universität wien

MASTERARBEIT /MASTER'S THESIS

Titel der Masterarbeit / Title of the Master's Thesis

Cross-Modal Priming of Homonym Meanings

verfasst von / submitted by

Qingyun Yu, BA

angestrebter akademischer Grad / in partial fulfilment of the requirements for the degree of

Master of Arts (MA)

Wien, 2024/Vienna, 2024

Studienkennzahl lt. Studienblatt / degree programme code as it appears on the student record sheet:	UA 066867
Studienrichtung lt. Studienblatt / degree programme as it appears on the student record sheet:	Masterstudium Allgemeine Linguistik: Grammatiktheorie und kognitive Sprachwissenschaft
Betreut von / Supervisor:	Univ.-Prof. Dr. Jutta Mueller

Abstract

The interactive two-step model proposed by Dell et al. (2014) suggested that implicit phonological representation could activate its corresponding semantic information via the bottom-up route, assuming that candidates for lemma selection could be retrieved not only based on semantic information but also based on implicit phonological representation. Although several studies have provided evidence for implicit phonological activation, it is still unclear whether subsequent information is activated based on implicit phonological representation. This study aimed to investigate subsequent activation based on implicit phonological information by examining the activation of alternative meanings of homonyms. 61 German native speakers participated in this study online and were asked to complete the lexical decision task with 180 trials. The target word was either identical to the name of the prime picture, semantically related to the alternative meaning of the name of the prime, or unrelated to the prime. The identical related prime-target pairs produced a significantly shorter reaction time than the other pairs. This suggests a prime effect from a non-linguistically encoded form to an identical linguistically encoded form. However, these data didn't provide evidence for subsequent information retrieval based on phonological information. Further research focusing on prime-target association and understanding of homonym processing is suggested.

Abstrakt

Das von Dell et al. (2014) vorgeschlagene interaktive zweistufige Modell schlug vor, dass die implizite phonologische Repräsentation die entsprechenden semantischen Informationen über den Bottom-up-Weg aktivieren könnte, wobei angenommen wurde, dass Kandidaten für die lexikalische Auswahl nicht nur auf der Grundlage semantischer Informationen, sondern auch auf der Grundlage der impliziten phonologischen Repräsentation abgerufen werden könnten. Obwohl mehrere Studien Belege für eine implizite phonologische Aktivierung geliefert haben, ist immer noch unklar, ob nachfolgende Informationen auf der Grundlage der impliziten phonologischen Repräsentation aktiviert werden. Ziel dieser Studie war es, die nachträgliche Aktivierung auf der Grundlage impliziter phonologischer Information zu untersuchen, indem die Aktivierung alternativer Bedeutungen von Homonymen untersucht wurde. 61 deutsche Muttersprachler nahmen online an dieser Studie teil und wurden gebeten, die lexikalische Entscheidungsaufgabe mit 180 Versuchen zu lösen. Das Zielwort war entweder identisch mit dem Namen des Hauptbildes, semantisch verwandt mit der alternativen Bedeutung des Namens des Hauptbildes oder nicht verwandt mit dem Hauptbild. Die identisch verwandten Primzahl-Ziel-Paare ergaben eine signifikant kürzere Reaktionszeit als die anderen Paare. Dies deutet auf einen Prime-Effekt von einer nicht sprachlich kodierten Form zu einer identischen sprachlich kodierten Form hin. Diese Daten lieferten jedoch keine Beweise für einen anschließenden Informationsabruf auf der Grundlage phonologischer Informationen. Weitere Forschungsarbeiten, die sich auf die Primzahl-Ziel-Assoziation und das Verständnis der Verarbeitung von Homonymen konzentrieren, werden vorgeschlagen.

Acknowledgements

I am grateful to everyone who has supported me with this Master's thesis. It is not possible to complete my research without your help,

First, I would like to thank my supervisor Univ.-Prof. Dr. Jutta Müller. She is the best supervisor I have ever met. She suggested this fabulous topic to me, I really enjoyed this topic and learned a lot from this research. I also love how she always hits the nail on the head, thank you for pointing me in the right direction for my research and showing me how to be a researcher.

