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L2 speakers' argument structure sensitivity inferring from the participant's eye gazes

An eye-tracking experimental study with adult Norwegian
learners of English

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Abstract

Eye tracking lets us record eye gazes and the eye-movements of the participants as they are monitored and listen at spoken sentences for words that match pictures on a visual display. Typically, fixation patterns are closely time-locked to the ongoing verbal input, providing a continuous real-time measure of comprehension that is independent of any overt spoken or manual response (Cooper, 1974; Tanenhaus, Spivey-Knowlton, Eberhard, & Sedivy, 1995). To test L2 speaker's sensitivity toward argument structure, we used Tanenhaus's well tested Visual World paradigm, along side with the addition Brock et.al (Brock, Norbury, Einav, & Nation, 2008) did, adding a second condition in which the phonological competitor was present on the screen but the target was absent but mentioned in the utterance (Brock et al., 2008). In addition, the stimuli design was improved compared to Brock & colleagues to avoid the use of verbs with highly predictable argument structure. Consistent with previous studies (Alloppenna, Magnuson, & Tanenhaus, 1998; Brock et al., 2008; Cooper, 1974; Tanenhaus et al., 1995), the results in the current study, conducted on adult University students, shows that eye-movements were affected by the semantic association between the sentence verb and the target object. Moreover, the effect observed in the target present condition, where the restriction effect is evident in the most restrictive sentences. Furthermore, participants looked less at the phonological competitor in the target-absent trails, but the data was not as salient as in the target-present condition.

Preface

This thesis would never have been written if it were not for the help and support of many brilliant people, and not without the knowledge I have acquired over the last five years of University education. These five years have prepared me to face my future work as a teacher. The road into the field of Psycholinguistics happened by coincidental. After my first practice period I faced challenges that made me understand that my basic grammar comprehension and experience needed to be reviewed and renewed. Therefore, when we could start choosing our own educational path, I chose the the path of linguistics; a path truly less traveled. I strongly believe this was the right choice, because when my second and final practice period came and went, I was left with a feeling of confidence and mastery. I was able to design and conduct more advanced, inspiring and more creative lectures. I realized that what I lacked in the first practice period I had gained during my linguistic classes. The solid academic foundation I have acquired combined with my pedagogical and didactical education I am filled with assurance that I am ready to face my future duties at a teacher.

The writing of this thesis have given me, not only an immersion into the field of Psycholinguistics, but self-reliance; positive aspects of teamwork and the importance of trusting one and other; and the most importantly: tenacity and determination.

First I would like to thank my supervisors, Mila Dimitrova Vulchanova & Giosuè Baggio, who have directed me in right direction and provided me with resourceful feedback. A thanks to my research partner, collaborator, and friend, Roger Johnsen. Additionally, I would like to give a special *thank you* to Hendrick Bertil Eshuis, for all your exceptional help with designing the experiment and the analysis that followed, and for your patience towards a statistic novice. Without you there would not be a thesis. Lastly, I would like to acknowledge Martina Pen, for lending us your voice.

My gratitude to our participants, and those who have aided me in creating something that I am really proud of.

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1. INTRODUCTION

This thesis is a result of experimental study conducted on two groups within the Visual World paradigm. The paradigm provides information about the way language users integrate linguistic information with information derived from the visual environment (Huettig, Rommers, & Meyer, 2010). The paradigm is therefore well suited to study the interplay between linguistic and visual information processing (Cooper, 1974; Huettig et al., 2010).

The current thesis is one-part of a two-part experiment. My collaborator and I worked together on every aspect of designing the experiment, from a native language survey to designing the eye-tracking experiment, and the analysis that followed. While my collaborator has worked with data based on Upper Secondary pupils at the age of 16 (Videregående elever), I have been working on data based on adult University students, who have at least completed one year of English studies at a University level.

The following Background section will give an overview of acquisition of argument structure and lexical semantics. Firstly, I will present fundamental ideas from Pinker (1989) regarding argument structure in L1 acquisition; Stringers's (2010) view on how the L1 and L2 compete with each other, and how recent findings show that also L2 users are sensitive to argument structure. Secondly, I will talk about the meaning of lexical units correlates with the structure of language. How verbs work in context; how their arguments are selected, and important features of verbs. In this section I will also talk about cohort competitors. Lastly in this chapter I will talk about the general application of the Visual World Paradigm in research, and the advantages of using it in the field of Psycholinguistics. The subsequent sections will closely examine the execution of the study and the results before finally discussing these results in light of the theory presented.

1.1 Why verbs?

Beth Levin (1993) work on verb "[...] is guided by a assumption that the behavior of a verb, particularly with respect to the expression and interpretation of its arguments, is to a large extent determined by its meaning" (Levin, 1993) The work with this thesis is also much guided by the same assumptions as Levin. By looking at the semantic properties of verbs this thesis investigates how verb's arguments selection sensitivity is found in second language speakers (L2). Verbs are linguistic units that designates events, and how the entities involved

in those events undergo a change of state. A verb such as *give*, is used to designate an event that involves three entities with very defined roles: One is the giver; one is the thing given, and lastly the receiver of the thing being given – each of the entities undergo a specific change of state. These conceptual roles are defined within the verbs meaning. The verb offers a kind of ‘frame’ for structuring larger linguistic expressions, such as sentences (Tomasello, 1992).

Recent work in linguistic theory has stressed the important role that structured lexical representations can play in natural language (Pustejovsky, 1991), for example: argument structure as a distinct level of representation. The main assumption with this thesis, is that lexical meaning of a verb predicts its thematic role selection. Therefore, the theoretical framework for the current thesis is found within the field of lexical semantics, which is the study of how and what the words of a language denote (Levin, 1993; Pustejovsky, 1991).

1.2 The current study

The aim of the study is to test argument structure sensitivity in L2-speakers. Therefore, we examined the processing of a semantically constraining or open verb following a spoken noun by monitoring listeners’ eye movements to pictured objects displayed on a computer screen as they heard the sentence. Their task was to indicate, by pressing a button corresponding to yes or no, which of the four objects was mentioned in the sentence. The target object was mentioned as the object noun.

Our aim with this study was to show: *How the restrictiveness of verbs with regards to their thematic role selection, can direct visual attention towards semantically related objects, and how the likelihood of looking at an object is related to the restrictiveness level of the verb.*

Our initial assumption was that the participants would look more toward the target in the target-present trials, and would look less toward the cohort competition in the target-absent trials, based on the restrictiveness effect of the verbs, and how the more restrictive verbs whose argument structure requires more specific item in object position discouraged participants to look towards unlikely objects.

2. BACKGROUND

2.1 Argument structure

The term “argument structure” is used to refer to the lexical representation of argument-taking lexical items, such as verbs, but also nouns, adjectives, and even prepositions. An argument structure typically indicates the number of arguments a lexical item takes; their syntactic expression, and their semantic relation to this lexical item. Lexical semantics approaches to verb meaning that verbs’ syntactic argument structures are completely predictable from their semantic representations (Gropen, Pinker, Hollander, & Goldberg, 1991; Levin, 1993), and further that the lexical information encoded in verbs can predict the syntactic realization of structures headed by those verbs and the variety of syntactic contexts in which a particular verb can be encountered.

2.1.1 *L1 speaker’s sensitivity to argument structure*

To become a competent speaker of a natural language it is necessary to be conventional: to use language the way that other people use it. Also, it is deemed necessary to be creative: to formulate novel utterances tailored to the constraints of particular communicative circumstances, and make out meaning and connect that meaning to concepts and entities in the world (Saeed, 2015; Tomasello, 2000). Children must generalize from verbs and syntactic constructions they have heard, and constrain those generalizations in order to use the generalization themselves (Brooks & Tomasello, 1999). Tomasello’s influential ‘Verb-island hypothesis’ states that the acquisition of grammar is dependent on the stage whereby children generalize patterns of usage on the basis of individual verbs. A child’s early language is organized and structured totally around these individual verbs and other predicative terms (Tomasello, 1992, 2000). Each verb develops its own mini-syntax independently of other verbs. Simple patterns are learned by imitating others while the more complex patterns develop from the simpler antecedents for each verb separately (Tomasello, 1992). Therefore, the structuring of verbs in children are not the typical verb-general things as ‘subject’ and ‘object’, or even ‘agent’ and ‘patient’, but they think in a more verb-specific way: someone is the ‘hitter’ and the ‘hittee’, and ‘someone is doing the sitting’ and ‘thing that is being sat upon’ (Tomasello, 2000). The child understands when using the verb ‘sit’, someone has to do the sitting and something has to be sat upon. This sensitivity towards argument structure is developed early – between the age of 2 and 4 (Brooks & Tomasello, 1999). One approach to

how children acquire this sensitivity is proposed by Steven Pinker. According to Pinker's theory (1989) children learn classes of verbs, guided by semantic constraints. Essentially, Pinker's idea is that when children acquire verbs, they map the sentences they hear to situations out in the world, and assess to what extent the properties of the situation are linked to that specific verb. These constraints can be broad or narrow: A broad constraint conveys the literal or metaphorical meaning of a syntactic construction, e.g. "Roger gave Lily a book." In that sentence the verb functions prototypically, and describes that a book is being transferred from Roger to Lily. A narrow constraint is when a verb shares a very subtle aspect of meaning with another verb e.g. "Roger awarded Lily a book", sounds a bit odd, nevertheless both the verbs (*gave and awarded*) share the meaning of transfer of possession. Pinker (1989) postulates that children's overgeneralizing errors may reflect the child's developing competence. If the child has not yet properly understood the meaning of a verb, the child may unintentionally use the verb in a construction where the verb does not belong (Pinker, 1989). But once the child has correctly identified the verb's meaning, by placing it in the right semantic class, such errors should automatically stop (Pinker, 1989).

Pinker's idea is that children who use verbs in the wrong syntactic context, e.g. using an intransitive verb in a transitive construction, make this mistake because they do not fully understand the lexical meaning and cannot therefore make the correct judgment how to use the verb in a specific construction. Therefore, constructions like, *Don't giggle me*, may occur, instead of *Don't tickle me*. According to this hypothesis, the child cannot make a distinction between two verbs that semantically convey the same meaning (Pinker, 1989). To stop making these mistakes it would seem that vocabulary size plays an important factor, as it attests to a more developed semantic network which may in turn assist appropriate verb use.

A more recent study by Brooks & Tomasello (1999) shed some light on Pinker's ideas. They observed that only the older children (4-4.5) in the experiment had the sufficient number of verbs in their vocabulary to identify regularities in the experimental constructions with verbs and note semantic similarities among the different verbs that appear in the same construction. When the child understood these similarities, and therefore the meaning of the verb, the child could categorize these new verbs with the ones they already know and add them in his/hers vocabulary (Brooks & Tomasello, 1999). A reason why only the older children showed that they could use novel verbs in new constructions may be because two-year olds show a limited productivity in using verbs in constructions they never have heard before (Brooks &

Tomasello, 1999). They seem to be more conservative in the way they use new constructions, and at a later stage realize that intransitive verbs can be used transitively based on more exposure to verb uses (Brooks & Tomasello, 1999). Brooks & Tomasello conclude that by the age of 2.5 children are aware of abstract transitive and intransitive constructions, and when they acquire more verbs in their vocabulary around the age of 4.0-4.5, they begin to constrain their use of constructions to adult like ranges on the basis of semantic classes, and learn alternative ways of saying things (Brooks & Tomasello, 1999).

2.1.2 Lexical competition between L1 and L2

When learning a new language one can expect to make mistakes. The grammatical errors L2 speakers make can be due to the fact that they transfer their lexical and grammatical knowledge from their L1 and apply those rules in their L2 use (Stringer, 2010). In the cases of verbs, it can be assumed that speakers of two languages do not actually make mistakes in the syntax, but rather that they tend to transfer the arguments of L1 onto the L2 (Stringer, 2010). This specific issue can be seen in context of the semantic value of a word. This value is not only determined by the relationship with an associated concept, but also by its relationship to other words in the same linguistic system (Stringer, 2010). This was already pointed out by Ferdinand de Saussure in 1916, in that a word in one language can correspond to several words in another (Stringer, 2010). De Saussure was also the first to propose the importance of inter-lexical relationships in a language (the notion of “value”). Therefore, errors by L2 speakers need to be seen in the context of sentence meaning, since the interference from the native lexicon is easily transferred from the L1 to the L2 (Stringer, 2010).

