Gaus og Roms Dal Fra NRK-serien Brødrene Dal	Brumund	Nitte	Bernard	Gudbrand	None of the above	2	6	7	67	0,1
2	16	20	2	1	1	Frontlokket på en bil	panser	dashbord	pinsett	støtfanger	None of the above	2	6	6	620	0,89
2	17	32	4	1	1	Fornavnet på barnebok-karakter som er kjent for bo sammen med faren sin og fantasivennen, Skybert	Albert	Åge	Alfred	Petter	None of the above	2	5	6	5198	7,42
2	18	33	4	1	1	Navnet på Disneyfilmen om den skotske prinsessen Merida	Modig	Rømmen	Mathilda	Havfruen	None of the above	2	4	5	146	0,2
2	19	13	2	1	1	Betegnelse på fiskeegg	rogn	kaviar	tegn	selje	None of the above	1	3	4	998	1,42
2	20	6	1	1	1	En sykkel laget for mer enn én person hvor man sitter etter hverandre	tandemsykkel	trehjulssykkel	tannhjulsykkel	terrengsykkel	None of the above	4	11	12	39	0,06

Norwegian Stimuli Set 1B

block	trial	item	Condition	List	Lang	Definition	Target	Foil1	Foil2	Foil3	None of the above	Syllables	Phonemes	Letters	NoWac	FreqPM
1	1	10	1	1	1	En maskin som skiller væsker med forskjellig massetetthet eller skiller væske fra faste stoffer ved hjelp av rask rotasjon.	sentrifuge	sentralmål	sugekopp	fugemasse	None of the above	4	10	10	54	0,08
1	2	2	1	1	1	Navnet på luftlaget som omgir jorden	atmosfære	stratosfære	atmometer	ozonlag	None of the above	4	9	9	5385	7,69
1	3	22	3	1	1	Hovedstaden i Portugal.	Lisboa	Porto	Libya	Ankara	None of the above	3	6	6	1804	2,58
1	4	27	3	1	1	Etternavnet til den franske politiske og militære lederen som var keiser av Frankrike fra 1804 til 1814. Han var kjent for	Bonaparte	DeGaulle	Beauport	Bernadotte	None of the above	3	8	9	891	1,27
1	5	36	4	1	1	baklengs inn i fuglekassa"	Solan	Mysil	Sonny	Simon	None of the above	2	5	5	450	0,64
1	6	7	1	1	1	En lærling som i religiøs sammenheng ble regnet som en religionsstifters tilhenger. Feks: Jesu 12 tilhengere.	disippel	tilhenger	disiplin	apostel	None of the above	3	7	8	489	0,7
1	7	30	3	1	1	Mowglis bjørnevenn i Jungelboken	Baloo	ShereKahn	Balto	Kaa	None of the above	2	4	5	57	0,08
1	8	17	2	1	1	Et støtteapparat eller stativ til å holde bilder eller annet flatt materiale stødig, særlig under arbeid med malerier	staffeli	canvas	stafett	stimuli	None of the above	3	6	7	62	0,09
1	9	23	3	1	1	Etternavnet til den kanadiske skuespilleren kjent for roller i filmer som "Deadpool", "The Proposal" or "Detective Pikachu".	Reynolds	Gosling	Randalls	Harris	None of the above	2	7	8	961	1,34
1	10	16	2	1	1	En tynn treskive som en kunstmaler bruker til å blande og tynne ut malerfarger på	palett	skala	paljett	polet	None of the above	2	5	6	314	0,45
1	11	37	4	1	1	Norsk stop-motionfilm om Reodor Felgen, hans venner og byggingen av Il Tempo Gigante	Flåklypa	Biler	Flokern	Rotfløyta	None of the above	3	8	8	536	0,77
1	12	40	4	1	1	Prinsessen som sov i hundre år etter å ha stukket seg i fingeren på en rokk	Tornerose	Snøhvit	Rapunzel	Ariel	None of the above	3	8	9	556	0,79
1	13	3	1	1	1	Betegnelsen på en større gruppe instrumentalmusikere (inkludert strykere, blåseinstrumenter, og slagverk), vanligvis innenfor klassisk musikk	orkester	korps	orkan	band	None of the above	3	8	8	2799	4
1	14	12	2	1	1	Stramt plagg til å bruke omkring anklene for å forhindre for eksempel å få snø i skoen.	gamasjer	anklets	masjete	pulsvanter	None of the above	3	6	7	69	0,09
1	15	26	3	1	1	Fornavnet til broren til Gaus og Roms Dal Fra NRK-serien Brødrene Dal	Brumund	Nitte	Bernard	Gudbrand	None of the above	2	6	7	67	0,1
1	16	20	2	1	1	Frontlokket på en bil	panser	dashbord	pinsett	støtfanger	None of the above	2	6	6	620	0,89
1	17	32	4	1	1	Fornavnet på barnebok-karakter som er kjent for bo sammen med faren sin og fantasivennen, Skybert	Albert	Åge	Alfred	Petter	None of the above	2	5	6	5198	7,42
1	18	33	4	1	1	Navnet på Disneyfilmen om den skotske prinsessen Merida	Modig	Rømmen	Mathilda	Havfruen	None of the above	2	4	5	146	0,2
1	19	13	2	1	1	Betegnelse på fiskeegg	rogn	kaviar	tegn	selje	None of the above	1	3	4	998	1,42
1	20	6	1	1	1	En sykkel laget for mer enn én person hvor man sitter etter hverandre	tandemsykkel	trehjulssykkel	tannhjulsykkel	terrengsykkel	None of the above	4	11	12	39	0,06
2	1	25	3	1	1	Etternavnet til den Amerikanske talkshow-vertinnen som sto frem som homofil i 1997 i sitt eget humor-talkshow, kjent for sitt korte blonde hår.	Degeneres	Winfrey	Degrassi	Banks	None of the above	4	9	9	1554	2,22
2	2	5	1	1	1	Læren om forestilte forbindelser mellom himmellegemene og jorden og kunsten å spå fremtidige hendelser og skjebner ut fra stjernenes stilling	astrologi	astronomi	analogi	horoskop	None of the above	4	8	8	1189	1,7
2	3	31	4	1	1	hovedrollene.	Dagboken	Titanic	Dagsturen	Inferno		3	8	8	53	0,07
2	4	14	2	1	1	En rot brukt som smakstilsetning i mat og drikke, ofte i frisk, tørket, malt eller syltet form. Blir også brukt til å lindre sår hals og mageproblemer	ingefær	anis	ginseng	lakris	None of the above	3	6	7	1227	1,61
2	5	15	2	1	1	Skål med spiss tut til å ha middagstilbehør av den flytende typen i.	sausenebb	mugge	Flauseredd	øse	None of the above	3	9	9	7	0,01
2	6	29	3	1	1	Den rosa sjøstjernevennen til Svampebob	Patrick	Bleke	Henrik	Sandy	None of the above	2	6	7	5876	8,39
2	7	8	1	1	1	Et dyr i kamelslekten med én pukkel	dromedar	kamel	dromund	gazelle	None of the above	3	8	8	295	0,42
2	8	21	3	1	1	Etternavnet på verdenskjente den britiske BBC naturprogramlederen spesielt kjent for dokumentarene "Our planet" og "Blue Planet".	Attenborough	Irwin	Battenburg	McGraw	None of the above	4	7	12	127	0,18
2	9	35	4	1	1	Den snakkende trefigurvennen til Lillebror i bøkene til Anne-Cath Vestly	Knerten	Karoline	Kvisten	Tretyting	None of the above	2	6	7	896	1,28
2	10	28	3	1	1	Etternavnet til den norske programlederen og komikeren kjent fra blant annet Nytt på Nytt og Side om Side.	Almaas	Tufte	Vesaas	Lyngbø	None of the above	2	5	6	835	1,19
2	11	11	2	1	1	Spredningen av stoffer til luft, vann eller jord som fører til ulempe eller skade på helse eller trivsel for mennesker, dyr og planter	forurensning	utslipp	forutsetning	tilsetning	None of the above	4	10	11	5458	7,8
2	12	34	4	1	1	Havet mellom Europa, Afrika og Asia	Middelhavet	Rødehavet	Alanterhaver	Dødehavet	None of the above	4	10	11	2243	3,49
2	13	9	1	1	1	regler for skikk og bruk i selskapslivet, særlig ved hoffet og i diplomatiet	etikette	manerer	sukett	etymologi	None of the above	4	7	8	252	0,36
2	14	19	2	1	1	Samlebetegnelse på små, buskformede planter i skogen hvor det vokser blant annet blåbær og tyttebær.	lyng	mose	lav	kvae	None of the above	1	3	4	2456	3,5
2	15	4	1	1	1	Gammel, egyptisk bildeskrift	hieroglyf	helleristninger	hiragana	sanskrit	None of the above	3	8	9	101	0,14
2	16	24	3	1	1	Fornavnet til Storbritannias statsminister under andre verdenskrig. Han var kjent for å bruke begrepet "jernteppet" for å referere til delingen av Europa under den kalde krigen	Winston	Chamberlain	Wilson	Windsor	None of the above	2	6	7	1772	2,53
2	17	18	2	1	1	Den hinnen som danner seg på varme, ofte melkeholdige væsker som får stå i ro uten å bli rørt i eller ristet på under nedkjøling	snerk	hinne	skurk	verk	None of the above	1	5	5	104	0,15
2	18	39	4	1	1	Navnet på et stjernemønster som utgjør en del av stjernebildet Store Bjørn	Karlsvogna	Orion	Kavalragnar	Lillebjørn	None of the above	3	9	10	92	0,13
2	19	38	4	1	1	Eselvennen til Ole Brum	Tussi	Kristoffer	Tassen	Tralte	None of the above	2	4	5	399	0,57
2	20	1	1	1	1	Betegnelsen på en person som er nominert av et politisk parti til å representere partiet ved valg	mandat	representant	kandidat	tjenestemann	None of the above	2	6	6	6007	8,58