Secondly, I would like to thank Uni-Prof. Dr. Susanne Reiterer. She is very helpful; she gave me a lot of useful information for choosing my master's thesis. Thank you for your kindness!

I would also like to thank all my colleagues and friends; they gave me a lot of advice and were always willing to support me in the process of my master's thesis. I am very lucky to have you in my life. I thank Anni Chen, Kuryeong Kim, and Paula Šarić, thank you for learning with me! Thank you, Viktoria Groiß and Yuzhe Sun, you supported me a lot in my pilot study and gave me useful advice.

More importantly, I would like to thank Yuqi He, thank you for always being there for me. I missed the chance to meet you once, I'm glad I didn't miss it twice. You are the best present that Vienna has given me.

I would like to express my deepest gratitude to my parents and cousins, your love, and encouragement and understanding have been the driving force behind my achievements.

Last but not least, I would also like to thank all the participants of my study, it is not possible to complete this study without your participation. Thank you for your time, I really appreciate it!

Table of Contents

Figure List

Table Lists

1. Introduction

"The minute I set eyes on an animal I know what it is. I don't have to reflect a moment; the right name comes out instantly…I seem to know just by the shape of the creature and the way it acts what animal it is. When the dodo came along he [Adam] thought it was a wild cat… But I saved him…I just spoke up in a quite natural way… and said 'Well, I do declare if there isn't the dodo!'" (Twain, 2011, pp. 8-9)

It is fascinating to think about the process of lexical access: How do people retrieve the appropriate words from the mental lexicon, which contains a vast amount of vocabulary?

Indeed, previous studies have suggested that speech production involves three components: conceptualization, linguistic formulation, and articulation, but the direction of the process within linguistic formulation is still a mystery. The discrete model of speech production suggested a strict successive model from selected semantic representation to phonological encoding (Levelt, 1989; Levelt et al., 1991). While the discrete model suggests that phonological representation could not affect the lemma selection, the Interactive Two-Step Model suggests the interactive activation between semantic representation and phonological representation (Dell, 1986; Dell et al., 1997, 2014). This interactive model assumed the possibility that implicit activated phonological representations could retrieve their associated word form prior to lemma selection, suggesting a greater number of candidates for lemma selection.

In this study, the activation of the phonological representation prior to lemma selection was defined as Implicit Naming. Given that the process of implicit naming allows the phonological representations to retrieve the candidates associated with them prior to lemma selection, a question arises: Could the semantic information

associated with the phonological representation also be activated? If so, one might expect that the alternative meaning of the phonological representation would be one of the candidates for lemma selection. This follow-up effect or consequence was defined as an Implicit Naming Effect in the current study.

1.1. Overview of This Study

In order to understand the implicit naming effect, homonymy was used as a phonological representation with dual semantic meanings. The main question of this study is whether the alternative semantic meaning of a single phonological representation (homonym) can be activated by the non-linguistically encoded form (picture).

This thesis is the following study of the pilot study by Hönig (2022), she put the idea forward to investigate the implicit activation of phonological representations by observing the activation of the alternative meaning of the homonym. The current study imitated her experiment design but lengthened the presentation time for prime pictures and modified the stimuli.

In this study, the activation of the alternative meaning of the homonym is considered to be the implicit activation of the phonological representation prior to lemma selection. Thus, the Lexical Decision Task (LDT) was used in our study because it is predicted that if the recognition of the target word is facilitated by the prime picture, it will result in higher accuracy and shorter reaction time.

As a web-based experiment, the data for this study was collected using PsychoPy (Peirce et al., 2019), which can record the participant's reaction time and accuracy during the task.

This thesis consists of seven sections: Following this introduction, Section 2 reviews the research background and findings of previous studies. Section 3 deals with the current research questions and hypothesis. The methodology will be then

presented in section 4, which includes a description of the participants, equipment, and materials used for this study. The results will be summarized in section 5. The discussion will be examined in section 6. When all is said and done, Chapter 7 is concerned with the conclusion of this study.