The lexicalization of concepts necessarily differs between languages. This can affect the referential properties of vocabulary items and any aspect of syntax that are lexically determined (Stringer, 2010). Verbs refer to events and situations out in the world, and their meaning specifies the involvement of participants, and the participant’s roles. How the verb is being used determines how the addresser conceptualizes the event or situation for the addressee. (M Dimitrova-Vulchanova & Dekova, 2007a) argue that the syntactic behavior of a verb is not only contingent on the verb’s meaning but it is closely related to the type of event lexicalized by the verb. The main idea is the recognition of a verb relies on the chosen representational format of the verb and the situation lexicalized by the verb, whereby each of the participants involved is specified by the encoded information encoded by the verb (M Dimitrova-Vulchanova & Dekova, 2007a). Across languages, the point being made is that

even very subtle differences in conceptualization can affect the syntax from L1 to L2, and even near synonyms across languages can show different argument realizations (Gropen et al., 1991; Stringer, 2010).

These subtle variations between L1 and L2 may cause confusion for L2 learners. Therefore, these learners may fall back on their L1 to help create their language system. By doing so, they mix the properties of the two languages, which may lead to overgeneralization also consistent with Pinker's hypothesis of stages in L1 acquisition (1989).

2.1.3 *L2 speaker's sensitivity to argument structure*

To offer a quick summary of the last paragraphs: It would seem that proficiency concerning the verb's meaning is the key to not making semantically and overgeneralization-related errors. This is interesting regarding L2 learning because the learning of argument structure includes learning both the meaning associated with the senses of the verb, and the specific narrow semantic verb classes consistent with verb meaning (Pinker, 1989). Regarding overgeneralization - learners use rules from the second language in roughly the same way that children overgeneralize, and they tend to overuse more general verbs (semantically underspecified verbs). The examples in (1) – (2) below illustrate verbs which are possible to use in Norwegian, but may require a specific variant of verb in English, rather than the direct translation equivalent.

(1) a) Å ta en beslutning
 #To take a decision
 To make a decision

 b) Å ta en jobb
 #To take a job
 To choose employment

(2) a) Å lage et fly
 #To make an airplane
 To construct an airplane

- b) Å lage en fest
 #To make a party
 To throw a party

In other words, L2 learners need to experience how verbs are used and behave in different contexts. In the same way as children generalize from verbs and syntactic constructions they have heard and then construct constraints on those constructions, L2 learners have to learn the very subtle differences between lexicalization of concepts in their L2 from their L1. By doing so, they will over time (exposure to input) create an understanding of both the semantic and syntactic properties of verbs.

With regards to exposure to input: In a more recent study, conducted by Treffers-Daller and Calude (2015) showed that word frequency is key for acquisition of L2 structures, and L2 learner are sensitive to frequent word input in the language they are learning. What they reported from their study is that word frequency was essential determinant of acquisition of French motion verbs for English learners. The reason being that, for L2 learners it is difficult to acquire new ways to conceptualize motion, and therefore has to to rely on the conceptualization patterns from their L1 (Treffers-Daller & Calude, 2015). Treffers-Daller & Calude found that statistical learning caused L2 motion event patterns to become entrenched and replace the patterns from the L1. In this respect, learning the lexicalization of concepts, and the language boundary crossing constraint is similar to learning argument structure, in that learning both of these requires learners to retreat from overgeneralization (Pinker, 1989). This is coherent with Pinker's semantic theory, but also it empathizes learning in *context* (Gropen et al., 1991; Pinker, 1989; Treffers-Daller & Calude, 2015). Later in this paper, context, will be given attention, as context plays an important role in speaker's conception about verbs (Gropen et al., 1991; Levin, 1993).

2.2 Lexical semantics

In what way do the meaning of lexical units correlate with the structure of language? Two essential properties of language are that language refers to things out in the world, and that parts of utterances describe situations. In order to comprehend communication, and, for example, for one to describe a situation, the situational information has to be understood by both the addresser and the addressee. A significant portion of that situational information which the addressee needs to retrieve is associated with the sentence's verb or verbs (Koenig,

Maurer, & Bienvenue, 2003). The type of situation being described, who is doing what in the situation, and how they contribute to the situation are assumed to be encoded in the lexical entry of the verb (Koenig et al., 2003). In really simple terms: verbs drive the construction of clauses and utterances, as such, a verb predicates situations or events, additionally, the verb describes involvement of participants in particular roles (Saeed, 2015).

2.2.1 *Lexical access or selection*

Dahan and Tanenhaus (2004) present a view, first articulated by Marslen-Wilson (W. Marslen-Wilson, 1989; W. D. Marslen-Wilson, 1987) that lexical prediction in spoken-word recognition can be divided into two partially overlapping sub-processes: *access* and *selection*. During *access*, the spoken input is mapped onto sound-form lexical representations, activating a set of lexical candidates. Access makes available lexically specific syntactic and semantic information about each candidate. A single best-fitting candidate is then selected, taking into account goodness of fit with the input and the context, and integrated with the current representation. The access–selection framework assumes a temporal window during which the activation of the syntactic and semantic components of a lexical candidate is determined solely on the basis of its phonetic match to the input, without influence from, or integration with, context. Under this view, context has a delayed influence on the recognition of a spoken word in spite of being available prior to sensory information about the word itself (Dahan & Tanenhaus, 2004). The important point Dahan & Tanenhaus make is that word prediction seems to be context-dependent. Another strong advocate for the context-dependent perspective is Zwitserlood (Zwitserlood, 1989). The pattern of results from her data is fully consistent with the idea that *access* made available lexical candidates based on their semantic properties (Zwitserlood, 1989).

However, in more recent results, this access-selection framework has been challenged by several authors, amongst them Allopenna et al. (1998), who argues that the system of spoken-word recognition is much more tolerant of phonetic mismatches than the access–selection framework assumes it is (Allopenna et al., 1998). Still, it would seem that Marslen-Wilson’s argument about that word prediction is context-dependent seem to stick (Dahan & Tanenhaus, 2004; W. Marslen-Wilson, 1989; W. D. Marslen-Wilson, 1987). As you will be shown shortly below, this proposition is reinforced by several linguists as well, such as Beth Levin (1993) and more recent Mila Mila Dimitrova-Vulchanova and Weisgerber (2007b).

2.2.2 *Verb features*

In a sentence such as, *Roger cuts Mary's hair*, the verb *cut* needs the overt realization of a subject (who is doing the cutting) and a direct object (the one that undergoes the cutting). This *argument selection/structure* is part of the syntactic and semantic information encoded in the verb (Koenig et al., 2003; Saeed, 2015). Upon hearing the verb, speakers activate knowledge related to obligatory participant information about that verb. Therefore, in the sentence *Roger cuts Mary's hair*, the tool used to do the cutting is also important. The scissors are present semantically, even if they are not realized overtly and not visible at the level of syntax. Just by hearing or reading the verb *cut*, the addressee must assume that the agent is using a tool to perform the task of cutting. This is the situational information that has to be understood by the addresser and the addressee for the sentence to be comprehended. We make these predictions of semantic properties of verbs because this information is inherently included in the lexical entry of the verb (Koenig et al., 2003).

2.2.3 *Verbs in context*

The syntactic behavior of a verb (theta roles, argument structure) can be predicted by the meaning of the verb (Levin, 1993). This is also supported by Gropen et al. (1991) who states that a verb's syntactic structure is predicted from its lexical meaning (Gropen et al., 1991). Therefore, to understand both the syntactic and semantic behavior of a verb, the verb has to be seen in the context of other words. Let us take a closer look at a verb like *run*:

- (3) I like to run.
- (4) She runs a successful business.
- (5) The bus company runs a regular weekend service.

Also the extended uses of the lexical features that are encoded in the verb:

- (6) The road runs parallel to the river
- (7) The motor is running.

We quickly notice that *run* can offer a vast range of meanings based on which context it is placed in. In sentence (3) the subject likes to exercise by moving quickly with his/her legs; in (4) the subject manages a business, and in (5) the bus company offers a service. In the extended use: in sentence (6) the road is situated parallel to the river in space, and is continuously flowing. In (7) the motor is transforming energy to motion energy. Of course *run* can also be realized as a noun:

- (8) Every morning I go for a 5k run.
- (9) The school play had a successful run.

In (8) *run* describes the total length the subject runs every morning, and lastly, in (9) *run* gives information about a period of time. The ambiguity in the processing of sentences is not only related to a verb's meaning but is also closely related to the type of event lexicalized by the verb (M Dimitrova-Vulchanova & Dekova, 2007a). A fully determined interpretation of all sentences, (1) - (9), requires knowledge about the extra-semantic properties of a said verb (Mila Dimitrova-Vulchanova & Weisgerber, 2007b). As a consequence, people are subject for a broad information input with accordingly many different interpretations; therefore, when hearing a word like *run* we access a vast amount of information regarding the word *run*. And then, our semantic knowledge about the word helps us filter out low priority items, and instead access the relevant information based on the discourse and context at hand (Mila Dimitrova-Vulchanova & Weisgerber, 2007b). This process to use context to narrow the possible senses down to the probable ones is called *Word Sense Disambiguation* (Moro, Raganato, & Navigli, 2014; Stevenson & Wilks, 2003).

Due to context and the semantic priming effect upon encountering a word, readers and listeners access a vast amount of both semantic and syntactic information (Koenig et al., 2003; Meyer & Schvaneveldt, 1971). Meyer and Schvaneveldt's (1971) original work showed that people were faster at recognizing a word is when the word was followed by an associatively or semantically related word (Meyer & Schvaneveldt, 1971). Hence, when you hear or read a word, you partially activate other words that are related in meaning (Meyer & Schvaneveldt, 1971) That word information is not limited to that word alone, however, and the information is shared across words. Because words are not organized in our minds independently of one another, they are rather highly interconnected (Koenig et al., 2003). As a consequence, when recognizing a word while reading or listening, our mind can more easily activate or access information regarding what words it is, its relatedness, or what category it belongs in. As a result, we continuously predict words, or situations, based on our lexical knowledge about them and the semantic meaning of the verb, and the context they are put in (Koenig et al., 2003; Levin, 1993; Saeed, 2015).

Similarly, *cohort competitors*, activate words in the lexicon that has the same onset syllable with a given word. This is activated immediately after the beginning of a word is detected. As more syllables are added, more words are ruled out, until only one single word is left that matches the input (W. D. Marslen-Wilson, 1987). The Cohort Model was developed by W. Marslen-Wilson (1989), and states that lexical candidates which together comprise a cohort

competes for recognition. For example, as the word *lasergun* is presented to the processing system, both *lasergun* and a word that has the same syllable onset, like *laces*, would initially become active members of the recognition cohort. But as the speakers continue to utter the word mismatches are detected over time between the two word candidates. Thus, the activation of *laces* would begin to decline at the second syllable of *lasergun*, because the input is no longer consistent with the lexical representation of *laces*. Selection occurs when the evidence is sufficiently strong to support one alteration over the other (Allopenna et al., 1998).

2.3 The visual world paradigm

The visual world paradigm (VWP) has been developed within the area of psycholinguistics. It was first established by Roger Cooper in 1974, as a tool for real-time investigation of speech perception, memory, and language processing (Cooper, 1974). However, Cooper's (Cooper, 1974) work was largely ignored for more than twenty years. Michael Tanenhaus with colleagues, in 1995, published a very influential paper, and proposed to use this paradigm to test the effects of relevant visual context on the rapid mental processes that accompany spoken language comprehension (Tanenhaus et al., 1995). Since the early eighties a key concern among psycholinguists has been how to determine the relationship between linguistic and non-linguistic processes, and how they jointly determine the listener's or reader's understanding of sentences (Huettig et al., 2010). In this perspective, Tanenhaus and his collaborators were the first to show that the visual world paradigm is powerful tool, and is well suited to study this interplay between linguistic and visual information processing (Huettig et al., 2010).