Norwegian Stimuli Set 2A

block	trial	Condition	List	Lang	Definition	Target	Foil1	Foil2	Foil3	None of the above	Syllables	Phonemes	Letters	NoWac	FreqPM
1	1	3	2	1	Panteren som finner og redder Mowgli i Jungelboken	Bagheera	Akela	Balenciaga	Scar	None of the above	3	6	8	27	0,04
1	2	2	2	1	Indisk krydder i pulverform med sterk gulfarge, som for mange er billigversjonen av safran	gurkemeie	karri	ginseng	enebær	None of the above	4	8	9	227	0,32
1	3	1	2	1	Årlig kalender som utgis i bokform og innerholder informasjon om et eller flere emner for de ulike dagene	almanakk	notisbok	anorakk	almisse	None of the above	3	7	8	91	0,13
1	4	4	2	1	Den første boka i Suzanne Collins triologi om Katniss Everdeen og Peeta Mellark	Dødslekene	Panem	Dødslagene	Konkurransen	None of the above	4	10	10	20	0,02
1	5	3	2	1	Etternavnet til den britiske forfatteren som særlig er kjent for å ha skrevet Ringenes herre-trilogien og Hobbiten	Tolkien	Rowling	Token	Meyer	None of the above	2	7	7	638	0,91
1	6	4	2	1	Tegneseriefiguren som blir sterk av å spise spinat	Skippern	Stomperud	Skoppum	Kipster	None of the above	2	6	8	115	0,16
1	7	3	2	1	Fornavnet til Tysklands forbundskansler (statsminister)	Angela	Erna	Angelika	Heidi	None of the above	3	6	6	1727	2,47
1	8	4	2	1	Barnebokkarakter kledd i blå bukse,briller og rød og hvit-stripet genser og lue som er gjemt på boksidene	Willy	Frans	Waldo	Finn	None of the above	2	4	5	4450	6,36
1	9	4	2	1	Jordklodens største hav, som dekker nesten en tredjedel av jordens overflate	Stillehavet	Atlanterhavet	Stormhavet	Indiahavet	None of the above	4	10	11	1940	2,77
1	10	1	2	1	Fransk gjenstand tidligere brukt til å utføre henrettelse av dødsdømte ved halshogging	giljotin	bøddel	gelatin	bue	None of the above	3	8	8	44	0,06
1	11	2	2	1	Svært produktive økosystemer i havet bygd opp av kalksjeletter, som er kjent for sine rike og varierte dyreliv. Verdens største ligger utenfor østkysten av Australia	korallrev	anemone	kalkrev	krystall	None of the above	3	8	9	827	1,18
1	12	3	2	1	Etternavnet til den unge svenske klimaaktivisten og skoleeleven som ble kjent da hun satt utenfor Riksdagshuset i Stockholm med plakaten «Skolstrejk för klimatet»	Thunberg	Ernman	Tumkrans	Andersson	None of the above	2	7	8	69	0,1
1	13	2	2	1	Små guloransje bær som vokser i høyfjellet, regnet som en delikatesse.	molte	krekling	svartsurbær	aronia	None of the above	2	5	5	123	0,18
1	14	3	2	1	Etternavnet til Sherlock Holmes' venn, assistent og biograf	Watson	John	Watergate	Philips	None of the above	2	6	6	2166	3,09
1	15	4	2	1	Lilla spøkelse fra Mummidalen	Hufsa	Hattifnatten	Hufflepuff	Casper	None of the above	2	5	5	62	0,09
1	16	1	2	1	Behandlingen av et lik med urter for å forhindre at det råtner. Spesielt kjent fra det gamle Egypt.	balsamering	konservering	balsamine	kremering	None of the above	4	10	11	33	0,04
1	17	1	2	1	En latterliggjørende etterligning hvor man gjør narr av originalen, men som er mindre kritiserende enn satire	parodi	herming	melodi	ironi	None of the above	3	6	6	2084	2,98
1	18	2	2	1	Fremkomstmiddel som ligner på en stol med skinner som brukes på is og hardpakket snø	spark	kjelke	spor	slede	None of the above	1	5	5	5824	8,32
1	19	1	2	1	En vedvarende vekst i det generelle prisnivået som resulterer i et fall i verdien av penger	inflasjon	priskrig	inkubasjon	infiltrering	None of the above	3	8	9	5477	7,82
1	20	2	2	1	En utendørs solskjerm som kan rulles opp og ned	markise	persienne	marsjandise	verandadør	None of the above	3	7	7	124	0,18
2	1	1	2	1	Et plagg som benyttes for å gi overkroppen en ønsket form av estetiske eller medisinske grunner (enten mens det bæres eller med mer varig virkning)	korsett	midje	mansjett	akvedukt	None of the above	2	5	7	285	0,41
2	2	1	2	1	En gjenkallelig viljeserklæring hvor en person bestemmer fordelingen av sin formue etter sin død	testament	arv	arrangement	miljø	None of the above	3	9	9	2490	1,63
2	3	4	2	1	Fornavnet til det pessimistiske pinnsvinet i Flåklypa, kjent for frasen "Det er farlig det"	Ludvig	Reodor	Lukas	Molo	None of the above	2	6	6	3542	5,06
2	4	4	2	1	Hjemstedet til Ole Brum og vennene hans	Hundremetersk	Bøkeskogen	Hakkebakkeskoge	Sherwoodskogen	None of the above	6	17	17	159	0,22
2	5	2	2	1	Det største medlemmet av mårfamilien, som kan ligne en liten bjørn i fargen og den kraftige kroppsbygning	jerv	grevling	ulv	oter	None of the above	1	4	4	2866	4,09
2	6	3	2	1	Etternavnet til Donald Trumps visepresident	Pence	Nickle	Spencer	Johnson	None of the above	1	4	5	67	0,1
2	7	2	2	1	Fotstykke på vinglass.	stett	kropp	stativ	krakk	None of the above	1	4	5	70	0,1
2	8	2	2	1	Typisk materiale brukt til emballering av takeaway-mat og elektronikkartikler	isopor	papp	isotop	plastikk	None of the above	3	6	6	472	0,67
2	9	3	2	1	Etternavnet til Norges første kvinnelige statsminister	Bruntland	Solberg	Brunstad	Jensen	None of the above	2	8	10	3332	4,76
2	10	3	2	1	Etternavnet til den italienske politikeren som grunnla fascismen	Mussolini	Fanco	Missouri	Rossi	None of the above	4	8	9	1188	1,7
2	11	4	2	1	Etternavnet til gutten som bor alene med faren sin og den usynlige vennen Skybert. Kjent for frasen "Jeg skal bare"	Åberg	Atkins	Borg	Alfred	None of the above	2	5	5	341	0,49
2	12	1	2	1	Lysebrunt krydder i pulverform som brukes til å gi den karakteristiske smaken til boller og vafler.	kardemomme	kanel	kommode	nellik	None of the above	4	9	10	669	0,96
2	13	1	2	1	En skuespillsjanger av alvorlig karakter med en sørgelig utgang, hvor hendelsesforløpet ofte leder til heltens undergang	tragedie	dramaserie	tragus	torget	None of the above	4	8	8	3464	4,95
2	14	3	2	1	Fornavnet til skaperen av kjente karakterer som Donald Duck og Mikke Mus	Walt	John	Whit	Hank	None of the above	1	4	4	1305	1,86
2	15	3	2	1	Navnet på flåten som Thor Heyerdahl brukte på sin ferd fra Sør-Amerika til Polynesia	Kon-Tiki	Ra	Kentucky	Titanic	None of the above	3	8	8	812	1,16
2	16	1	2	1	En påstand eller uttalelse som er virkelig eller sann, men som innebærer to motsatte trekk og derfor virker selvmotsigende, urimelig eller absurd, for eksempel ordet kjempeliten	paradoks	motsetning	parafin	ortodoks	None of the above	3	8	8	3671	5,25
2	17	2	2	1	Betegnelse på hunnrein.	simle	søye	gimle	lemen	None of the above	2	5	5	27	0,04
2	18	2	2	1	En person som har overoppsyn med serveringen og behandlingen av gjestene på et hotell eller en restaurant (Opprinnelig i et herskaplig hus eller en hoffhusholdning)	hovmester	tjener	hovmod	byggmester	None of the above	3	9	9	189	0,27
2	19	4	2	1	Vennen til mummitrollet med grønn hatt og frakk som liker å fiske og røyke pipe	Snusmumrikken	Sniff	Stinkesnufs	Hemulen	None of the above	4	12	13	22	0,03
2	20	4	2	1	Boken som handler om en ung, hvit kvinne og hennes forhold til to svarte hushjelper i USA på begynnelsen av 60-tallet.	Barnepiken	Butler	Bondepike	Gjøkeredet	None of the above	4	10	11	18	0,02