2. Literature Review

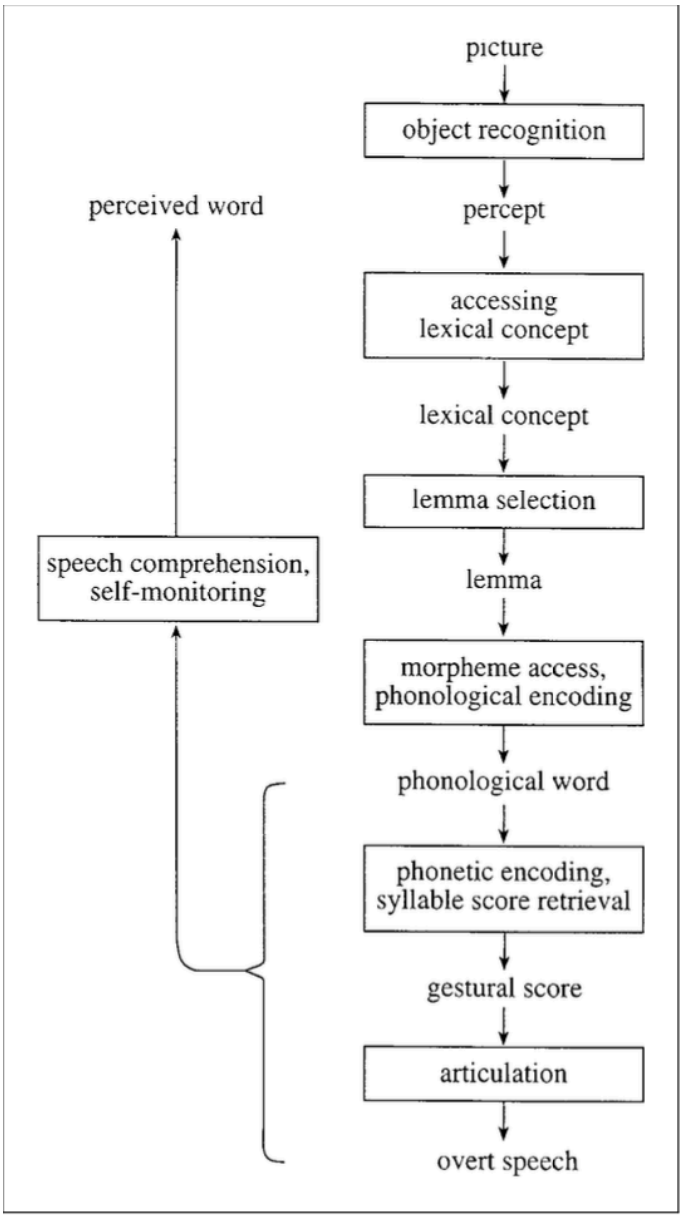
2.1. Speech Production Model

Preliminary works on speech production examined the time windows of lexical access based on the speech errors and delays that occur when participants are asked to name a picture (i.e., Picture Naming Task) (Butterworth, 1989; Garrett, 1975; Indefrey & Levelt, 2004; Levelt, 1989; Levelt et al., 1991; W. Levelt & Maasen, 1981; Schriefers et al., 1990). In particular, Schriefers et al. (1990) investigated the time windows of lexical access using a Picture-Word Interference Paradigm. In this paradigm, an auditory word was presented as a distractor while participants named the target picture, the distractors could be either semantically related to the target picture (e.g., TV set, when the target was radio), or phonologically related to the picture (e.g., radish, when the target was radio), or unrelated to the picture (e.g., church, when the target was radio).

They found that the semantic distractors could delay the time of naming pictures (naming latencies) only when the distractors were displayed before the presentation of the target pictures, whereas the phonological distractors had to be presented synchronously with the targets or shortly after the targets. It was suggested that the process of phonological encoding should occur after lemma selection and become evidence of discrete models of speech production. Therefore, Levelt (1989) clarified the process of picture naming based on the discrete models. In general, the first step is to match the semantic representation to the lexical item. Secondly, the phonological representations corresponding to the selected lexical item were retrieved. This process is so-called Lexical Access or lexicalization (Dell & Reich, 1981; Garrett, 1975; Levelt, 1989; Levelt et al., 1991). After the process of

lexicalization, the phonological representation is articulated via the motor system when it is required for the speech production task (See Figure 1).