2.3.1 Key properties of the visual world paradigm

The basic set-up for a for a visual world comprehension experiment is: For each of the trials the participants hear an utterance, while looking at visual stimuli. A camera built in the screen records the participants' eye movements for later analyses. Most commonly, pictures of objects that are mentioned in the utterance are displayed on the screen as target objects, alongside with distractor objects and a phonological competitor to the target object (Huettig et al., 2010). Cooper's study in 1974 first demonstrated that eye movements are directed towards the objects which are in the concurrent visual field when the participants hear an utterance in which the words refer to a target associated with the visual display (Cooper, 1974; Huettig & Altmann, 2005). Perhaps the most interesting observation Cooper made was that, as the words

unfolded in time, participants were more likely to gaze towards a picture of an object (e.g., dog) when the participants heard the onset of the object label (e.g., the word *dog*), rather than to fixate on unrelated pictures (Huettig & Altmann, 2005). This, as mentioned earlier, was later confirmed by Tanenhaus et al (1995) and Allopenna et al (1998).

However, in more recent experimental designs the introduction of a *cohort competitor* has shed light on some interesting effects. Visual world studies with a cohort competitor have examined whether the objects are phonologically, semantically or visually related to a target attract attention (Huettig et al., 2010). For instance, Allopenna, Magnuson, and Tanenhaus (1998) studied if listeners would look equally at the target referent and the cohort competitor shortly after the onset of the word. In doing so, they were the first to observe that a presence of a cohort competitor increased the latency of eye movements to the target, but actually also induced more frequent looks to the target (Allopenna et al., 1998). The presence of a competitor in fact activates also the target, leading to increased proportion of looks towards the target soon after the phonological competition has been resolved. With a cohort competitor present on a visual display, it would seem that even potential lexical candidates that are sufficiently similar to the spoken word can become activated enough to compete for recognition (Allopenna et al., 1998). The presence of a phonological competitor on the screen also induced frequent looks away from the target word. These results indicated to Allopenna et al that two words with similar phonological sounds compete with each other, and the time the participants uses to gaze toward the target word increases (Allopenna et al., 1998). At 200ms after the onset of the word, listeners would start to gaze towards the objects matching either the target or cohort competitor in the utterance instead of gazing to the unrelated distractors. In fact, eye movements to the cohort competitor would not begin to drop off before after the end of the word being said, at around 600ms, in response to new sound input that ruled the cohort competitor as an incompatible match (Allopenna et al., 1998).

In a more recent study, Huettig & Altmann (2005) conclude from their semantic priming study that eye movements are driven by the degree of match between a word and the mental representations of objects in the concurrent visual field (Huettig & Altmann, 2005). Both the studies by Allopenna (1998) and Huettig & Altmann (2005) show that the presence of a cohort competitor greatly increases the likelihood of observing competition effects. Visual attention can be directed almost immediately, as a word unfolds, towards an object of interest even if that object is a mismatch of the target referent mentioned in the utterance. This

demonstrate that language-mediated eye movements are sensitive to the overlap between the conceptual information conveyed by what the participants hear, and the participant's conceptual knowledge associated with the visual objects on the screen (Huettig & Altmann, 2005). So, what participants engage in in such tasks is to judge the degree of match/overlap between the language they are hearing and what is represented in the visual display on screen. This is what drives the language-mediated visual attention (looks towards objects) and this what the VWP exploits. It can tap both on-line comprehension and lexical retrieval (judging by the change in gaze pattern as the utterance unfolds), as well as check to what extent the visual world affects our understanding of language, and possibly constrains it (this is seen by how participants attend to objects present or absent on screen).

2.3.2 *Advantages*

A clear advantage of the visual world paradigm compared to other psycholinguistic paradigms is that listeners are not required to perform any meta-linguistic tasks or judgments. The visual world paradigm solely relies on the listeners' look towards objects of interest on a computer screen as they are mentioned. This way researchers can study some groups that otherwise would be excluded, e.g. individuals with developmental deficits (Huettig et al., 2010). Brock with colleagues (2008) investigated the claim that people with autism have difficulty processing ambiguous linguistic information in context. They conducted a study of 24 adolescents with autism by recording their eye-movements (Brock et al., 2008). Eye-tracking the participants' behavior turned out to be a useful tool when gathering data in that group. In the VW paradigm, the eye movements that are measured provide a level of sensitivity necessary when studying such groups. It can thus detect subtle competitor effects, speech processing, and the relationship between linguistic and non-linguistic processes in spoken word recognition (Allopenna et al., 1998; Huettig & Altmann, 2005; Huettig et al., 2010).

By using the visual world paradigm, language comprehension can be studied in a realistic and almost natural environment with real-time precision and with non-invasive tasks - where words are embedded in connected and meaningful language (Tanenhaus & Spivey-Knowlton, 1996). The analyses in the VWP studies focus on the question of how likely the participants are to look at specific regions of interest at different times during a trial. The most common dependent variable are fixation proportions on the the interest areas during a defined time window (Huettig et al., 2010). Spoken and visual media provide complementary information, and it is deemed useful to process them together. The reason for this effect is because listening for a word, or gazing to an object of interest, not only facilitate the recognition of the word or the object, but also activates associated information (Huettig et al., 2010). On this backdrop, the VW paradigm can help shed light on the mental processes connected to speech and visual interpretation, and by doing so can help us to better understand the interplay between linguistic and non-linguistic processes.

3. METHOD AND MATERIAL

Eye tracking lets us record eye gazes and the eye-movements of the participants as they are monitored and listen at spoken sentences for words that match pictures on a visual display. Typically, fixation patterns are closely time-locked to the ongoing verbal input, providing a continuous real-time measure of comprehension that is independent of any overt spoken or manual response (Cooper, 1974; Tanenhaus et al., 1995). To test L2 speaker's sensitivity toward argument structure, we used Tanenhaus's well tested Visual World paradigm, along side with the addition Brock et.al (Brock et al., 2008) did, adding a second condition in which the phonological competitor was present on the screen but the target was absent but mentioned in the utterance (Brock et al., 2008). In addition, the stimuli design was improved compared to Brock & colleagues to avoid the use of verbs with highly predictable argument structure. Our experiment is approved by the Norwegian Centre for Research Data (NSD). All results concerning sensitive participant data have been anonymized and the participants' names are not stored with the participant list.

3.1 Participants

The eye-tracking experiment was conducted on 29 individuals at the Language and Acquisition lab at NTNU Dragvoll. Three participants had to be excluded from the analysis due to different reasons: One male had hearing impairments; one female had learning disabilities, and one female had English as her native language. Therefore, 26 participants were included in the analysis (n=26, M=12 and F=14, age range: 20-28, age mean: 24.07). All the participants involved in the analysis were Norwegian native speakers. They had all completed a one-year introductory course of English at University level.

3.2 Stimuli

3.2.1 Visual

The eye-movements were analyzed by four rectangular pictures that were defined as the areas of interest. Each picture occupying 25% of the screen height and width and centered on one of the four objects in the display. During the experiment, for each of the trials, the participants were presented with four pictures. In the target-present conditions, one picture was the target object; the one the participants were instructed to look for based on the utterance they heard. One picture represented the phonological competitor of the target object; phonological competitors had the same onset syllable as the target objects. In addition, there were two

distractor pictures, with no relevance to the utterance being spoken. In the target-absent condition, each display contained a phonological competitor of the target word and three unrelated distractors. The distractors in one trial could be the target object or the phonological competitor in another trial. Thus, all of the 24 pictures were recycled, and reused in other trials. This ensured that we could effectively control for stimulus characteristics, such as word frequency or picture salience. The position and identity of the target object and phonological competitor were fully counterbalanced, so that one picture would not be more looked at more frequently or longer. Additionally, all the pictures were clip art pictures, gathered from open online resources. Clip art is pre-made images used to illustrate any medium, they are often in vector graphics and very simple drawn pictures of everyday objects; not flamboyant, and use few colors. None of them were visually more salient than the others, and therefore, they were very suitable for our purposes. For complete list of all the visual stimuli, see appendix 2.

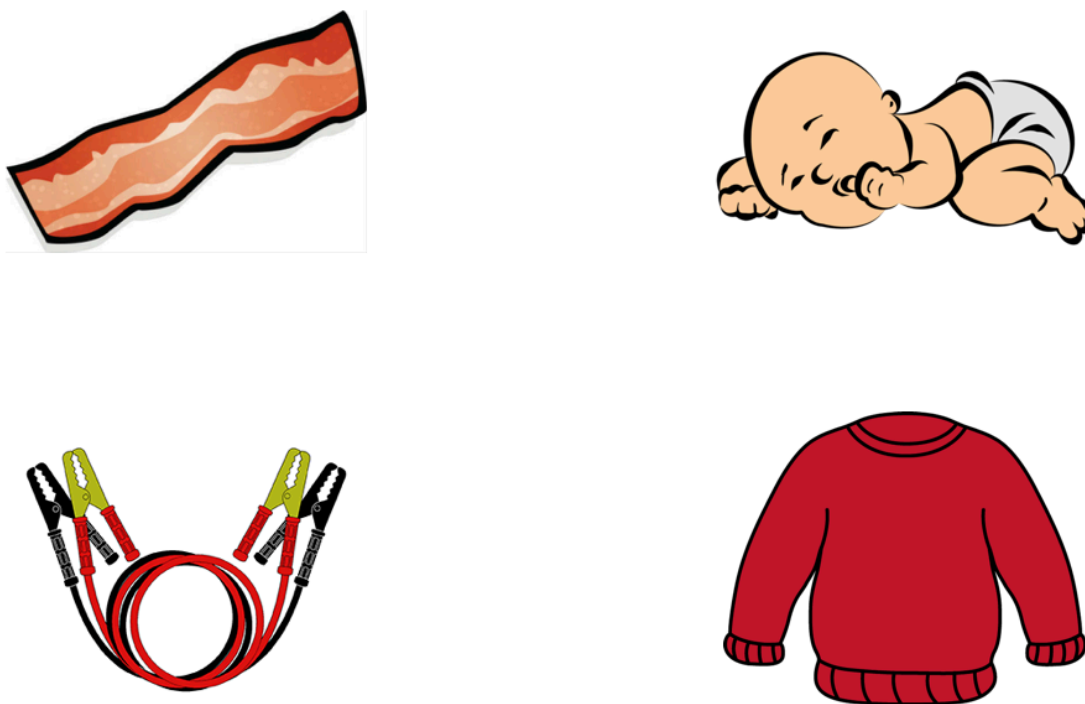


Figure 1. Screen-shot of experimental stimuli. Eye-movements were analyzed by defining four rectangular regions of interest, each occupying 25% of the screen height and width and centered on one of the four objects in the display.

Allopenna et al. (1998) included a preface where the participants were exposed to the visual stimuli before the start of the experiment to explicitly express the relationship between the

visual stimuli and words. The present study did not have such preface and in order to ensure that the participants perceived *back door*, *cattle*, *lemming* and *laces*, as such and not as *door*, *cow*, *hamster* and *shoelaces* respectively, these items first occurred as competitors in the target-absent trials. By doing so we could ensure that the items were referred to as the objects we intended. As a result, by the time participants saw these images as targets, they had already heard them being referred to as *back door* rather than *door*. Thus excluding any ambiguity.

3.2.2 Auditory

The sentences used were recorded digitally at the Phonlab at NTNU Dragvoll by a female native English speaker. Each sentence was five words long, consisting of an agent (subject), a verb, a definite article, the target noun, and an adverb. In all, 144 recorded sentences were used in the duration of the experiment. For a complete list of all the sentence as they occurred in the experiment, see appendix 1.