Norwegian Stimuli Set 2B

block	trial	Condition	List	Lang	Definition	Target	Foil1	Foil2	Foil3	None of the above	Syllables	Phonemes	Letters	NoWac	FreqPM
1	1	1	2	1	Et plagg som benyttes for å gi overkroppen en ønsket form av estetiske eller medisinske grunner (enten mens det bæres eller med mer varig virkning)	korsett	midje	mansjett	akvedukt	None of the above	2	5	7	285	0,41
1	2	1	2	1	En gjenkallelig viljeserklæring hvor en person bestemmer fordelingen av sin formue etter sin død	testament	arv	arrangement	miljø	None of the above	3	9	9	2490	1,63
1	3	4	2	1	Fornavnet til det pessimistiske pinnsvinet i Flåklypa, kjent for frasen "Det er farlig det"	Ludvig	Reodor	Lukas	Molo	None of the above	2	6	6	3542	5,06
1	4	4	2	1	Hjemstedet til Ole Brum og vennene hans	Hundremeterskogen	Bøkeskogen	Hakkebakkeskogen	Sherwoodskogen	None of the above	6	17	17	159	0,22
1	5	2	2	1	Det største medlemmet av mårfamilien, som kan ligne en liten bjørn i fargen og den kraftige kroppsbygning	jerv	grevling	ulv	oter	None of the above	1	4	4	2866	4,09
1	6	3	2	1	Etternavnet til Donald Trumps visepresident	Pence	Nickle	Spencer	Johnson	None of the above	1	4	5	67	0,1
1	7	2	2	1	Fotstykke på vinglass.	stett	kropp	stativ	krakk	None of the above	1	4	5	70	0,1
1	8	2	2	1	Typisk materiale brukt til emballering av takeaway-mat og elektronikkartikler	isopor	papp	isotop	plastikk	None of the above	3	6	6	472	0,67
1	9	3	2	1	Etternavnet til Norges første kvinnelige statsminister	Bruntland	Solberg	Brunstad	Jensen	None of the above	2	8	10	3332	4,76
1	10	3	2	1	Etternavnet til den italienske politikeren som grunnla fascismen	Mussolini	Fanco	Missouri	Rossi	None of the above	4	8	9	1188	1,7
1	11	4	2	1	Etternavnet til gutten som bor alene med faren sin og den usynlige vennen Skybert. Kjent for frasen "Jeg skal bare"	Åberg	Atkins	Borg	Alfred	None of the above	2	5	5	341	0,49
1	12	1	2	1	Lysebrunt krydder i pulverform som brukes til å gi den karakteristiske smaken til boller og vafler.	kardemomme	kanel	kommode	nellik	None of the above	4	9	10	669	0,96
1	13	1	2	1	En skuespillsjanger av alvorlig karakter med en sørgelig utgang, hvor hendelsesforløpet ofte leder til heltens undergang	tragedie	dramaserie	tragus	torget	None of the above	4	8	8	3464	4,95
1	14	3	2	1	Fornavnet til skaperen av kjente karakterer som Donald Duck og Mikke Mus	Walt	John	Whit	Hank	None of the above	1	4	4	1305	1,86
1	15	3	2	1	Navnet på flåten som Thor Heyerdahl brukte på sin ferd fra Sør-Amerika til Polynesia	Kon-Tiki	Ra	Kentucky	Titanic	None of the above	3	8	8	812	1,16
1	16	1	2	1	En påstand eller uttalelse som er virkelig eller sann, men som innebærer to motsatte trekk og derfor virker selvmotsigende, urimelig eller absurd, for eksempel ordet kjempeliten	paradoks	motsetning	parafin	ortodoks	None of the above	3	8	8	3671	5,25
1	17	2	2	1	Betegnelse på hunnrein.	simle	søye	gimle	lemen	None of the above	2	5	5	27	0,04
1	18	2	2	1	En person som har overoppsyn med serveringen og behandlingen av gjestene på et hotell eller en restaurant (Opprinnelig i et herskaplig hus eller en hoffhusholdning)	hovmester	tjener	hovmod	byggmester	None of the above	3	9	9	189	0,27
1	19	4	2	1	Vennen til mummitrollet med grønn hatt og frakk som liker å fiske og røyke pipe	Snusmumrikken	Sniff	Stinkesnufs	Hemulen	None of the above	4	12	13	22	0,03
1	20	4	2	1	Boken som handler om en ung, hvit kvinne og hennes forhold til to svarte hushjelper i USA på begynnelsen av 60-tallet.	Barnepiken	Butler	Bondepike	Gjøkeredet	None of the above	4	10	11	18	0,02
2	1	3	2	1	Panteren som finner og redder Mowgli i Jungelboken	Bagheera	Akela	Balenciaga	Scar	None of the above	3	6	8	27	0,04
2	2	2	2	1	Indisk krydder i pulverform med sterk gulfarge, som for mange er billigversjonen av safran	gurkemeie	karri	ginseng	enebær	None of the above	4	8	9	227	0,32
2	3	1	2	1	Årlig kalender som utgis i bokform og innerholder informasjon om et eller flere emner for de ulike dagene	almanakk	notisbok	anorakk	almisse	None of the above	3	7	8	91	0,13
2	4	4	2	1	Den første boka i Suzanne Collins triologi om Katniss Everdeen og Peeta Mellark	Dødslekene	Panem	Dødslagene	Konkurransen	None of the above	4	10	10	20	0,02
2	5	3	2	1	Etternavnet til den britiske forfatteren som særliger kjent for å ha skrevet Ringenes herre-trilogien og Hobbiten	Tolkien	Rowling	Token	Meyer	None of the above	2	7	7	638	0,91
2	6	4	2	1	Tegneseriefiguren som blir sterk av å spise spinat	Skippern	Stomperud	Skoppum	Kipster	None of the above	2	6	8	115	0,16
2	7	3	2	1	Fornavnet til Tysklands forbundskansler (statsminister)	Angela	Erna	Angelika	Heidi	None of the above	3	6	6	1727	2,47
2	8	4	2	1	Barnebokkarakter kledd i blå bukse, briller og rød og hvit-stripet genser og lue som er gjemt på boksidene	Willy	Frans	Waldo	Finn	None of the above	2	4	5	4450	6,36
2	9	4	2	1	Jordklodens største hav, som dekker nesten en tredjedel av jordens overflate	Stillehavet	Atlanterhavet	Stormhavet	Indiahavet	None of the above	4	10	11	1940	2,77
2	10	1	2	1	Fransk gjenstand tidligere brukt til å utføre henrettelse av dødsdømte ved halshogging	giljotin	bøddel	gelatin	bue	None of the above	3	8	8	44	0,06
2	11	2	2	1	Svært produktive økosystemer i havet bygd opp av kalksjeletter, som er kjent for sine rike og varierte dyreliv. Verdens største ligger utenfor østkysten av Australia	korallrev	anemone	kalkrev	krystall	None of the above	3	8	9	827	1,18
2	12	3	2	1	Etternavnet til den unge svenske klimaaktivisten og skoleeleven som ble kjent da hun satt utenfor Riksdagshuset i Stockholm med plakaten «Skolstrejk för klimatet»	Thunberg	Ernman	Tumkrans	Andersson	None of the above	2	7	8	69	0,1
2	13	2	2	1	Små guloransje bær som vokser i høyfjellet, regnet som en delikatesse.	molte	krekling	svartsurbær	aronia	None of the above	2	5	5	123	0,18
2	14	3	2	1	Etternavnet til Sherlock Holmes' venn, assistent og biograf	Watson	John	Watergate	Philips	None of the above	2	6	6	2166	3,09
2	15	4	2	1	Lilla spøkelsefra Mummidalen	Hufsa	Hattifnatten	Hufflepuff	Casper	None of the above	2	5	5	62	0,09
2	16	1	2	1	behandlingen av et lik med urter for å forhindre at det råtner. Spesielt kjent fra det gamle Egypt.	balsamering	konservering	balsamine	kremering	None of the above	4	10	11	33	0,04
2	17	1	2	1	En latterliggjørende etterligning hvor man gjør narr av originalen, men som er mindre kritiserende enn satire	parodi	herming	melodi	ironi	None of the above	3	6	6	2084	2,98
2	18	2	2	1	Fremkomstmiddel som ligner på en stol med skinner som brukes på is og hardpakket snø	spark	kjelke	spor	slede	None of the above	1	5	5	5824	8,32
2	19	1	2	1	En vedvarende vekst i det generelle prisnivået som resulterer i et fall i verdien av penger	inflasjon	priskrig	inkubasjon	infiltrering	None of the above	3	8	9	5477	7,82
2	20	2	2	1	En utendørs solskjerm som kan rulles opp og ned	markise	persienne	marsjandise	verandadør	None of the above	3	7	7	124	0,18