Figure 1 The Stage of Picture Naming (Levelt et al., 1998).
A stage model of picture naming. Preparing a name proceeds through stages of visual processing, activating a lexical concept, word selection, phonological encoding, phonetic encoding, and the initiation of articulation. Self-monitoring refers to phonological codes and overt speech.

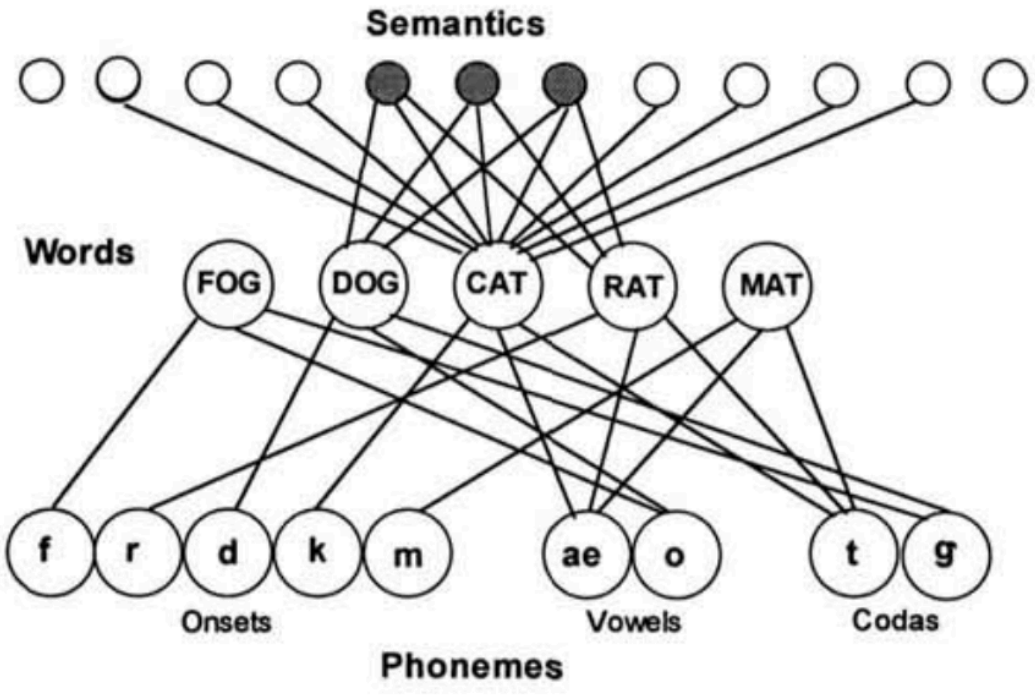


However, Dell et al. (2014) pointed out that a strictly discrete model implies a modular stage model. In this case, the phonological representation could only be activated after the process of lemma selection has been completed. In other words, only those phonological features that are relevant to the selected lemma are activated. The discreteness of the speech production model could be argued against by the study of Peterson and Savoy (1998), who found that the target word could

be primed by the picture name that was phonologically related to the target. For example, the target word “SODA” could be primed by the picture of a couch with its alternative name “SOFA”. Although this finding is appropriate to the first step that Lexicalization suggested, both lemma "COUCH" and "SOFA" were activated by the semantic feature indicated by the picture, Levelt’s (1998) model failed to explain the activation of "SODA"; the activation of the lemma that phonologically related to the alternative name suggested that its phonological representation was activated before the lemma was selected. Otherwise, only the lemmas that were phonologically related to "COUCH" could be activated.

Therefore, Dell et al. (1997) (See. Figure 2) proposed an Interactive Two-Step Model, this cascaded model suggests that phonological encoding occurred prior to lemma selection, Dell et al. (2014) maintains to allow the bottom-up activation from the phonological representation to the semantic information via the word form (lemma). The bottom-up route could be easily interpreted as P -> Word Form -> S. After the bottom-up route, the lemma selection step begins.