3.3 Procedure

3.3.1 Preparatory stage

Before designing the experiment, we had to decide on which verbs we wanted to use in the experimental trials. First of all, we needed a basis for the categories of verbs to be included. Therefore, we decided to categorize verbs based on their argument selection. We assumed that some verbs were more restrictive in the way they selected their arguments. Consequently, we decided that we would categorize verbs in 'open' and 'constraining' categories, and this would be based on how restrictive the verb is based on the number of possible fillers for an argument each verb selects.

The question was: "How can we say that a verb is open or constraining?" At least by the definition we were thinking. To our knowledge no previous attempt to categorize verbs in this manner has been done. Yet, some classification of verbs has been previously attempted. The largest verb classification for English is Levin's (1993) work which defined groupings of verbs based on syntactic and semantic properties (Levin, 1993). These classes are useful for their ability to capture generalizations about a range of cross-linguistic properties (Kipper, Korhonen, Ryant, & Palmer, 2008). For example, verbs which share the meaning component of 'manner of motion' (such as travel, run, walk), behave similarly also in terms of sub-categorization (I traveled/ran/walked, I traveled/ran/walked to London, I traveled/ran/walked

five miles). Although the correspondence between the syntax and semantics of words is not perfect and these classes do not provide means for full semantic inference, their predictive power is nevertheless considerable (Kipper et al., 2008). Still, this was not helpful in the way we wanted to group the verbs. Where Levin's work is guided by the assumption that the behavior of a verb, particularly with respect to the expression and interpretation of its arguments, is to a large extent determined by what meaning it denotes, e.g. verb of motion, verbs of touch (Levin, 1993). Our classification is guided by how restrictive the verb's argument structure is, and therefore, how many arguments the verb is capable of taking. Therefore, we decided that Levin's categorization was not suitable for our intentions. Thus, we took this as an opportunity to do something for our self, and the way we decided on was to get English L1 feedback. Therefore, the next step was to make an investigative survey.

3.3.2 L1 speaker input and verb categorization

An important aspect of the present study was to examine how the level of constraint enforced by the sheer number of possible fillers in argument positions a verb can take would affect participants' expectations as reflected in the gaze proportion data. The expectation we had was that a more constraining verb would aid the participants and increase the probability of looks towards the target object compared to less constraining verbs.

Based on an online corpus we made an initial list of 100 of the most commonly used verbs in English used by native speakers in everyday conversation. Within short time, the initial list was down-sized to a list containing 77 verbs. We excluded 'psych verbs' that includes verbs of perception, cognition and emotion, as they appear quite non-tangible and usually take an abstract direct-object. We did this based on our understanding that it would be easier to find images that depict everyday- and concrete objects.

With these 77 verbs we constructed non-complete sentences. The sentences we constructed had an agent and a verb, but lacked the patient, or the theme (direct object) e.g. 'He wore...'. All the sentences we constructed were in the past tense.

We made an arrangement with a British University to help us distribute our survey. 105 University students ended up taking our survey. Approximately 20% were male and 80% female; all the participants had an average age of 19.68 years, ranging from 19 to 45 years old; over 80% only spoke one language at home, and all of the participants had English as

their native language, which in fact was the most important factor regarding validity. The survey was voluntarily, but was encouraged by an academic staff member. The participants received a small remuneration for their participation. The survey was approved by The Ethics Committee at the University of East Anglia.

Based on the data from the L1 survey, we were able to determine which verbs selected highly conventionalized direct object instantiations, while others elicited a greater variety of responses. Since we did not have any previous research to refer to and sort out the categories, we set up rules and criteria on to how to categorize the verbs. We adopted McRae's (1997) view on constraints as verb-specific concepts associated with the arguments of a verb (McRae, Ferretti, & Liane Amyote, 1997).

These *constraints* we put on the verbs would be based on the information about the range of arguments fillers that occurred with each verb. Therefore, we decided that if a verb would take 3 different objects and those objects would constitute 55% of the responses, we would put that verb in the '*narrow category*'. E.g. the sentence "*He watered...*" elicited few different responses; almost all the responses were *the flowers* or *the plants*. Consequently, *watered* was put in the narrow category. Concerning the other categories, if a verb would have between 4 and 6 different objects, and those responses also would constitute 55% of the participant's responses we would put the verb in a '*middle category*'. E.g. the sentence "*Bob painted...*" gave more variety of responses compared to "*He watered...*". Therefore, *painted* ended up in the middle category. The last category would contain the most '*open*' verbs. To be added into this category the verb had to have more than 7 different objects and the responses would have to constitute 55% of the answers. It should be added that this was a 'try-and-fail' attempt by us to see what eventually would work. But by using these constraints described here, all of the verbs were distributed quite evenly among the three categories.

An important note to be made regarding the distribution of the verbs is that our method in by no means precise. It is solely based on the criteria we set and the native speaker responses. Yet, we feel the quality of categories match and reflect our own definition of open and constraining verbs, and our own initial thoughts on the subject.

Furthermore, we decided that we would have 16 verbs in each category, meaning that we had to further downsize the lists. We did so by excluding the verbs that had objects that we

thought would be difficult to depict, included ambiguity, or did take abstract entities as their objects. Such verbs as *reduced* and *worshiped* were excluded because it would be difficult to find pictures matching *price* and *God*, which was the most common responses to *reduced* and *worshiped*.

3.3.3 Object pictures and sentences

The next step in the process was to find appropriate objects that could be used as both targets and phonological competitors. It was important that the objects could be used in both positions because we wanted to use each object twice across the three categories. All of the objects used in both conditions were associated with the verbs in both target and competitor trials. By doing so, we could facilitate the condition so that the pictures on each trial were presented in a fixed pseudo-random order to ensure that the same pictures were not repeated on consecutive trials. In order to comply with the L1 survey, the object nouns were constructed that either matched one of the most frequent answers from the survey identically, or came as closely as possible with regards to semantic characteristics. For example, the item *laces* was constructed for the verb (to) *tie*, which had shoelaces as its most common answer. This object functioned as competitor to *laser-gun*, which again was constructed from the frequent answer *gun* from the verb (to) *fire*. This way we could comply with our own preferences, and use the object in both present and absent trials.

In addition to the 3 test categories we had a neutral condition. In this filler condition the verbs were always *picked*, *chose*, *selected*, or *took*. (e.g. Alex selected the *notes* carefully). In all there were 24 filler sentence, so each object was used once in each trials in this condition.

The final step before designing the experiment on a Tobii computer was to construct sentences. Each sentence began with one of three gender-neutral names, (Sam, Alex, or Charlie), Mary was also one of the names used but to not confuse the participants with the object ‘man’ actually being referred to the subject, a girl’s name was used. Each of the sentences ended with one of eight adverbs (gently, hastily, happily, carefully, accidentally, quickly, regularly, or eagerly). The adverb at the end is added so the object will not be the last word the participants perceive. In all the categories the verb was somehow associated with the target (e.g. Alex memorized the *notes* carefully).

3.3.4 *Eye-tracking – equipment and set-up*

The experiment was conducted using a Tobii T120 eye-tracker. Eye-movements were sampled at 60 Hz with an integrated eye-tracker camera. Sources of near infrared light produce reflections on the pupils. These reflections are used by the system to calculate eye movements and where someone is looking on the display. The eyetracker was calibrated prior to testing and again before every trial was conducted.

Prior to the start of the experiment, each participant completed two proficiency tests, and one self-evaluation test. The two proficiency tests were both administered online and included one test on grammar and one on vocabulary. The grammar test is a ‘Level of English’ test developed to assess the participant’s ‘Common European Framework of Reference for Languages’ (CEFR) level. CEFR is put together by the Council of Europe as a way of standardizing the levels of language exams in different regions. It is very widely used internationally and often important exams are mapped to the CEFR. Within the framework there are six levels: A1, A2, B1, B2, C1, C2. Where as A1 is the least proficient speaker and C2 is the most proficient, and closest to a native speaker. The vocabulary test is developed at Ghent University, and test how many words the participant knows. The self-evaluation questionnaire was used to give us some background information about the participants. We could check if some participants had to be excluded from the analysis based on different reasons. But it also provided us about some general information about the amount of input from different media the participants are exposed to. The two proficiency tests were conducted so we could add a proficiency variable in the analysis if we would deem it necessary.

Each of the participants were seated in a chair, with their face approximately 60 cm away from- and directly in front of the screen. The audio output for the participants came through Philips Citiscape headphones. The headphones are, according to Philips, rather good at filtering out irrelevant sound and noise. The participants sat alone in a room with no other instruction to complete the experiment and contact us when they were done.

The participants received the exact same instructions to listen to a recoding, and identify if the object mentioned in the sentence corresponded with any of the four pictures on the screen. If the participants could identify the object mentioned in the utterance on one of the pictures they were instructed to press a button on a controller corresponding to YES. If they could not

identify the object mentioned in the utterance, they were instructed to press a button corresponding to NO. The controller in use was a simplistic Xbox-controller, originally designed to be used for playing Xbox games on a Windows computer. As an assurance, the controller's buttons was clearly marked with tags with the labels yes and no. As an extra precaution, the buttons that were used were not situated close to each other, so the participants would not accidentally press the wrong button.

Each trial began with an animated, centrally-located windmill. Once the participant was looking at the center of the windmill, the experimental display was presented and remained onscreen until the trial's conclusion. The conclusion for each trial came after the participants pressed a button, or if the participants did nothing to interact, the trial would automatically end after 8000msecs, thus moving on to the next trial. The recorded sentences would begin 1000msecs after the display onset, and each sentences lasted an average of 3000msecs. The 1000msec preview of the objects on the screen is of significance: the likelihood of fixating particular objects depended on the time participants were given to retrieve relevant representations about the objects (Huettig et al., 2010). The latency between the visual and auditory stimuli give the participants time to familiarize themselves with the objects on screen.

3.3.5 Analysis

Prior to the analysis, we decided that trials that had less than 25% registered gazes during the duration of each trial would be excluded. Consequently, 1.20% of the trial data had to be excluded due to missing user values (due to blinking; looking away from the monitor). Which was to be expected and since the percent of excluded trials were so low this would not have any affect on any further analyses.

For each analysis, a critical time window was defined. The two conditions were divided up into two different time windows due to the fact that in the target present trials, the participants were much faster to conclude if the target object was on the screen contra in the target-absent trials. We then calculated for each participant the proportion of time spent fixating within the region of interest. ANCOVA repeated measures were then applied, in which compares a response variable by both a factor and a continuous independent variable. Analysis of covariance (ANCOVA) was employed to explore prediction in eye- movements in terms of the restrictiveness of verb types, with proficiency scores treated as a covariate.

4. RESULTS

4.1 Proficiency results

4.1.1 Grammar

All the participants except one scored at the highest level on the grammar proficiency test (C2), with the exception scoring at the second highest level (C1). Therefore, we could not use the grammar test as a covariate in the ANCOVA, due to the *ceiling effect*, which could mask a potential effect of the independent variable. The reason being that all the participants would have been grouped into one single category, and therefore they would not be distinguished for a real effect on the dependent variable. Therefore, the grammar proficiency score was excluded as a covariate.

4.1.2 Vocabulary

Vocabulary scores, on the other hand, were included as a covariate when ANCOVA was applied. When a multivariate ANCOVA test between the subjects was used the vocabulary scores *almost* showed a significant between-subjects effects (tab. 1)

Table 1. Effects of the participants' vocabulary (IV) scores as a predictor of gazes towards the area of interest in the target-present condition.

	Difference	F	Significance	η^2
Vocabulary	1	3.871	.061	.139
Error	24			

With a moderate measure of the strength of the relationship between vocabulary score and the dependent variable gives an indication that participants with a higher vocabulary score have increased looks at the target. This is quite evident when table 1 is represented as a scatter graph, as show in figure 1. The most significant item the graph shows is that the participants with the highest vocabulary score are the ones that have faster and more looks at the target in all categories. We would expect that below the most restrictive line we would find the moderate restrictive sentences, and the least restrictive and followed by the baseline sentence.

This is just shown for the case in the participants that scored the lowest on the vocabulary test. The most proficient participants seem to have more looks towards the target in the least restrictive and in the baseline sentences than in the moderate restrictive sentences.