English Stimuli Set 1A

block	trial	item	Condition	List	Lang	Definition	Target	Foil1	Foil2	Foil3	None of the above	Syllables	Phonemes	Letters	NoWac	FreqPM
	1	1	18	2	3	2	A town or district that has local government. Norway's lowest administrative level below the county and the state	municipality	community	multiplicity	metropolis	None of the above	6	13	12	24	0,12
	1	2	9	1	3	2	a fake drug that people think is real but that doesn't have any active ingredients	placebo	panacea	gazebo	folio	None of the above	3	7	7	106	0,52
	1	3	31	4	3	2	The last name of the doctor in a series of children's novels who learns to talk to animals and becomes their champion around the world.	Dolittle	Popper	Delamotte	Littleborough	None of the above	3	7	8	66	0,33
	1	4	25	3	3	2	A pre-historic monument in Wiltshire, England. Consisting of big, upright stones positioned in a circle	Stonehenge	Rushmore	Strasbourg	Avebury	none of the above	2	8	10	602	2,99
	1	5	19	2	3	2	A deep-bowled, long-handled spoon used for serving soup.	ladle	colander	meddle	lever	None of the above	2	4	5	329	1,63
	1	6	38	4	3	2	Last name of the headmaster of Hogwarts in the Harry Potter franchise	Dumbledore	Slughorn	Dimbledork	Pampledore	None of the above	3	9	10	55	0,27
	1	7	4	1	3	2	The first performance of a musical or theatrical work or the first showing of a film	premiere	debut	premium	investigation	None of the above	3	6	8	681	3,38
	1	8	24	3	3	2	Last name of English television personality, most known for being a hard-to-impress judge on song contests in both Britain and America	Cowell	Mendel	Corell	Jones	none of the above	2	4	6	817	4,06
	1	9	31	4	3	2	The 1975 American thriller film about killer sharks, directed by Steven Spielberg	Jaws	Underwater	Jagged	Chops	None of the above	1	3	4	1286	6,38
	1	10	11	2	3	2	The ceremony or formal admission of someone to office.	inauguration	accolade	incubation	graduation	None of the above	5	10	12	12	0,06
	1	11	21	3	3	2	Capital and largest city of the Czech Republic	Prague	Kiev	Perugia	Munich	None of the above	1	4	6	401	1,99
	1	12	8	1	3	2	A person who neither believes or disbelieves in a god or religious doctrine	agnostic	atheist	antagonist	apathy	None of the above	3	8	8	66	0,33
	1	13	29	3	3	2	Last name of the Norwegian experimental archaeologist most known for sailing on an expedition in 1947 on a self-made boat from South America to Polynesia	Heyerdahl	Erikson	Nytterdal	Amundsen	None of the above	3	6	9	5	0,02
	1	14	35	4	3	2	The country on the eastern coast of the Baltic Sea in Northern Europe, with the capital city of Tallinn.	Estonia	Pretoria	Sedonia	Estland	None of the above	4	7	7	270	1,34
	1	15	14	2	3	2	a tall, rounded vase used for storing the ashes of a cremated person	urn	casket	urim	crate	None of the above	1	3	3	331	1,64
	1	16	34	4	3	2	Winnie the Pooh's pink friend	Piglet	Tigger	Pinker	Jiggler	None of the above	2	6	6	316	1,56
	1	17	5	1	3	2	An extreme or irrational fear of or aversion to a particular object or situation	phobia	anxiety	phoneme	repulsion	None of the above	3	5	6	315	1,56
	1	18	1	1	3	2	A person who prepares, stuffs, and mounts the skins of animals with lifelike effect.	taxidermist	embalmer	tamoxifen	taxonomy	None of the above	4	12	11	45	0,22
	1	19	28	3	3	2	The worst nucelar disaster in history, caused by an explorsion at a nuclear power plant in Ukraine in 1986	Chernobyl	Hiroshima	Chernabog	Pribyl	none of the above	3	7	9	139	0,69
	1	20	15	2	3	2	a soft quilt filled with down, feathers, or a synthetic fibre, used instead of a blanket	duvet	comforter	dove	cover	None of the above	2	5	5	498	2,42
	2	1	26	3	3	2	Sleeping Beauty's first name	Aurora	Ariel	Leona	Alana	None of the above	3	5	6	275	1,37
	2	2	27	3	3	2	First name of the founder of the fashion brand Chanel	Coco	Betty	Cora	Carola	none of the above	2	4	4	400	1,99
	2	3	3	1	3	2	The branch of science which deals with celestial objects, space, and the physical universe as a whole	astronomy	physics	astrology	aquarius	None of the above	4	9	9	716	3,56
	2	4	40	4	3	2	The ancient Hebrew religion defined as belief in one God based on the laws and teachings of the Holy	Judaism	Christianity	Juxism	Islam	None of the above	3	7	7	269	1,33
	2	5	36	4	3	2	The large fat orange cartoon cat who loves lasagna	Garfield	Heathcliff	Ginger	Felix	None of the above	2	7	8	147	0,73
	2	6	33	4	3	2	The American Disney cartoon about six elementary school students, featuring characters such as TJ Detweiler, Vince LaSalle, and Gretchen Grundler	Recess	Simpsons	Rugrats	Filmore	None of the above	2	5	6	487	2,41
	2	7	6	1	3	2	An open rebellion against the proper authorities, especially by soldiers or sailors against their officers	mutiny	revolution	matinee	mutation	None of the above	3	7	6	269	1,34
	2	8	30	3	3	2	The last name of the British actor who played Sherlock Holmest in the recent BBC series and starred in the movies "The Imitation Game" and "Doctor Strange"	Cumberbatch	Bale	Bumbercrotch	Hoult	none of the above	3	11	8	62	0,31
	2	9	7	1	3	2	into gold.	alchemy	algebra	alcove	chemistry	None of the above	3	6	7	164	0,81
	2	10	17	2	3	2	a type of claw, especially one belonging to a bird of prey	talon	paw	tarot	crook	None of the above	2	5	5	51	0,25
	2	11	16	2	3	2	a slow-moving tropical mammal that hangs upside down from the branches of threes using its long limbs and hooked claws	sloth	mammoth	slob	scythe	None of the above	1	4	5	303	1,57
	2	12	10	1	3	2	A mythical creature with the head, arms, and torso of a man and the body and legs of a horse	centaur	hybrid	centurian	avatar	None of the above	2	5	7	37	0,18
	2	13	12	2	3	2	A vertical channel or pipe which conducts smoke up from a fire or furnace, typically through the roof	chimney	furnace	chimenia	grate	None of the above	2	5	7	1609	7,99
	2	14	20	2	3	2	A secret listener to private conversations, for instance outside someones door	eavesdropper	sleuth	earworm	auditor	None of the above	3	8	11	6	0,03
	2	15	13	2	3	2	The meat from a deer	venison	pork	venom	vision	None of the above	3	7	7	1224	5,58
	2	16	22	3	3	2	Last name of the British singer and actress most famous for starrring in the original "The Sound of Music" and "Mary Poppins"	Andrews	Hepburn	Anderson	Garbot	None of the above	2	6	7	1785	8,86
	2	17	37	4	3	2	First part of the name of the fairy friend of Peter Pan	Tinker	Adelina	Timper	Bella	None of the above	2	5	6	369	1,83
	2	18	23	3	3	2	Last name of American actress often described as the best of her generation, most famous for roles in The Devil Wears Prada and Mamma Mia	Streep	Fonda	Streuss	Mirren	None of the above	1	5	6	311	1,54
	2	19	2	1	3	2	The remains of a building, city, etc., that has been destroyed or that is in a state of decay	ruins	wreckage	driuds	remnants	None of the above	2	5	5	1363	6,77
	2	20	32	4	3	2	The disney movie about the adventures of Rapunzel	Tangled	Snarled	Target	Braids	None of the above	2	6	7	504	2,5