Figure 2 Illustration of a Lexical Network for the Interactive Two-Step Model of Naming. (Dell et al., 1997)
Connections are excitatory and bidirectional. The common semantic features of cat, dog, and rat are shaded in gray.



.

To understand the difference between the models of Level(1989) and Dell et al. (1997), we could use the example shown in Figure 2. As shown, the word forms “DOG”, “CAT”, and “RAT” could be activated first by certain semantic features (the black circles), in the second step (phonological encoding), the corresponding phonological features (phonemes) were activated by the words. These two steps have been claimed by many researchers (Dell & Reich, 1981; Garrett, 1975; Levelt, 1989; Levelt et al., 1991). However, according to Levelt’s (1989) model, lemma selection takes place before phonological encoding, so that the related word forms cannot be further activated in the second step. In other words, only three candidates for lemma selection could be activated by the specific semantic features: "DOG", "CAT", and "RAT". By contrast, the model of Dell et al. (1997) suggests the possibility of further activation after the second step, by postponing the process of lemma selection, the activation of the words “FOG” and “MAT” is allowed, which is phonologically related to the activated phonological representation in the second step. Because the phonological representation activated in the second step (e.g., "dog", "cat") is not selected and is thought to be an initial process of lexical access, we refer to this representation in this paper as the "implicit phonological representation" to distinguish it from the subsequent word form activated by this representation.

Further studies with the picture-word interference paradigm (Cutting & Ferreira, 1999; Jescheniak & Schriefers, 1998a) support the hypothesis of cascaded processing of lexical access. The study by Jescheniak & Schriefers (1998b) investigated the influence of distractors on picture naming task, the participants were asked to name the picture while the distractor was presented. The distractors are phonologically related either to non-target near-synonyms of the target words (e.g., COUCH is the near-synonym of SOFA) or semantically related to the target word. For example, when the target word was SOFA, the distractors were either COOKIE, SODA, or CHAIR. During the task, the visual stimulus was expected to

activate a set of semantic features and their related word form (the first step), including the word form of near-synonym. After that, all the implicit phonological representations of word forms were activated (the second step). Given the distractors that are phonologically related to near-synonyms were activated in the second step, they should be deemed to be the candidates of lemma selection and inhibit the process of picture naming.

Just as the cascaded model assumed, at the early SOAs (from -150ms to 150ms), it was found that the distractors that phonologically related to non-target near-synonym yielded a slower reaction time than unrelated condition and no-distractor condition (Jescheniak & Schriefers, 1998b). This study supported the hypothesis that the implicit phonological representation could further retrieve subsequent phonological representation, providing evidence for Dell's primary cascaded model (Dell, 1986; Dell et al., 1997). However, it is unclear if the bottom-up route works: The semantic information related to the implicit phonological representation was not necessarily activated in this study. More evidence is needed in support of the bottom-up route.

As noted by Dell et al. (2014), the speech error of mixing two words with similar meanings and the same initial word units (i.e., the Mixed-Error Effect) could be explained by bottom-up activation. Dell used the example of confusing the words "Pope" and "President" to illustrate this. When Joe Biden tried to activate the word "president" with its specific semantic features, the implicit phonological representation along with its associated phonological features /p/ were activated. Next, all /p/initial word units were activated by the implicit phonological features. In this case, the word form "POPE", which shares some semantic features and the same initial word unit with the target word "PRESIDENT" has a greater chance of slipping, due to the double activation from the phonological and semantic flow.

Apart from the evidence provided by speech errors, several EEG and MEG studies have been used to determine the time course of lexical access in the picture

naming task. The pioneering MEG study by Salmelin et al. (1994) found that brain activation spreads from posterior to frontal temporal networks within 400 ms of picture onset (As cited in Morsella & Miozzo, 2002). This activation flow is thought to be the bottom-up process: The phonological representation is first encoded in posterior areas, including the auditory cortex and the posterior superior temporal (ST) area, and then the information is transferred to frontal areas, including anterior superior temporal area, to categorized and identified the semantic information there (Skeide & Friederici, 2016). This bottom-up process was also in line with Skeide & Friederici's definition of the language network, indicating the effect of phonological representation at the semantic level, suggesting a bottom-up route in the picture naming task.