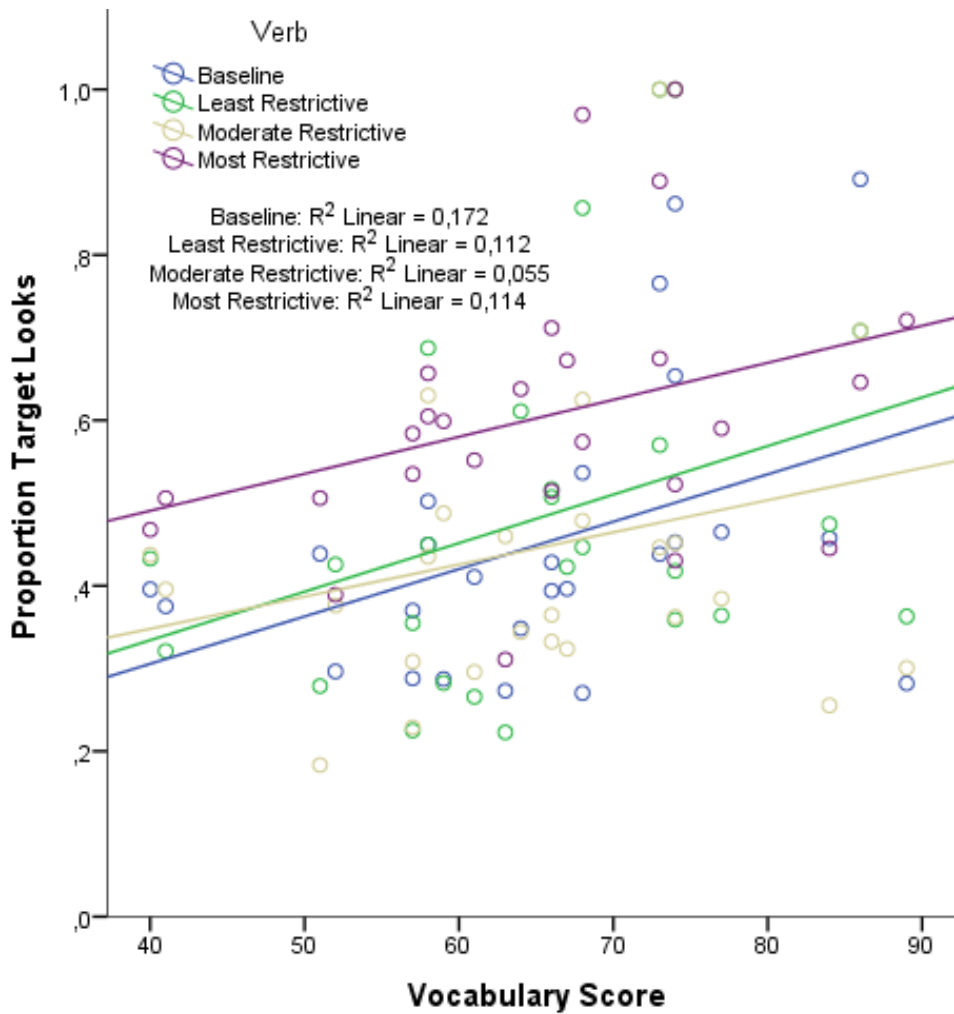


Figure 2: The graph shows vocabulary score compared to proportions of target looks.

4.2 Descriptive results

4.2.1 Accuracy and Response time

In table 2. and 3. accuracy and reaction time (RT) are showed in target absent and target present conditions, respectively. In both tables RT is from the onset of the verb, and the accuracy is shown as if the participants pressed the correct YES/NO button during the trial to answer if the target was on screen or not.

Table 2. Shows the mean of accuracy and reaction time (RT in msec) in the target absent conditions.

Target present	Verb type	Minimum	Maximum	Mean	Std. Deviation	
NO	0	Accuracy	.75	1.00	.921	.10
		RT	2511.08	3949.88	3278.14	405.21
	1	Accuracy	.75	1.00	.96	.05883
		RT	2544.53	4132.87	3270.65	357.15
	2	Accuracy	.81	1.00	.96	.048
		RT	2566.81	4040.31	3351.10	409.29
	3	Accuracy	.81	1.00	.944	.060
		RT	2451.56	3871.38	3297.14	384.21

Table 3. Shows the mean of accuracy and reaction time (RT in msec) in the target present conditions.

Target present	Verb type	Minimum	Maximum	Mean	Std. Deviation	
YES	0	Accuracy	.79	1.00	.96	.051
		RT	2458.63	3677.50	3179.48	314.87
	1	Accuracy	.88	1.00	.98	.031
		RT	2412.06	3625.81	3142.51	300.88
	2	Accuracy	.81	1.00	.9615	.047
		RT	2519.06	3658.06	3234.01	335.06
	3	Accuracy	.81	1.00	.97	.047
		RT	2346.38	3835.63	3130.38	356.85

Even though there are some differences between reaction time between conditions, the mean reaction time across all verb types is significant. The accuracy score is also very high; this is to be expected. Nonetheless some participants have still made a few occasional errors in all

categories and both conditions, even though we clearly marked the controller with YES and NO labels.

The table shows that the participants had the fastest RT in verb type 3 in the target present condition across both tables. Yet, in the absent conditions, participants were the second slowest in the same verb category across both tables, also with the second lowest accuracy score across both tables.

To summarize, even though there are some minor differences, both the high accuracy score and reaction time, indicates that the participants did what we instructed them to do.

4.3 Target present condition

In the target-present, anticipatory looks towards the target item reflects an understanding of the verb and an ability to map that verb onto a likely referent (Brock et al., 2008).

Gaze proportions towards the different item were averaged over the course of the critical time window in order to compare the different verb categories. This window was defined on the basis of visual inspection of figure 3: This was done in order to establish when the auditory stimuli, from the onset of the verb, facilitated looks towards the interest areas on the screen. The time window was therefore defined to 400msec to 1400msec from the onset of the verb. The resulting mean scores from the critical time window are presented in table 4, and show that the sentences with the most restrictive verb mediated most looks towards the target. Additionally, the least restrictive category actually facilitated slightly more looks than the moderate restrictive category.

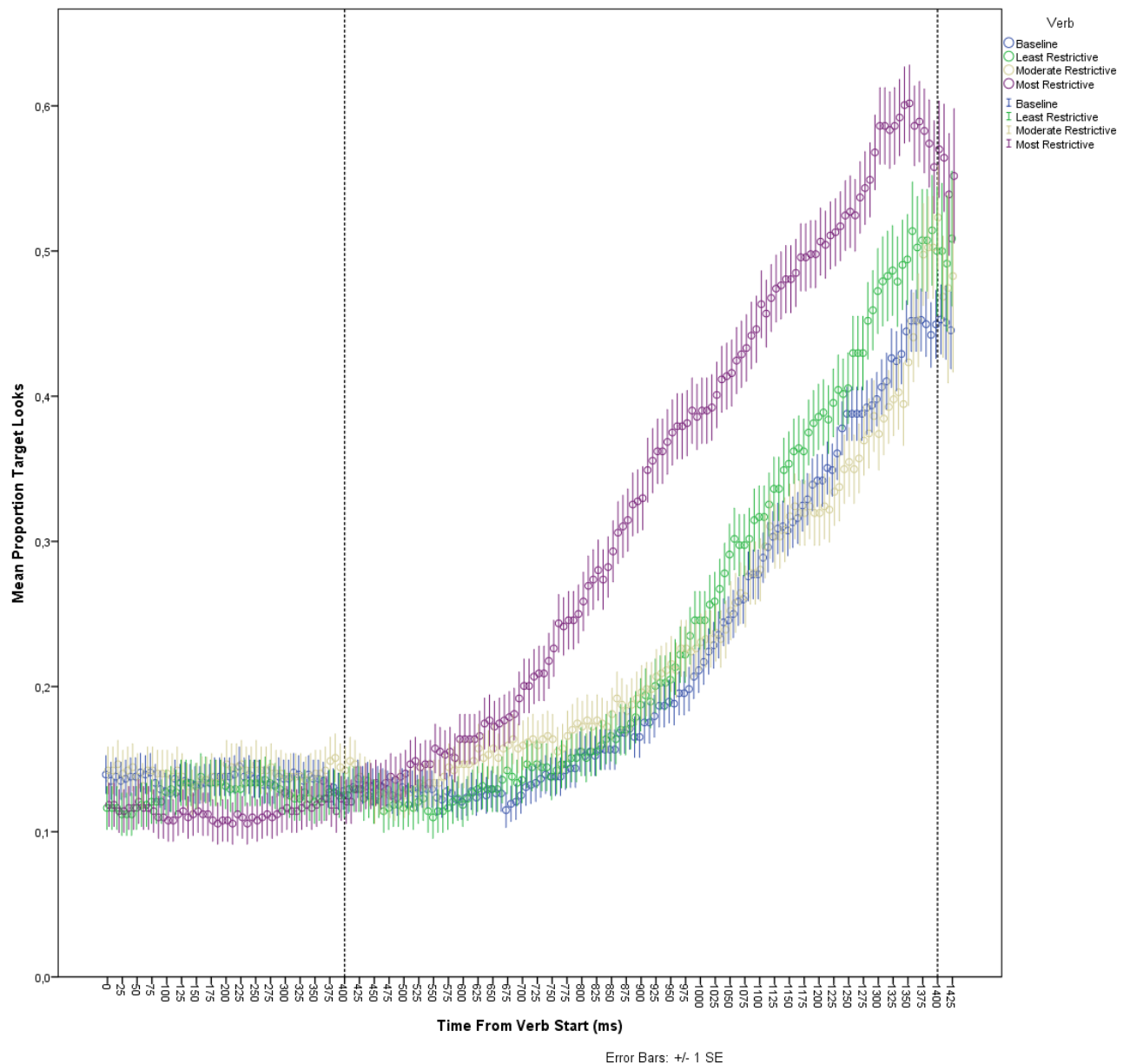


Figure 3. Presented are the mean proportions of looks towards the target across all verb sentence types. The dotted line indicates the critical time window.

It is quite obvious that the most restrictive verb sentences elicit the most looks at the target. But what is surprising is that the least restrictive verb sentences are the ones that comes in second, closely followed by the baseline sentences. The moderate restrictive verb sentences are the ones that elicit the least looks toward the target. The mean onset from the utterance start to the start of the verb is 614 msec, and the mean target object onset is 1256 msec from the utterance start. Given the previously mentioned finding from (Allopenna et al., 1998) that fixation on appropriate objects start about 200msec after the onset of target word(around 1500msec after post utterance start), we would not expect participants to start increasing their looks towards the target item before app. 820 msec post verb onset if their gaze was not

mediated by any previous linguistic information (i.e. the verb). Increased gaze proportions towards the target item is seen well before this point, with a much larger effect for the constraining verb than the less constraining ones, and it seems that this effect lasts until around 1400 msec post verb before it gradually wears off, and the participants have pressed a button (mean=3171msec after utterance onset). In order to compare the different categories, gaze proportions were averaged across a defined time window. Performance was above chance level, chance level would be below .25. This is shown in table 4.

Table 4. Mean of proportions of gazes towards the target item for all the participants per verb category during the critical time window (400msec to 1400msec).

Verb category	Mean	Std. Deviation	N
Baseline (0)	.45110	.169412	26
Least restrictive (1)	.48323	.215273	26
Moderate restrictive (2)	.44676	.202961	26
Most restrictive (3)	.60423	.162625	26

The most restrictive verb sentences elicited more looks towards the target than the rest of verb sentences did. To test whether the difference in gaze proportions across verb sentence types were significant a pairwise comparison was done. The data are presented in table 5.

Table 5. The comparison between the verb types in the present condition.