English Stimuli Set 1B

block	trial	item	Condition	List	Lang	Definition	Target	Foil1	Foil2	Foil3	None of the above	Syllables	Phonemes	Letters	NoWac	FreqPM
1	1	26	3	3	2	Sleeping Beauty's first name	Aurora	Ariel	Leona	Alana	None of the above	3	5	6	275	1,37
1	2	27	3	3	2	First name of the founder of the fashion brand Chanel	Coco	Betty	Cora	Carola	none of the above	2	4	4	400	1,99
1	3	3	1	3	2	The branch of science which deals with celestial objects, space, and the physical universe as a whole	astronomy	physics	astrology	aquarius	None of the above	4	9	9	716	3,56
1	4	40	4	3	2	The ancient Hebrew religion defined as belief in one God based on the laws and teachings of the Holy Scripture and the	Judaism	Christianity	Juxism	Islam	None of the above	3	7	7	269	1,33
1	5	36	4	3	2	The large fat orange cartoon cat who loves lasagna	Garfield	Heathcliff	Ginger	Felix	None of the above	2	7	8	147	0,73
1	6	33	4	3	2	The American Disney cartoon about six elementary school students, featuring characters such as TJ Detweiler, Vince LaSalle, and Gretchen Grundler	Recess	Simpsons	Rugrats	Filmore	None of the above	2	5	6	487	2,41
1	7	6	1	3	2	An open rebellion against the proper authorities, especially by soldiers or sailors against their officers	mutiny	revolution	matinee	mutation	None of the above	3	7	6	269	1,34
1	8	30	3	3	2	The last name of the British actor who played Sherlock Holmes t in the recent BBC series and starred in the movies "The Imitation Game" and "Doctor Strange"	Cumberbatch	Bale	Bumbercrotch	Hoult	none of the above	3	11	8	62	0,31
1	9	7	1	3	2	the medieval forerunner of chemistry, concerned with the transmutation of matter, such base metals into gold.	alchemy	algebra	alcove	chemistry	None of the above	3	6	7	164	0,81
1	10	17	2	3	2	a type of claw, especially one belonging to a bird of prey	talon	paw	tarot	crook	None of the above	2	5	5	51	0,25
1	11	16	2	3	2	a slow-moving tropical mammal that hangs upside down from the branches of threes using its long limbs and hooked claws	sloth	mammoth	slob	scythe	None of the above	1	4	5	303	1,57
1	12	10	1	3	2	A mythical creature with the head, arms, and torso of a man and the body and legs of a horse	centaur	hybrid	centurian	avatar	None of the above	2	5	7	37	0,18
1	13	12	2	3	2	A vertical channel or pipe which conducts smoke up from a fire or furnace, typically through the roof of a building	chimney	furnace	chimenia	grate	None of the above	2	5	7	1609	7,99
1	14	20	2	3	2	A secret listener to private conversations, for instance outside someones door	eavesdropper	sleuth	earworm	auditor	None of the above	3	8	11	6	0,03
1	15	13	2	3	2	The meat from a deer	venison	pork	venom	vision	None of the above	3	7	7	1224	5,58
1	16	22	3	3	2	Last name of the British singer and actress most famous for starrring in the original "The Sound of Music" and "Mary Poppins"	Andrews	Hepburn	Anderson	Garbot	None of the above	2	6	7	1785	8,86
1	17	37	4	3	2	First part of the name of the fairy friend of Peter Pan	Tinker	Adelina	Timper	Bella	None of the above	2	5	6	369	1,83
1	18	23	3	3	2	Last name of American actress often described as the best of her generation, most famous for roles in The Devil Wears Prada and Mamma Mia	Streep	Fonda	Streuss	Mirren	None of the above	1	5	6	311	1,54
1	19	2	1	3	2	The remains of a building, city, etc., that has been destroyed or that is in a state of decay	ruins	wreckage	driuds	remnants	None of the above	2	5	5	1363	6,77
1	20	32	4	3	2	The disney movie about the adventures of Rapunzel	Tangled	Snarled	Target	Braids	None of the above	2	6	7	504	2,5
2	1	18	2	3	2	A town or district that has local government. Norway's lowest administrative level below the county and the state	municipality	community	multiplicity	metropolis	None of the above	6	13	12	24	0,12
2	2	9	1	3	2	a fake drug that people think is real but that doesn't have any active ingredients	placebo	panacea	gazebo	folio	None of the above	3	7	7	106	0,52
2	3	31	4	3	2	The last name of the doctor in a series of children's novels who learns to talk to animals and becomes their champion around the world.	Dolittle	Popper	Delamotte	Littleborough	None of the above	3	7	8	66	0,33
2	4	25	3	3	2	A pre-historic monument in Wiltshire, England. Consisting of big, upright stones positioned in a circle	Stonehenge	Rushmore	Strasbourg	Avebury	none of the above	2	8	10	602	2,99
2	5	19	2	3	2	A deep-bowled, long-handled spoon used for serving soup.	ladle	colander	meddle	lever	None of the above	2	4	5	329	1,63
2	6	38	4	3	2	Last name of the headmaster of Hogwarts in the Harry Potter franchise	Dumbledore	Slughorn	Dimbledork	Pampledore	None of the above	3	9	10	55	0,27
2	7	4	1	3	2	The first performance of a musical or theatrical work or the first showing of a film	premiere	debut	premium	investigation	None of the above	3	6	8	681	3,38
2	8	24	3	3	2	Last name of English television personality, most known for being a hard-to-impress judge on song contests in both Britain and America	Cowell	Mendel	Corell	Jones	none of the above	2	4	6	817	4,06
2	9	31	4	3	2	The 1975 American thriller film about killer sharks, directed by Steven Spielberg	Jaws	Underwater	Jagged	Chops	None of the above	1	3	4	1286	6,38
2	10	11	2	3	2	The ceremony or formal admission of someone to office.	inauguration	accolade	incubation	graduation	None of the above	5	10	12	12	0,06
2	11	21	3	3	2	Capital and largest city of the Czech Republic	Prague	Kiev	Perugia	Munich	None of the above	1	4	6	401	1,99
2	12	8	1	3	2	A person who neither believes or disbelieves in a god or religious doctrine	agnostic	atheist	antagonist	apathy	None of the above	3	8	8	66	0,33
2	13	29	3	3	2	Last name of the Norwegian experimental archaeologist most known for sailing on an expedition in 1947 on a self-made boat from South America to Polynesia	Heyerdahl	Erikson	Nytterdal	Amundsen	None of the above	3	6	9	5	0,02
2	14	35	4	3	2	The country on the eastern coast of the Baltic Sea in Northern Europe, with the capital city of Tallinn.	Estonia	Pretoria	Sedonia	Estland	None of the above	4	7	7	270	1,34
2	15	14	2	3	2	a tall, rounded vase used for storing the ashes of a cremated person	urn	casket	urim	crate	None of the above	1	3	3	331	1,64
2	16	34	4	3	2	Winnie the Pooh's pink friend	Piglet	Tigger	Pinker	Jiggler	None of the above	2	6	6	316	1,56
2	17	5	1	3	2	An extreme or irrational fear of or aversion to a particular object or situation	phobia	anxiety	phoneme	repulsion	None of the above	3	5	6	315	1,56
2	18	1	1	3	2	A person who prepares, stuffs, and mounts the skins of animals with lifelike effect.	taxidermist	embalmer	tamoxifen	taxonomy	None of the above	4	12	11	45	0,22
2	19	28	3	3	2	The worst nucelar disaster in history, caused by an explorsion at a nuclear power plant in Ukraine in 1986	Chernobyl	Hiroshima	Chernabog	Pribyl	none of the above	3	7	9	139	0,69
2	20	15	2	3	2	a soft quilt filled with down, feathers, or a synthetic fibre, used instead of a blanket	duvet	comforter	dove	cover	None of the above	2	5	5	498	2,42