In a different line of research, the reading research investigates the effect of phonology on the recognition of visual words. The study by Lesch & Pollatsek (1993) examined whether the target word recognition was facilitated by the homophone that was semantically associated with the target word: A homophone "BEACH" " was set as a prime, which is associated with "BEECH", while "BEECH" is semantically associated with the target word "NUT", "BEACH" is not semantically associated with the target. Thus, the prime and target could only be associated with the implicit phonological representation "BEECH". In each trial, participants were first presented with the prime stimuli within 50 ms or 200 ms, followed by a 200 ms or 50 ms exposure to pattern masking (a series of "#" was shown as a masker), which is a paradigm for reducing the advantage of lexical decision making based on lexical information. The total displayed time of the prime word and the masker should be 250 ms; after the presentation of the masker, the target word would be presented until the participants had named it. Pronunciation Error and naming time were recorded. It was reported that the homophone prime (e.g., BEACH) facilitated recognition of the target word "NUT" only when the prime was presented for 50 ms, but not for 200 ms. The successful facilitation confirms the association

between prime and target via the implicit phonological representation and provides evidence for activation of the implicit phonological representation to semantic information in word recognition.

Collectively, the study above has proposed the possibility of a bottom-up route in lexical access, instead of a one-way flow of activation from semantic information to phonological encoding, the flow of activation from phonological representation to a set of semantic features before lemma selection is supposed to occur in lexical access.

2.2. Implicit Naming Effect

Many people have the experience of calling the name of an object in their thoughts, the name of the object has not been called out and remains in our mind, but it is clear to imagine the articulation of it. The process of implicit naming is the process of automatic activation of the implicit phonological representation, which is the process we discussed in Chapter 2.1. To understand the process of implicit naming, we need to study the implicit naming effect with a different paradigm. Two different paradigms were popular for the study of implicit naming effect: The Picture-Picture Paradigm and the Cross-Modal Paradigm. While the two paradigms used different types of stimuli as targets (visual or auditory), they both used pictures as prime. Nevertheless, regardless of the paradigm used, these paradigms aim to observe whether the implicit phonological representation of the prime picture has been activated, and if so, the implicit phonological representation of the prime stimuli would either facilitate or inhibit the recognition of the target word.

2.2.1. Evidence From Picture-Picture Paradigm

One kind of picture-picture paradigm is the visual search paradigm, In the traditional visual search paradigm, a target picture appears in the center of the screen, followed by a "+" as a fixation point. Twelve pictures then appear on the screen simultaneously, from which subjects are asked to find the target picture as quickly as possible, the non-target pictures that are displayed on the search screen are defined as competitors. The work on visual search paradigms investigated the effectiveness of phonological competitors that shared part of phonological features with the name of the target picture. It was expected that phonological competitors would divert participants' attention from recognizing the target picture, thereby lengthening the response time of the task.

The inhibition induced by the phonological competitor was taken as evidence for the activation of the implicit phonological representation: Due to the target-similar phonological information activated by the competitor, the matching of information distracts participants from the target, so that participants must deal with more information for lemma selection, resulting in the longer reaction time and longer fixation on the phonological competitor. When the implicit phonological representation was not activated and used as a retrieval guide, participants were able to find the target quickly by focusing on semantic information. This is not the case: The previous finding concluded that phonological competitors captured longer fixations during target search, supporting the initial activation of phonological information and consistent with the implicit naming effect (see Huettig & McQueen, 2007; Righi et al., 2010).

Along the same lines, Meyer and Belke (2007) used the visual search paradigm to investigate the implicit naming effect. Participants were asked to answer whether the target word appeared and where it was. In parallel with the recording of their response latencies and error rates, their eye movements were also recorded. The phonological and semantic competitors were set up for the paradigm, participants

were asked to view the target picture within 1 second, followed by another fixation point presented for 1 s. After fixation, a four-object search display with either a member of the phonological or semantic competitors was presented, then participants were asked to press the left or right button to indicate whether the target was present or not. The results showed that the homophonous competitors could affect accuracy and reaction time in the same way as the semantic competitors. In addition, the percentage of first saccades to both semantic and phonological competitors remained the same. This is consistent with the assumption of search guidance by a phonological competitor, and with the hypothesis that implicit phonological representation further retrieves information.