Verb type	Compared to...	Mean Difference	Std. Error	Significance	Effect size (Cohan's <i>d</i>)
0	1	-.032	.030	1.000	-.224
	2	.004	.031	1.000	.0224
	3	-.153	.031	<.001	-.981
1	2	.036	.028	1.000	.123
	3	-.121	.027	<.001	-.700
2	3	-.157	.035	<.001	-.927

Table 5 shows pairwise post-hoc comparison between the verb types in the target present condition. The baseline sentences (0) is not different from the least restrictive (1) and the moderate restrictive sentences (2), but compared to the most restrictive sentences there is a clear significance, $M_{diff} = -.153$, $sem = .031$ $p = <.001$. The least restrictive sentences are not different from the moderate sentences, but again, they are significantly different from the most restrictive sentences, $M_{diff} = -.121$, $sem = 0.027$ $p = <.001$. Lastly, the moderate restrictive sentences are significantly different from the least restrictive sentences, $M_{diff} = -.157$, $sem = .035$, $p <.001$. In other words, the most restrictive verbs are significantly different from all other verb types. But the data shows that other verb types do not differ from each other.

With vocabulary scores as covariate when applying ANCOVA, and a test between subjects is used; which measures of how much each individual participant tends to change (or vary) over time, revealed that there is no significance between the verb types and vocabulary scores, $F(3,72) = .294$, $p = .829$, $\eta^2 = .012$.

4.4 Target absent condition

In the target absent condition, the cohort competitor effect was the main point of interest. Increased gaze proportions towards the cohort competitor in trials where the target item was not present would indicate that the cohort competitor items were effective, and that the presence of an object with similar phonological onset would attract attention. Decreased probability of looks towards the cohort competitors in the more restrictive sentences compared to the more open and less restrictive sentences, could indicate that verb whose argument structure requires more specific item in object position discouraged participants to look towards unlikely objects.

As in the target-present conditions, gaze proportions towards the cohort competitor item were averaged over the course of the critical time window in order to compare the different verb categories. This window was defined on the basis of visual inspection of figure 4 in order to establish when the mean of the auditory stimuli, on the onset of the object. The time window was then defined to 220msec to 720msec from the onset of the object word.

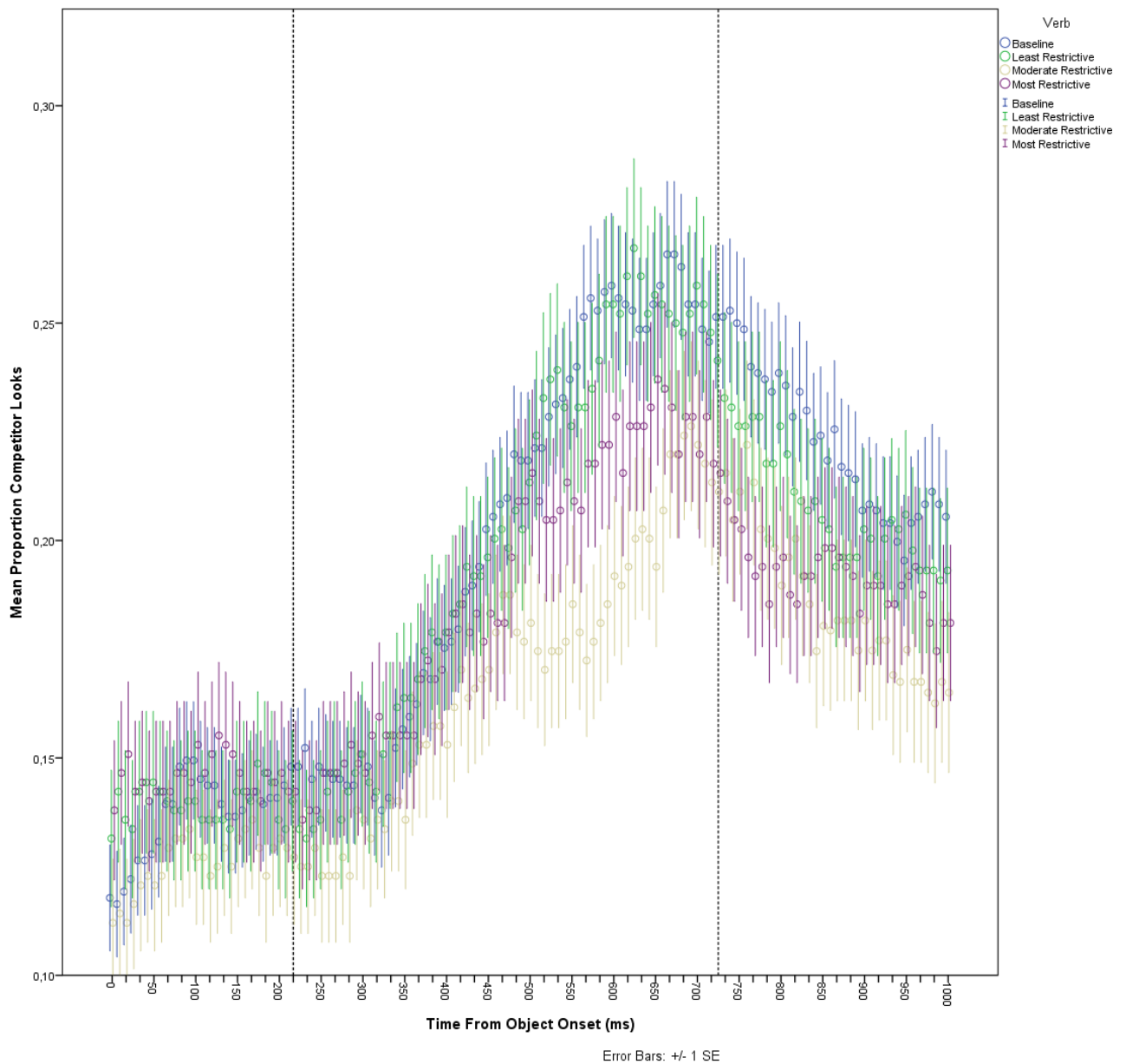


Figure 4. Presented are the mean proportions of looks towards the cohort competitor across all verb sentence types. The dotted line indicates the critical time window.

Figure 4 shows that around 150 msec after the object onset, the participants have slightly increased looks at the cohort competitor in the most restrictive sentences, but only for a very brief moment of time (for about 100msec). The figure also shows that the moderate restrictive verb sentences are the ones that seems to elicit the fewest looks through out the whole duration of the trial. When the defined time critical window starts it is distinct that the least restrictive verb sentences elicit more frequent looks at the cohort competitor than the rest of the verb type sentences, and it seems that it that category elicit the most looks through the remainder of the trial. It would seem that around 400msec after the the object onset that participants have concluded that in the most and moderate restrictive verb sentences that the

object in the utterance is not compatible with the cohort competitor. In order to compare the different categories, gaze proportions were also averaged in the target-absent conditions across the defined time window. Performance was above chance level, chance level would be below .25. The resulting mean scores from the critical time window are presented in table 6.

Table 6. Mean of proportions of gazes towards the cohort competitor item for all the participants per verb category during the critical time window (220msec to 720msec).

Verb category	Mean	Std. Deviation	N
Baseline (0)	.40677	.167181	26
Least restrictive (1)	.36219	.139524	26
Moderate restrictive (2)	.33050	.202821	26
Most restrictive (3)	.33889	.164786	26

During the critical time window the moderate and the most restrictive elicited fewer looks towards the cohort competitor compared to the baseline and the least restrictive sentences. To account for any difference between the verb categories a pairwise post-hoc comparison between the verb types was done. That revealed that there was no significant difference in gaze proportions for the different verb categories ($p > 1.00$ for all cases across the verb categories). Even though the moderate and most restrictive categories elicited fewer looks towards the cohort competitor, the constraint of the argument structure did not seem to influence the probability of look towards the cohort competitor in the target-absent trials. Even though the post-hoc comparison did not reveal any significant difference between the verb sentence types, the cohort activation, as measured by the proportion of looks to the cohort competitor rose more rapidly and had a higher peak in the baseline and least restrictive sentences than in the moderate and most restrictive verb sentences.

5. DISCUSSION

Consistent with previous studies (Allopenna et al., 1998; Brock et al., 2008; Cooper, 1974; Tanenhaus et al., 1995), eye-movements were affected by the semantic association between the sentence verb and the target object. Moreover, the effect observed in the target present condition, the graph (figure 2) paints a rather obvious picture that the restriction effect is evident in the most restrictive sentences. Furthermore, participants looked less towards the phonological competitor when the preceding verb in the most restrictive sentences made the phonological competitor a more unlikely referent. Accuracy and response time were generally also very high across all verb sentences types, therefore not playing any significant difference.

5.1 Proficiency, context, and prediction

It seems that the initial thought that some verbs behave differently based on their semantic selectivity is correct. This is shown by the pairwise post-hoc comparison in the target-present condition. The three categories: least-, moderate- and baseline restrictive sentences all are significantly different from the most restrictive sentences. This also shows that the categorization, that was based on the answers from the L1 survey, on how to put verbs into different categories based on their argument selection seem to provide reliable and significant data.

Participants' language proficiency scores were overall high. The grammar scores indicate that the participants are very close to native speaker proficiency. As a consequence, the grammar scores had to be excluded as it would only create a ceiling effect. Only the vocabulary scores did almost show an overall significant effect on the proportion of target looks. But if one is to look at the verb sentence types individually, (figure 2) the participants with higher vocabulary scores are the ones that have faster and more looks at the target across all categories.

Furthermore, in the same figure, the most restrictive category provided the most proportion of looks towards the target, and participants with higher vocabulary scores looked even more at the target compared to the ones with lower vocabulary score. Language proficiency seems to be associated with effects of verb semantics (proportion of looks towards the target in verb restrictive sentences). The data showed almost a significance ($p = 0.061$) between the vocabulary scores and gazes towards the area of interest in the target-present condition. Even though this is not significant, it would seem that the higher the vocabulary score, the more looks towards the target. Alas, the more words the participants know and understand, the

better are their semantic judgment – as it attests to a more developed semantic network which in turn assist appropriate verb understanding and use (Brooks & Tomasello, 1999; Pinker, 1989).

As established earlier, how verbs occur in context and discourse determines their syntactic and semantic behavior. Therefore, argument structure can be predicted based on the meaning of the verb and how the verb is placed in the context, and this information is assumed to be encoded in the lexical entry of the verb (Gropen et al., 1991; Koenig et al., 2003; Levin, 1993). Figure 2 shows that when the participants listened to a verb restrictive sentence their gaze towards the target was faster than compared to a less restrictive verb sentence.

According to the study conducted by Allopenna et al. (1998), gazes towards areas of interest do not start until 200msec after the target onset if there has not been any previous linguistic information that would direct the gaze towards an area of interest. What figure 3 shows is that gazes towards the target item is seen well before this point, with a much larger effect for the constraining verb than the less constraining ones. From that, it is possible to say that the verb initiates gazes towards the target sooner than expected. Based on the lexical information encoded in the verb, and together with the participant's understanding of the utterance, it is possible to make predictions based on the verb. The participants access information linked to the verb they hear and based on that input they can make predictions about which word is coming next in the discourse, this is due to the semantic priming effect upon encountering a word (Koenig et al., 2003; Meyer & Schvaneveldt, 1971). In the more restrictive sentences this is guided by a narrower semantic constraint that is put upon the verb, rather than a broader constraint on the less restrictive verbs (Pinker, 1989). As a result, the knowledge the participants have about a verb and how the verb behaves in the context, the participants start making a prediction immediately post verb. In sum, the participants use a vast amount of linguistic as well as visual information to disambiguate different sentence structures and to predict the upcoming linguistic input (Huettig et al., 2010).

5.2 Restrictiveness on competitor effect

The present study addresses the basis on which eye movements can be mediated by verbs, towards objects in the visual field. The assumption regarding the target-absent trials were the same we had in the target-present trial: Because of the restrictiveness of the verb sentence types we would observe a more salient competition effect in the baseline and the least restrictive verb sentence types compared to the moderate and the most restrictive verb

sentences. We thought it would elicit fewer looks towards the phonological competitor, because it would not fit in semantically. The post-hoc comparison that was applied to establish any significance between the verb sentence types produced no significance between the sentences in the target-absent condition. Still, the data from the gaze proportions (table 6) during the critical time window give an indication that the moderate and most restrictive verb sentences elicited fewer looks than the baseline and least restrictive verb sentences did. Yet, the variances between the sentences are too small to elicit a significance ($p > 1.00$). The moderate and most restrictive sentences had decreased probability of looks towards the cohort competitors, but based on the no significance finding in the post-hoc comparison, it seems that does not indicate that verb whose argument structure requires more a specific item in object position discouraged participants to look towards the phonological competitor.