English Stimuli Set 2A

block	trial	item	Condition	List	Lang	Definition	Target	Foil1	Foil2	Foil3	None of the above	Syllables	Phonemes	Letters	NoWac	FreqPM
1	1	34	4	4	2	Country bordered by Russia, Ukraine, Poland, Lithuania and Latvia. Its capital and most populous city is Minsk	Belarus	Belize	Benin	Lebanon	None of the above	3	7	7	292	1,45
1	2	14	2	4	2	The watery liquid secreted into the mouth by glands, aiding chewing digestion processes	saliva	urine	cylinder	sliver	None of the above	3	6	6	386	1,92
1	3	8	1	4	2	A game played by two teams of players using a long stick with a net at the end to catch, carry, and throw a small ball into the opponents goal	lacrosse	rugby	lactose	carousel	None of the above	2	6	8	87	0,43
1	4	1	1	4	2	The basic principles and laws of a nation that determine the powers and duties of the government and guarantee the rights of the people.	constitution	legislation	constipation	continuance	None of the above	4	12	12	1711	8,77
1	5	18	2	4	2	Each of the branched horns on the head of a male adult from the deer family	antler	beak	mantle	altar	None of the above	2	5	6	105	0,52
1	6	29	3	4	2	Last name of the British film star and humanitarian who starred in Breakfast at Tiffany's and My Fair Lady	Hepburn	Carroll	Napburn	Hepford	none of the above	2	6	7	281	1,4
1	7	39	4	4	2	The name of Garfield's dog	Odie	Nermal	Odo	Dio	None of the above	2	3	4	48	0,24
1	8	28	3	4	2	Famous outdoor rock festival held in the US in 1969. It was originally arranged as a protest against the Vietnam war	Woodstock	Stonewall	Woodruff	Rostock	None of the above	2	7	9	157	0,78
1	9	25	3	4	2	Last name of the female French Canadian singer. Famous for songs such as "My Heart Will Go On" and "Power of Love"	Dion	Lavigne	Dina	Winslet	None of the above	2	4	4	237	1,18
1	10	19	2	4	2	An animal or person that eats a variety of food of both plant and animal origin	omnivore	herbivore	carnival	omnious	None of the above	3	6	8	17	0,08
1	11	11	2	4	2	A person walking on a pavement rather than travelling in a vehicle	pedestrian	gallivanter	pedestal	wanderer	None of the above	4	10	10	394	1,95
1	12	38	4	4	2	The name of the 1984 film that centers on a group of eccentric New York City scientists who investigate and capture paranormal creatures for a living.	Ghostbusters	Scooby-Doo	Ghosted	Gremlins	None of the above	3	11	12	122	0,6
1	13	21	3	4	2	Last name of the South African anti-apartheid activist who was imprisoned in Robben Island Prison from 1964-82	Mandela	Freeman	Mandala	Nelson	none of the above	3	7	7	1015	5,04
1	14	9	1	4	2	An angel that is represented in art as a beautiful, fat, naked child with small wings	cherub	cupid	chinook	seraph	None of the above	2	5	6	107	0,53
1	15	39	4	4	2	Name of the house elf who becomes Harry Potters friend	Dobby	Hedwig	Buddy	Hagrid	None of the above	2	4	5	25	0,12
1	16	5	1	4	2	A person who is killed because of their religion or other beliefs	martyr	scapegoat	martian	mormon	None of the above	2	4	6	334	1,66
1	17	35	4	4	2	The name of the tough but loveable stray dog who falls in love with a wealthy house dog in one of the classic Disney movies.	Tramp	Pongo	Trump	Tripp	None of the above	1	5	5	651	3,23
1	18	24	3	4	2	First name of the influential thinker of the early twentieth century considered the father of psychoanalysis, famous for his theories about sexual repression.	Sigmund	Immanuel	Sigurd	Siegfried	None of the above	2	7	7	98	0,14
1	19	15	2	4	2	An optical instrument with a lens for each eye, used for viewing distant objects	binoculars	telescope	binomial	magnifier	None of the above	4	9	10	777	3,86
1	20	4	1	4	2	The mammal known for its ability to spray a liquid with a strong, unpleasant smell	skunk	possum	stink	porcupine	None of the above	1	5	5	416	2,2
2	1	33	4	4	2	The name of the orphan girl who lives with her evil step mother and step sisters, famous for losing her glass slipper on the steps of the castle	Cinderella	Belle	Salmonella	Candace	None of the above	4	9	10	706	3,51
2	2	6	1	4	2	A human egg during the period from approximately week 2 to week 8 after fertilization	embryo	nucleus	embroidery	brioche	None of the above	3	6	6	261	1,5
2	3	3	1	4	2	A system of institutionalised racial segregation that existed in South Africa and South West Africa from 1948 until the early 1990s	apartheid	discrimination	apathy	halocaust	None of the above	3	7	9	715	3,55
2	4	17	2	4	2	**A time in which there is not enough food for a great number of people, causing illness and death**	famine	drought	forrage	harvest	None of the above	2	5	6	834	4,14
2	5	2	1	4	2	A dummy used to display clothes in a shop window.	mannequin	model	ramekin	manifold	None of the above	3	7	9	127	0,63
2	6	7	1	4	2	A long-standing rival or an arch-enemy that cannot be conquered	nemesis	feud	menestrel	anomaly	None of the above	3	7	7	361	1,79
2	7	22	3	4	2	British claymotion character who is a cheese-loving inventor living with his intelligent dog	Wallace	Homer	Willis	Walter	None of the above	2	5	7	1731	8,6
2	8	23	3	4	2	Last name of African American actor known for his distinctive deep voice. He has contributed in the movies: Batman, Invictus, Shawshank Redemption	Freeman	Jackson	Foreman	Nelson	None of the above	2	6	7	618	3,07
2	9	12	2	4	2	A speech that praises someone or something highly, especially a tribute at a funeral of someone who has just died.	eulogy	obituary	eunuch	etymology	None of the above	3	5	6	70	0,34
2	10	36	4	4	2	Mickey Mouse's tall and clumsy dog friend	Goofy	Donald	Gruffy	Foggy	None of the above	2	4	5	155	0,77
2	11	13	2	4	2	A small woodland animal with a coat of sharp spines on its back that curls into a spikey ball as defence if threatened	hedgehog	groundhog	fledgling	penguin	None of the above	2	6	8	1061	5,2
2	12	16	2	4	2	Refers to general loss of memory, such as facts, information and experiences. Often caused by head injuries	amnesia	dementia	amnesty	anesthesia	None of the above	3	6	7	191	0,95
2	13	30	3	4	2	Last name of the British host of American talkshow The Late Late Show, most famous for his Carpool	Corden	Colbert	Gorden	Kimmel	None of the above	2	6	6	133	0,66
2	14	10	1	4	2	A person who is excessively and unduly worried about having serious illnessness	hypochondriac	arachnophobia	mitochandria	hypocrite	None of the above	5	12	13	47	0,23
2	15	40	4	4	2	Last name of a cartoon character who lives in a pineapple under the sea	Squarepants	Plankton	Squareface	Patrick	None of the above	2	9	10	40	0,19
2	16	37	4	4	2	Name of the creature in Lord of the Rings who refers to the one ring as his precious	Gollum	Bilbo	Gurran	Gandalf	None of the above	2	5	6	97	0,48
2	17	20	2	4	2	A moving staircase consisting of an endlessly circulating belt of steps driven by a motor.	escalator	elevator	accelerator	scallion	None of the above	4	8	9	261	1,3
2	18	27	3	4	2	First name of the Cuban revolutionary and politician who served as prime minister of Cuba between 1959 to 1976 and as president between 1976 to 2008	Fidel	Marrero	Fido	Delfo	None of the above	2	5	5	232	1,15
2	19	26	3	4	2	Last name of American actress and cultural icon from the 50s/60s who sang "diamonds are a girls best friend".	Monroe	Patula	Myrna	Medusa	none of the above	2	5	6	522	2,59
2	20	32	4	4	2	The four-legged animal who talks non-stop in the Shrek-movies	Donkey	Mule	Dinker	Jackass	None of the above	2	5	6	1966	9,76