This raises an issue to how suitable the restrictiveness constraints are. As pointed out earlier, potential lexical candidates that are sufficiently similar to the spoken word can become activated enough to compete for recognition (Allopenna et al., 1998) Our initial assumption was that the verb's restrictiveness constraints would to some extent eliminate this competition for recognition due to the fact the verb's restricted argument structure would elicit fewer looks towards the cohort competitor. Thus aiding the participants to conclude that the target was not on the screen.

A possible explanation to why the restrictiveness effect is not as salient in the target-absent condition as in the target-present condition is the native like proficiency in the L2 speakers. This claim is suggested based on a visual inspection of the time-line in figure 4: The participants start at approximately 220msec after word onset gazing towards the cohort competitor due to phonological processing of the input. When the lexical constraints (e.g. argument structure preferences) of the verb are realized the participants start resolve the competition as they comprehend that the phonological competitor does not semantically match the verb, as it does not provide sufficient information on its thematic role selection. This is coherent with Allopenna et al. (1998) findings: At 200msec, listeners were beginning to launch more eye movements to the referents matching either the target or cohort competitor than to the unrelated distractor. Allopenna et al. also reported that eye movements to the cohort competitor would began to drop off shortly after the end of the word, in response to new sound input that ruled the cohort competitor as an incompatible match. In contrast to Allopenna's findings, in the current study the participants eye-movements would begin to

drop off across all verb sentence types before the object word was finalized (the end of the critical window at 720 msec post object onset). Therefore, the time course of gaze behavior here suggests that processing is fast and possible predictive.

The data shown in figure 4 provide support for that speech input is continuously mapped onto potential lexical representations as it unfolds over time (Alloppenna et al., 1998; Cooper, 1974; Tanenhaus et al., 1995). By looking at the moderate and most restrictive verb sentences this is noticeable: As the spoken word unfolds over time less looks are towards the cohort competitor. Due to the resolution of the competition participants comprehend that the target is absent well before the whole word has been uttered. If we isolated look at the figure 3 and table 6, then the presence of competitor effect is evident in the target-absent trials. Although it seems that the effect is more salient in the baseline and least restrictive verb. Overall, with the no significance finding in the pairwise post-hoc comparison between the verb sentence types in the absent-condition, that will indicate that phonological competition obtains when the verb does not provide sufficient information on its thematic role selection. This is coherent with Alloppenna et al. (1998) study – with speech input continuously mapped, selection occurs when the evidence is sufficiently strong to support one alteration over the other. Therefore, it would seem that the L2 participants in this study actually have enough evidence to ultimately support one alteration over the other before the whole object word is uttered.

5.3 Validity

An obvious weakness in the experimental design is our assumption that the participants understand the words, and perceive the pictures as we want them to. There are a few cases (objects) of the visual stimuli that are of concern. These cases are the *cattle* and *mansion*, and *back door* and *lemming*. *Cows* and *house* are generally more commonly used words than *cattle* and *mansion*. Also, the participants could also encounter what they could experience as a visual mismatch. They could hear the object in the utterance but could not link that to what they are perceiving at the screen. Only by looking at a picture of a door, you do not automatically understand that this is a back door based on no previous information. Also, all the pictures were clip art pictures: Clip art is pre-made images used to illustrate any medium, they are often in vector graphics and very simple drawn pictures of everyday objects. These type of pictures are very suitable for our experiment, but they do not exactly illustrate objects as life-like. Therefore, a picture of a lemming could easily be interpreted as a hamster. Yet, there were made attempts in our experiment to try to control for these issues by having the

experiment run a group consisting of half the trials, including the object mentioned here in a random order before running the other half of the trials, which included sentences where the item where competitors in random order. The assumption being that by the time participants saw these images as competitors, they had already heard them being referred to for example as *back door* rather than *door*.

Regarding the verb sentence types, there is reason to believe that the data would have showed a significant difference between the verb sentence types if there only where two categories instead of three. In the pairwise post-hoc comparison there is no significant difference between the least, moderate and baseline sentences. The data show only a difference if these three types are compared to the most restrictive sentence type. If the moderate category was to be excluded then the verbs would be re-distributed into the most restrictive and the least restrictive categories, concluding in one narrower and one broader category. This could maybe show a clearer distinction between the categories. In that case, the categorization method also had to be renewed, and adapted.

It should be noted that caution is at the importance when making a generalization. In the present study the participants' grammar proficiency scores were excluded because of the apparent risk of ceiling effect, and therefore, vocabulary score functioned as the only covariant that had an effect on the dependent variable. It would seem that language proficiency scores would be of more importance if two groups were compared across age. Also the suggestion that links restrictiveness to proficiency is based on visual inspection of figure 4, and therefore not precise. It is also based off similar results presented by Allopenna et al. (1998) and Brock et al. (2008). A time-line analysis could answer if the suggestion holds up. But for the initial purpose of this thesis a time-line analysis was not conducted. Therefore, making a bold statement that vocabulary scores and proficiency is directly linked to mediated eye-movements is resolute. This thesis alone is not capable to make such a claim.

5.4 Conclusion

To conclude, it appears that visual context and language proficiency, and mode of processing all determine to what extent L1 speakers activate representations of their L2 language. This study shows how *lexical semantics* can direct visual attention towards semantically *related* objects based on the restrictiveness of verbs. Therefore, this experiment cannot say anything about how L2 learners learn sensitivity towards argument structure in

their L2 respectively, however, it can say give a confirmation that it is really there and seem to be quite obvious in more proficient speakers.

The visual world paradigm has proven to be a very useful tool to investigate cognitive processing. Predictions can be inferred from the participant's eye gazes. The L2 participants in this study showed similar behavior as L1 speakers. The study provides strong support for lexical constraint-based accounts of sentence processing

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7. Appendix

Appendix A. All the verb sentences types.

1 The least restrictive verb sentence types.									
Nr	Subject	Verb		Target (present)	Adverb	Instead (Absent)	Competitor	D1	D2
101	Alex	memorised	the	notes	carefully	lightbulb	Nose	Laces	lasergun
102	Mary	played	the	bagpipe	happily	Backback	Bags	Mansion	Man
103	Sam	guarded	the	bell	carefully	Jumper	Belt	Flowers	Flour bag
104	Charlie	removed	the	jumper cables	gently	Belt	Jumper	Bacon	Baby
105	Alex	rubbed	his	nose	regularly	Lifeboat	Notes	Laces	lasergun
106	Mary	watched	the	bags	carefully	Back door	Bagpipe	Mansion	Man
107	Sam	wore	the	back pack	happily	Bagpipe	Back door	Cattle	Kettle
108	Charlie	bought	the	lasergun	happily	Lemon	Laces	Notes	Nose
109	Mary	broke	the	bagpipe	accidentally	Backpack	Bags	Mansion	Man
110	Jesse	carried	the	jumper cables	regularly	Belt	Jumper	Bacon	Baby
111	Sam	changed	the	lightbulb	quickly	Notes	Lifeboat	Lemming	Lemon
112	Charlie	cut	the	lemon	carefully	Lasergun	Lemming	Lightbulb	lifeboart
113	Alex	dropped	the	kettle	accidentally	Man	Cattle	Backpack	Backdoor
114	Jesse	examined	the	bell	carefully	Jumper	Belt	Flowers	Flour bags
115	Sam	filled	the	back pack	quickly	Bagpipe	Back door	Cattle	Kettle
116	Mary	judged	the	man	quickly	Kettle	Mansion	Bags	Bagpipe

2 The moderate restrictive verb sentence types.									
Nr	Subject	Verb		Target (present)	Adverb	Instead (Absent)	Competitor	D1	D2
201	Alex	loaded	the	lifeboat	quickly	Nose	Lightbulb	Lemming	Lemon
202	Jesse	mended	the	belt	carefully	Jumper cables	Bell	Flowers	Flour bags
203	Sam	missed	the	lifeboat	accidentally	Nose	Lightbulb	Lemming	Lemon
204	Charlie	ordered	the	flowers	eagerly	Bacon	Flour bags	Bell	Belt
205	Mary	painted	the	mansion	carefully	Cattle	Man	Bags	Bagpipe
206	Jesse	pinched	his	nose	regularly	Lifeboat	Notes	Laces	Lasergun
207	Sam	pushed	the	back door	gently	Bags	Back door	Cattle	Kettle
208	Charlie	served	the	bacon	eagerly	Flowers	Baby	Jumper	Jumper cables
209	Alex	typed	the	notes	hastily	Lightbulb	Nose	Laces	Lasergun
210	Mary	visited	the	mansion	regularly	Cattle	Man	Bags	Bagpipe
211	Sam	delivered	the	flourbags	quickly	Baby	Flowers	Bell	Belt
212	Charlie	entertained	the	baby	happily	Flourbags	Bacon	Jumper	Jumper cables
213	Alex	frightened	the	cattle	accidentally	Mansion	Kettle	Back pack	Back door
214	Jesse	hunted	the	lemming	eagerly	Laces	Lemon	Lightbulb	Lifeboat
215	Sam	impressed	the	baby	happily	Flourbags	Bacon	Jumper	Jumper cables
216	Mary	collected	the	bags	quickly	Back door	Bagpipe	Mansion	Man

3 The most restrictive verb sentence types.

Nr	Subject	Verb		Target (present)	Adverb	Instead (Absent)	Competitor	D1	D2
301	Alex	milked	the	cattle	carefully	Mansion	Kettle	Backpack	Back door
302	Jesse	squeezed	the	lemon	gently	Lasergun	Lemming	Lightbulb	Lifeboat
303	Sam	stroked	the	lemming	carefully	Laces	Lemon	Lightbulb	Lifeboat
304	Charlie	tied	the	laces	quickly	Lemming	Lasergun	Notes	Nose
305	Alex	tightened	the	laces	carefully	Lemming	Lasergun	Notes	Nose
306	Jesse	fastened	the	belt	eagerly	Jumper cables	Bell	Flowers	Flour bags
307	Sam	locked	the	back door	accidentally	Bags	Back pack	Cattle	Kettle
308	Charlie	watered	the	flowers	regularly	Bacon	Flourbags	Bell	Belt
309	Mary	arrested	the	man	quickly	Kettle	Mansion	Bags	Bagpipe
310	Jesse	boiled	the	kettle	hastily	Man	Cattle	Backpack	Back door
311	Sam	emptied	the	flourbags	accidentally	Baby	Flowers	Bell	Belt
312	Charlie	fired	the	lasergun	quickly	Lemon	Laces	Notes	Nose
313	Alex	fried	the	bacon	hastily	Flowers	Baby	Jumper	Jumper cables
314	Jesse	ironed	the	jumper	carefully	Bell	Jumper cables	Bacon	Baby
315	Sam	knitted	the	jumper	carefully	Bell	Jumper cables	Bacon	Baby
316	Charlie	lit	the	lightbulb	quickly	Notes	Lifeboat	Lemming	Lemon

4 Baseline verb sentences.

Nr	Subject	Verb		Target (present)	Adverb	Instead (Absent)	Competitor	D1	D2
401	Alex	chose	the	jumper	eagerly	Bell	Jumper cables	Bacon	Baby
402	Jesse	chose	the	notes	regularly	Lightbulb	Nose	Laces	Lasergun
403	Mary	chose	the	bags	quickly	Back door	Bagpipe	Mansion	Man
404	Charlie	chose	the	man	quickly	Kettle	Mansion	Bags	Bagpipe
405	Alex	chose	the	flowers	eagerly	Bacon	Flourbags	Bell	Belt
406	Jesse	chose	the	bacon	quickly	Flowers	Baby	Jumper	Jumper cables
407	Sam	picked	the	lightbulb	eagerly	Notes	Life boat	Lemming	Lemon
408	Mary	picked	the	mansion	regularly	Cattle	Man	Bags	Bagpipes
409	Alex	picked	the	back door	quickly	Bags	Back pack	Cattle	Kettle
410	Jesse	picked	the	cattle	eagerly	Mansion	Kettle	Backpack	Back door
411	Sam	picked	the	lemming	happily	Laces	Lemon	Lightbulb	Lifeboat
412	Charlie	picked	the	laces	quickly	Lemming	Lasergun	Notes	Nose
413	Alex	selected	the	jumper cables	quickly	Belt	Jumper	Bacon	Baby
414	Jesse	selected	his	nose	quickly	Lifeboat	Notes	Laces	Lasergun
415	Mary	selected	the	bagpipe	accidentally	Backpack	Bags	Mansion	Man
416	Charlie	selected	the	belt	carefully	Jumper cables	Bell	Flowers	Flour bags
417	Alex	selected	the	flour bags	quickly	Baby	Flowers	Bell	Belt
418	Jesse	selected	the	baby	regularly	Flour bags	Bacon	Jumper	Jumper cables
419	Sam	took	the	lifeboat	accidentally	Nose	Lightbulb	Lemming	Lemon
420	Charlie	took	the	bell	eagerly	Jumper	Belt	Flowers	Flour bags
421	Alex	took	the	backpack	quickly	Bagpipe	Back door	Cattle	Kettle
422	Mary	took	the	kettle	gently	Man	Cattle	Backpack	Backdoor
423	Sam	took	the	lemon	gently	Lasergun	Lemming	Lightbulb	Lifeboat
424	Charlie	took	the	lasergun	regularly	Lemon	Laces	Notes	nose

Appendix B. Visual Stimuli

 <p>Baby</p>	 <p>Back door</p>	 <p>Back pack</p>	 <p>Bacon</p>
 <p>Bagpipe</p>	 <p>Bags</p>	 <p>Bell</p>	 <p>Belt</p>
 <p>Cattle</p>	 <p>Flour bags</p>	 <p>Flowers</p>	 <p>Jumper cables</p>
 <p>Jumper</p>	 <p>Kettle</p>	 <p>Laces</p>	 <p>Lasergun</p>
 <p>Lemming</p>	 <p>Lemon</p>	 <p>Lifeboat</p>	 <p>Lightbulb</p>
 <p>Man</p>	 <p>Mansion</p>	 <p>Nose</p>	 <p>Notes</p>

Appendix C: Participant Information Sheet (Native speaker survey)

Norwegian University of Science and Technology

Sensitivity to argument structure in second language

Participant Information Sheet

Thank you for your interest in this study. Before you decide whether to take part, please read the following information carefully (this sheet is for you to keep).

What is this research looking at?

As part of research into the linguistic capabilities of second language English speakers, we need to know how native English speakers would use some common English verbs in regular sentences. This examination is part of the initial stages of the research.

Do I have to take part?

It is up to you to decide to join the study. We will describe the study in this information sheet. If you agree to take part, you will be presented with an online questionnaire which you fill out anonymously, and by submitting this questionnaire, you consent to participation. You are free to withdraw at any time, without giving a reason, and if you do not submit the questionnaire, your answers will not be saved in any database. Withdrawing would not affect you in any way.

What will happen if I agree to take part?

You will have to fill out an online questionnaire, which will take about 15-20 minutes to complete. At first we ask for some basic information about you (age, gender, number of languages spoken at home, education level). Then you will be asked to complete a number of incomplete sentences by writing short answers in text boxes.

Are there any problems with taking part?

There are no problems or disadvantages to taking part in this study.

Will it help me if I take part?

No.

How will you store the information that I give you?

All information which you provide during the study will be stored in accordance with the 1998 Data Protection Act and kept strictly confidential. The chief investigator will be the custodian of the anonymous research data. No identifiable data will be collected. All anonymized results will be stored indefinitely on a password protected computer. Only the research team will have access to the data.

How will the data be used?

The data will be part of a research project at the Norwegian University of Science and Technology and might be presented in journals and conferences. Participants will not be identifiable in the presented data.

What happens if I agree to take part, but change my mind later?

Once the data is submitted, it is no longer possible to withdraw from the survey. However, you may choose to withdraw from the survey at any point while filling out the questionnaire, and the data will not be saved in any database until you click to submit it at the end.

How do I know that this research is safe for me to take part in?

All research in the University is looked at by an independent group of people, called a Research Ethics Committee, to protect your safety, rights, wellbeing and dignity. This research was approved by The Ethics Committee at the University of East Anglia on the 16.10.2015

You are under no obligation to agree to take part in this research.

If you do agree you can **withdraw at any time without giving a reason.**

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Do also contact us if you have any worries or concerns about this research.

Appendix D: Background questionnaire.

Bakgrunnsinformasjon for forskningsprosjekt om andrespråksforståelse

Tusen takk for at du har sagt ja til å delta i vårt forskningsprosjekt om andrespråksforståelse. I dette skjemaet ber vi om bakgrunnsinformasjon som er nødvendig for at resultatene fra undersøkelsen skal kunne brukes.

Informasjonen som du oppgir vil bli behandlet uten direkte gjenkjennende opplysninger. En kode knytter deg til dine opplysninger gjennom en deltakerliste. Det er kun autorisert personell knyttet til prosjektet som har adgang til deltakerlisten og som kan finne tilbake til informasjonen. Del B, C og D av dette skjemaet vil bare oppbevares med koden. All informasjon vil bli anonymisert ved prosjektslutt. Det vil ikke være mulig å identifisere deg i resultatene av studien når disse publiseres. Vi ber deg legge merke til at skjemaet har totalt 7 sider.

Roger Johnsen / Anders Schärer Reine

Studenter ved lektorutdanningen med master i språk, NTNU

Deltakerkode:

g informasjon

Studieretning og

trinn: _____

Fødselsår _____

Kjønn **Kvinne** **Mann**

Bostedskommune _____

Deltakerkode:

Del B: Språklig bakgrunn

Morsmål

Er norsk morsmålet ditt?

- Ja Nei

Hvis ja, har du andre morsmål i tillegg?

- ja Nei

Hvis ja, hvilke(t) språk? _____

Hvilket språk bruker dere hjemme? _____

Hvor ofte leser du tekst skrevet på norsk?

- Hver dag Flere ganger i uka Et par ganger i uka Av og til Aldri

Hvor ofte skriver du tekst på norsk?

- Hver dag Flere ganger i uka Et par ganger i uka Av og til Aldri

Engelsk og andre fremmedspråk

I engelsk, hvordan vurderer du ferdighetene dine på hvert av disse områdene?

	Grunnleggende	Middels	Avansert	Flytende
Lesing				
Skrijving				
Snakke				
Lytte				
Totalt				

Har du bodd i, eller hatt lengre opphold i, et land hvor engelsk er hovedspråk?

- Ja Nei

Hvis ja, hvor lenge varte oppholdet/oppholdene? _____

Har du vært på kortere (under 14 dager) reise i et land hvor engelsk er hovedspråk?

- Ja Nei

Har du bodd i, eller hatt lengre opphold i, et land hvor annet enn engelsk er hovedspråk?

- Ja Nei

Hvis ja, hvor var det, og hvor lenge varte oppholdet/oppholdene? _____

Hvilke språk kan du utover morsmålet ditt og engelsk?

Språk	Nivå			
	Grunnleggende	Middels	Avansert	Flytende
Tysk				
Fransk				
Spansk				
-Angi språk				
-Angi språk				
-Angi språk				

Hvor ofte leser du tekster på engelsk?

- Hver dag Flere ganger i uka Et par ganger i uka Av og til Aldri

Hvor ofte skriver du tekster på engelsk?

- Hver dag Flere ganger i uka Et par ganger i uka Av og til Aldri

Hvor ofte lytter du til/hører du engelsk?

- Hver dag Flere ganger i uka Et par ganger i uka Av og til Aldri

Hvor ofte ser du på engelskspråklige serier/filmer?

- Hver dag Flere ganger i uka Et par ganger i uka Av og til Aldri

Når du ser på engelskspråklige filmer, hvilken av disse alternativene bruker du mest?

- Undertekst på norsk Undertekst på engelsk Ingen undertekst

Hvor ofte ser du på engelskspråklige tegneseriefilmer/serier?

- Hver dag Flere ganger i uka Et par ganger i uka Av og til Aldri

Hvor ofte spiller du engelskspråklige data/TV-spill?

- Hver dag Flere ganger i uka Et par ganger i uka Av og til Aldri

Hvilke type spill spiller du? _____

Hvor mange timer cirka per dag? _____

Hvor mye TV ser du på hver dag?

- 7 timer eller mer 5-6 timer 3-4 timer 1-2 timer aldri eller nesten aldri

Del C: Andre faktorer i språklæring

Har du, eller har du hatt, problemer med synet utover normal brillebruk?

- Ja Nei

Har du, eller har du hatt, problemer med hørselen?

- Ja Nei

Har du, eller har du hatt, språkvansker av noe slag (spesifikke språkvansker, lese-/lærevansker eller lignende)?

- Ja Nei

Har du, eller har du hatt, andre diagnoser som kan tenkes å påvirke språklæring (ADHD, autisme eller lignende)?

- Ja Nei

Er du venstrehendt?

- Ja Nei

Del D: Vokabulartest og grammatikktest

Resultat vokabulartest:

Resultat grammatikktest:

Appendix E: Request for participation in the research project

Forespørsel om deltakelse i forskningsprosjektet

”Andrespråksbrukeres behandling av engelske verb”

Bakgrunn og formål

Vi er to masterstudenter ved Institutt for språk og litteratur ved NTNU som jobber med et forskningsprosjekt. Vi trenger deltakere både fra videregående skole og universitetet. Målet med prosjektet vårt er å undersøke hvordan norske fremmedspråksbrukere av engelsk prosesserer (hvordan hjernen behandler) engelske verb. Deltakelse er frivillig, og vi er svært takknemlige for alle som har mulighet til å være med.

Hva innebærer deltakelse i studien?

Deltakerne vil gjennomføre tre elektroniske spørreskjemaer/tester på PC, samt en test hvor deltakerne sitter foran en datamaskin og får høre opptak av engelske setninger samtidig som de ser ulike bilder på skjermen. I denne testen bruker vi en ”eye-tracker” (et kamera som kun registrerer øyebevegelse og lagrer informasjon om hvor på skjermen man ser). Testene vil samlet sett ta omtrent en time.

Hva skjer med informasjonen om deg?

Alle personopplysninger vil bli behandlet konfidensielt. En ”koblingsnøkkel” (et deltakernummer) vil knytte navnene til resultatene. For skoleelevene vil det kun være læreren som har tilgang til listen som knytter navnene til deltakernummeret, og denne skal lagres utilgjengelig for uvedkommende. Enkelt personer vil ikke kunne gjenkjennes i publikasjonen.

Prosjektet skal etter planen avsluttes juni 2016. Personopplysninger vil da slettes, slik at datamaterialet er anonymisert

Frivillig deltakelse

Det er frivillig å delta i studien, og du kan når som helst trekke ditt samtykke uten å oppgi noen grunn. Dersom du trekker deg, vil alle opplysninger om deg bli anonymisert.

Dersom du har spørsmål til studien, ta kontakt med:

Roger Johnsen, masterstudent ved Institutt for språk og litteratur, NTNU
Tlf.: 416 75 224
E-post: roger.johnsen88@gmail.com

Anders Schärer Reine, masterstudent ved Institutt for språk og litteratur, NTNU
E-post: andersscharer@gmail.com

Mila Vulchanova, professor ved Institutt for språk og litteratur, NTNU
E-post: mila.vulchanova@ntnu.no

Studien er meldt til Personvernombudet for forskning, Norsk samfunnsvitenskapelig datatjeneste AS.

Samtykke til deltakelse i studien

Jeg har mottatt informasjon om studien, og er villig til å delta:

(Signert av prosjektdeltaker, dato)