English Stimuli Set 2B

block	trial	item	Condition	List	Lang	Definition	Target	Foil1	Foil2	Foil3	None of the above	Syllables	Phonemes	Letters	NoWac	FreqPM
1	1	33	4	4	2	The name of the orphan girl who lives with her evil step mother and step sisters, famous for losing her glass slipper on the steps of the castle	Cinderella	Belle	Salmonella	Candace	None of the above	4	9	10	706	3,51
1	2	6	1	4	2	A human egg during the period from approximately week 2 to week 8 after fertilization	embryo	nucleus	embroidery	brioche	None of the above	3	6	6	261	1,5
1	3	3	1	4	2	A system of institutionalised racial segregation that existed in South Africa and South West Africa from 1948	apartheid	discrimination	apathy	halocaust	None of the above	3	7	9	715	3,55
1	4	17	2	4	2	A time in which there is not enough food for a great number of people, causing illness and death	famine	drought	forrage	harvest	None of the above	2	5	6	834	4,14
1	5	2	1	4	2	A dummy used to display clothes in a shop window.	mannequin	model	ramekin	manifold	None of the above	3	7	9	127	0,63
1	6	7	1	4	2	A long-standing rival or an arch-enemy that cannot be conquered	nemesis	feud	menestrel	anomaly	None of the above	3	7	7	361	1,79
1	7	22	3	4	2	British claymotion character who is a cheese-loving inventor living with his intelligent dog	Wallace	Homer	Willis	Walter	None of the above	2	5	7	1731	8,6
1	8	23	3	4	2	Last name of African American actor known for his distinctive deep voice. He has contributed in the movies: Batman, Invictus, Shawshank Redemption	Freeman	Jackson	Foreman	Nelson	None of the above	2	6	7	618	3,07
1	9	12	2	4	2	A speech that praises someone or something highly, especially a tribute at a funeral of someone who has just died.	eulogy	obituary	eunuch	etymology	None of the above	3	5	6	70	0,34
1	10	36	4	4	2	Mickey Mouse's tall and clumsy dog friend	Goofy	Donald	Gruffy	Foggy	None of the above	2	4	5	155	0,77
1	11	13	2	4	2	A small woodland animal with a coat of sharp spines on its back that curls into a spikey ball as defence if threatened	hedgehog	groundhog	fledgling	penguin	None of the above	2	6	8	1061	5,2
1	12	16	2	4	2	Refers to general loss of memory, such as facts, information and experiences. Often caused by head injuries	amnesia	dementia	amnesty	anesthesia	None of the above	3	6	7	191	0,95
1	13	30	3	4	2	Last name of the British host of American talkshow The Late Late Show, most famous for his Carpool Karaoke episodes	Corden	Colbert	Gorden	Kimmel	None of the above	2	6	6	133	0,66
1	14	10	1	4	2	A person who is excessively and unduly worried about having serious illnessness	hypochondriac	arachnophobia	mitochandria	hypocrite	None of the above	5	12	13	47	0,23
1	15	40	4	4	2	Last name of a cartoon character who lives in a pineapple under the sea	Squarepants	Plankton	Squareface	Patrick	None of the above	2	9	10	40	0,19
1	16	37	4	4	2	Name of the creature in Lord of the Rings who refers to the one ring as his precious	Gollum	Bilbo	Gurran	Gandalf	None of the above	2	5	6	97	0,48
1	17	20	2	4	2	A moving staircase consisting of an endlessly circulating belt of steps driven by a motor.	escalator	elevator	accelerator	scallion	None of the above	4	8	9	261	1,3
1	18	27	3	4	2	First name of the Cuban revolutionary and politician who served as prime minister of Cuba between 1959 to 1976 and as president between 1976 to 2008	Fidel	Marrero	Fido	Delfo	None of the above	2	5	5	232	1,15
1	19	26	3	4	2	Last name of American actress and cultural icon from the 50s/60s who sang "diamonds are a girls best friend".	Monroe	Patula	Myrna	Medusa	none of the above	2	5	6	522	2,59
1	20	32	4	4	2	The four-legged animal who talks non-stop in the Shrek-movies	Donkey	Mule	Dinker	Jackass	None of the above	2	5	6	1966	9,76
2	1	34	4	4	2	Country bordered by Russia, Ukraine, Poland, Lithuania and Latvia. Its capital and most populous city is Minsk	Belarus	Belize	Benin	Lebanon	None of the above	3	7	7	292	1,45
2	2	14	2	4	2	The watery liquid secreted into the mouth by glands, aiding chewing digestion processes	saliva	urine	cylinder	sliver	None of the above	3	6	6	386	1,92
2	3	8	1	4	2	A game played by two teams of players using a long stick with a net at the end to catch, carry, and throw a small ball into the opponents goal	lacrosse	rugby	lactose	carousel	None of the above	2	6	8	87	0,43
2	4	1	1	4	2	The basic principles and laws of a nation that determine the powers and duties of the government and guarantee the rights of the people.	constitution	legislation	constipation	continuance	None of the above	4	12	12	1711	8,77
2	5	18	2	4	2	Each of the branched horns on the head of a male adult from the deer family	antler	beak	mantle	altar	None of the above	2	5	6	105	0,52
2	6	29	3	4	2	Last name of the British film star and humanitarian who starred in Breakfast at Tiffany's and My Fair Lady	Hepburn	Carroll	Napburn	Hepford	none of the above	2	6	7	281	1,4
2	7	39	4	4	2	The name of Garfield's dog	Odie	Nermal	Odo	Dio	None of the above	2	3	4	48	0,24
2	8	28	3	4	2	Famous outdoor rock festival held in the US in 1969. It was originally arranged as a protest against the Vietnam war	Woodstock	Stonewall	Woodruff	Rostock	None of the above	2	7	9	157	0,78
2	9	25	3	4	2	Last name of the female French Canadian singer. Famous for songs such as "My Heart Will Go On" and "Power of Love"	Dion	Lavigne	Dina	Winslet	None of the above	2	4	4	237	1,18
2	10	19	2	4	2	An animal or person that eats a variety of food of both plant and animal origin	omnivore	herbivore	carnival	omnious	None of the above	3	6	8	17	0,08
2	11	11	2	4	2	A person walking on a pavement rather than travelling in a vehicle	pedestrian	gallivanter	pedestal	wanderer	None of the above	4	10	10	394	1,95
2	12	38	4	4	2	The name of the 1984 film that centers on a group of eccentric New York City scientists who investigate and capture paranormal creatures for a living.	Ghostbusters	Scooby-Doo	Ghosted	Gremlins	None of the above	3	11	12	122	0,6
2	13	21	3	4	2	Last name of the South African anti-apartheid activist who was imprisoned in Robben Island Prison from 1964-82	Mandela	Freeman	Mandala	Nelson	none of the above	3	7	7	1015	5,04
2	14	9	1	4	2	An angel that is represented in art as a beautiful, fat, naked child with small wings	cherub	cupid	chinook	seraph	None of the above	2	5	6	107	0,53
2	15	39	4	4	2	Name of the house elf who becomes Harry Potters friend	Dobby	Hedwig	Buddy	Hagrid	None of the above	2	4	5	25	0,12
2	16	5	1	4	2	A person who is killed because of their religion or other beliefs	martyr	scapegoat	martian	mormon	None of the above	2	4	6	334	1,66
2	17	35	4	4	2	The name of the tough but loveable stray dog who falls in love with a wealthy house dog in one of the classic Disney movies.	Tramp	Pongo	Trump	Tripp	None of the above	1	5	5	651	3,23
2	18	24	3	4	2	First name of the influential thinker of the early twentieth century considered the father of psychoanalysis, famous for his theories about sexual repression.	Sigmund	Immanuel	Sigurd	Siegfried	None of the above	2	7	7	98	0,14
2	19	15	2	4	2	An optical instrument with a lens for each eye, used for viewing distant objects	binoculars	telescope	binomial	magnifier	None of the above	4	9	10	777	3,86
2	20	4	1	4	2	The mammal known for its ability to spray a liquid with a strong, unpleasant smell	skunk	possum	stink	porcupine	None of the above	1	5	5	416	2,2

Appendix C: Study Description and Consent Form

INVITATION TO PARTICIPATE IN A RESEARCH PROJECT

English as a second language: language processing and bilingual profile

We are looking for Native speakers of Norwegian to take part in a study investigating the relationship between bilingualism and language processing.

In order to participate in this study you need to be between **18 and 35 years of age** and a **Native speaker of Norwegian** with no other home languages (excluding perhaps English). You should have a reasonable proficiency in **English as your second language**. You should have normal or corrected-to-normal vision and hearing and have no diagnosed cognitive impairments or language impairments such as dyslexia or stuttering.

This research is conducted in the Experimental Linguistics Research groups at the University of Agder, headed by Professor Linda Wheeldon (linda.r.wheeldon@uia.no), Professor Allison Wetterlin (Allison.wetterlin@uia.no).

The study is run by our Masters students Ellinor Skjerli (ellinor.skjerli@gmail.com), Karethe Nilsen (karethe.nilsen@gmail.com), Renate Gjetnes (renatg16@student.uia.no), Helene Øya (heleno15@student.uia.no), Heidi Baardsen (heidi.baardsen@gmail.com), and Yvonne Møtteberg Karlsen (yvonmk15@student.uia.no). Please contact them if you have any queries about the study.

WHAT IS THE STUDY ABOUT?

This study is designed to investigate the use of English as a second language. We are interested in how aspects of bilingual learning and language-use relate to language processing. The study has two components:

1. A questionnaire asking questions about your language background and about how you rate your own level of proficiency in different aspects of the languages that you speak.

2. Some simple tests assessing language processing in Norwegian and English. These tests are designed to investigate word finding, sentence production and sentence comprehension.

If, after having read the information below, you agree that you are eligible, and you decide to take part in the study, you will be sent a consent form to be filled out and signed.

VOLUNTARY PARTICIPATION AND THE POSSIBILITY TO WITHDRAW CONSENT (OPT-OUT)

Participation in the study is voluntary. If you wish to take part, you will need to sign the declaration of consent. This will allow us to process your data. You can, at any given time and without reason withdraw your consent. If you decide to withdraw participation in the project, you can ask that your test results and personal data be deleted, unless the data and tests have already been analysed or used in scientific publications.

So long as you can be identified in the collected data you have the right to:

- access the personal data that is being processed about you
- request that your personal data is deleted
- request that incorrect personal data about you is corrected/rectified
- receive a copy of your personal data (data portability), and
- send a complaint to the Data Protection Officer or The Norwegian Data Protection Authority regarding the processing of your personal data.

If you at a later point, wish to withdraw consent or have questions regarding the project, you can contact the principal investigator (Linda Wheeldon). Questions about the study or withdrawing consent can also be directed to the University of Agder's Data protection officer Ina Danielsen ina.danielsen@uia.no or NSD (Norsk senter for forskningsdata AS) by email personvernombudet@nsd.no or telephone: 55 58 21 17.

WHAT WILL HAPPEN TO YOUR INFORMATION?

The study will collect and record personal information about you. However, you will never at any time be mentioned as an individual in relation to this study. The information that is recorded about you will only be used as described in the purpose of the study. Your personal data will be assigned a number code related to your name and stored on a non-networked, password protected PC. Only the laboratory directors and experimenters will have access to your data and to the key relating your data number to your name. In addition, we will record the responses you produce during the experiment, this includes key strokes and speech. These data will be also be anonymised and treated as described above.

The results derived from the pooled data will be published. In the interest of being open to the scientific community and others interested in this research we would also like, with your permission, to publish the anonymised data to an open access database. If you agree to this, please sign the consent form. The decision you make does not affect your eligibility for this study.

All information will be processed and used without your name or personal identification number, or any other information that is directly identifiable to you.

The principal investigators have the responsibility for the daily operations/running of this research project and that any information about you will be handled in a secure manner. Information about you will be anonymised or deleted a maximum of 5 years after the project end date (20.12.2021).

FINANCE

In appreciation for your time and effort, you will receive a voucher for 300 NOK on completion of this study.

Participant consent form

English as a second language: language processing and bilingual profile

ID#

PARTICIPANT IDENTIFICATION NUMBER FOR THIS STUDY

1) I confirm that I have read and understand the information sheet for the above study. I have had the opportunity to consider the information, ask questions and have had these answered satisfactorily.

2) I understand that my participation is voluntary and that I am free to withdraw at any time without giving any reason. I understand that I can withdraw my data at any time during the experiment and for the duration of one month after my completion of the study.

3) I understand that data collected during the study will be looked at by researchers from the University of Agder. I give permission for these individuals to have access to my data. Upon completion of the study, the data may be placed on an appropriate repository for data-sharing and be accessed by researchers not affiliated with the University of Agder. I understand that all my data will be stored anonymously.

4) I agree to take part in the study.

Name of Participant (BLOCK LETTERS)	Date	Signature
Name of Researcher (BLOCK LETTERS)	Date	Signature

date Participant's Signature

Appendix D: Experiment Instructions and Procedure

The experiment started with the participants reading the experiment instructions: “This is a word finding study. You will read definitions of difficult words and names and we will ask you if you know what the word or name is or not. Sometimes you may think you know the word or name but you are unable to say it, i.e. it’s on the tip of your tongue. When we ask whether you know the word or not there are three possible responses. 1 for Yes, 2 for No and 3 for ToT (Tip of the Tongue”. If you choose option 3 we will ask you some further questions about this item. Please do not worry if you do not know many of the items. Many are things you would hear very rarely so we expect them to be difficult.”

After the participants had read and understood the task instructions, the experimenter pressed the button to start the first trial, in which a definition appeared on the screen. The definition was followed by a question asking whether the participant knew the word with three options present: “1 Yes”, “2 No”, and “3 ToT”. If the participants answered yes, they were instructed to say the word, before continuing to the next trial. If the participants did not know the word and answered no, the experimenter immediately skipped to the next trial. Finally, if the participants experienced a TOT, they were asked if they could guess the initial letter or sound. If so, the experimenter would type in the letter/sound. The participants were then asked if they could guess the positions of those letters or sounds, and then asked if they could guess the number of syllables. If the participants were unable to guess either of these, the experimenter skipped the rest of these questions without writing any letters or numbers. Finally, four options in random order appeared on the screen, including the target word, a phonologically similar word, a semantically similar word, and a random unrelated word. The participants were then asked whether one of these words was the one they were thinking of.

During the experiment, the experimenter pressed keys on the keyboard to continue the experiment and to register their answers (e.g., 1 = yes, 2 = no, 3 = TOT). Additionally, the experimenters wrote down whenever the participants thought they knew the target word, but then produced the wrong word. A log was also written in case any of the data got lost.

Appendix E: Removed Variables From the Correlation Matrix

- One variable had no correlations of at least 0.3 with another variable and therefore was removed from the analysis set due to insufficient co-variation:

  Q8b. intentional use of Norwegian in English

- Variables with a correlation of 0.9 or above with another variable were also examined. This means that the variables are measuring almost the same thing and that one of them should be removed. Where the correlation was between L1 and L2 versions of a variable, the L1 variable was removed (highlighted in blue).

Q3a.Exposure to L1/ Q3b.Exposure toL2	-0.99
Q4a.Speaking in L1/ Q4b.Speaking inL2	-0.98
Q5a.Reading in L1/Q5b.Reading in L2	-0.90
Q6a.Choice of speaking in L1/Q6b.Choice of speaking in L2	-0.99

For the remaining high correlations, one of the pairings was removed.

Q4n.Proficiency grammar English/Q4p. Proficiency spelling English	0.86
Q2f.Contribution of Norwegian TV/Q2g.Contribution of Norwegian music	0.81
Q3e.Exposure to Norwegian TV/Q3f.Exposure to Norwegian music	0.82

The remaining 38 variables were submitted to a factor analysis.

Appendix F: Access to Phonology Results

Mean Correct Phonology				
	Estimate	Std. Error	z value	p value
(Intercept)	1.68	0.12	14.23	<1e-04
language	0.15	0.20	0.75	0.46
typeName	-0.03	0.21	-0.14	0.89
Cognate	-0.08	0.21	-0.39	0.70
Nowac_Subtlex_Zipf	-0.18	0.16	-1.09	0.28
language:typeName	0.13	0.41	0.32	0.75
language:Cognate	-0.04	0.42	-0.10	0.92
typeName:Cognate	0.30	0.42	0.72	0.47
language:Nowac_Subtlex_Zipf	0.14	0.32	0.43	0.67
typeName:Nowac_Subtlex_Zipf	0.07	0.34	0.20	0.84
Cognate:Nowac_Subtlex_Zipf	0.31	0.35	0.89	0.37
language:typeName:Nowac_Subtlex_Zipf	-0.77	0.67	-1.14	0.25
language:Cognate:Nowac_Subtlex_Zipf	-0.11	0.69	-0.15	0.88
typeName:Cognate:Nowac_Subtlex_Zipf	0.12	0.66	0.18	0.85
language:typeName:Cognate	-0.78	0.84	-0.93	0.35

No effects

Raw counts								
	= cognate common	= EN proper	= nonCognate common	= EN proper	= cognate common	= NO proper	= nonCognate common	= NO proper
0	7	22	10	4	7	11	11	6
1	6	9	4	6	5	11	3	5
2	4	4	4	7	2	3	5	2
3	11	6	4	4	3	6	4	5
4	1	8	2	1	5	9	5	3