Nevertheless, a different perspective on phonological competition was examined by Walenchok et al. (2016), who used the traditional visual search paradigm to investigate phonological competition. The results of the eye movement analysis showed a negligible effect of phonological competition when the picture stimuli (non-linguistically encoded word forms) were used as stimuli: Although participants fixated longer on the phonological competitors, search time was only marginally affected by the competitors. In contrast, verbal stimuli (linguistically encoded word forms) were found to have a significant effect on search time. This suggests that phonological activation tends to be driven by the linguistically encoded form. The results of Walenchok et al. were opposite to the previous study (A. S. Meyer et al., 2007), Walenchok et al. (2016) attributed this difference to the different spatial arrangement of the objects and the different measure of fixations. While Meyer and Belke measured the percentage of first fixations, Walenchok et al. measured the number of total fixations and refixations.

2.2.2. Evidence From Cross-Modal Paradigm

Apart from the picture-picture paradigm, the cross-modal paradigm also contributed to the study of the implicit naming effect; this paradigm investigated whether

the recognition of the target word was facilitated when its corresponding phonological features matched the implicit phonological representation of the prime picture. In a study with infants, the experimenter investigated the influence of the name of prime pictures on the length of time that infants fixated on the target picture. Compared to the phonologically unrelated name, the fixation time on the target picture was longer when it was phonologically related to the name of the prime. The results also showed that infants failed to recognize the target picture when the prime and target had no semantic or phonological relationship. Taken together, they found that the phonologically related name of the prime picture facilitated the recognition of the target picture, suggesting a silent phonological activation during the observation of the prime picture since the age of 18 months old (Mani & Plunkett, 2010). It is worth noting that although Mani and Plunkett used pictures as targets, they also played audio of the target name 50 ms after the onset of the target picture. Thus, it is unclear whether the implicit phonological representation was activated by the visual stimuli or by the auditory stimuli. As a result, we considered this study to be a cross-modal paradigm rather than a picture-picture paradigm.

The N400 amplitude is the waveform that appears in the brain scan and indicates the negative inflection peak that occurs around 400ms after stimulus onset. The occurrence of the N400 is often associated with language comprehension, with a larger N400 amplitude indicating increased difficulty in integrating the stimulus with prior knowledge (Kemmerer, 2022; Van Petten & Kutas, 1987). Therefore, it is also a good way to test the relationship between the prime and target by observing the N400 amplitude of participants when hearing the target word. Recently, the study by Von Holzen & Mani (2014) examined the N400 amplitude when bilinguals hear L1 target words. Based on the names of the prime picture in two languages (German as L1 and English as L2), four conditions were constructed: The identity condition with pairs of identical names of prime picture and target word

that were within the same language; the unrelated condition with completely unrelated names of prime and target; in the within-language condition, the name of the prime picture and the target word were within the same language and were phonologically related; in the between-language condition, the name of prime picture in L2 and target word in L1 were phonologically related (or conversely, prime in L1 with target word in L2). Among the conditions, they found that the N400 amplitude was significantly reduced when hearing the target word that was phonologically related to the name of the presented picture within the L1 language. It suggested the implicit name in L1 was activated by pictures, while the name in L2 wasn't, revealing the implicit phonological activation by pictures in the first language.

2.2.3. Summary

The two paradigms above detected phonological activation in different ways: The picture-picture paradigm attempted to find a relationship between phonologically related names of pictures. In this paradigm, it was expected that the name of both pictures would be implicitly activated when the picture was perceived, and that the phonological similarity would facilitate the target recognition. Whereas in the cross-modal paradigm, it was expected that only the implicit phonological representation of the prime would be activated by the picture and facilitate the recognition of the target word, which was presented as a linguistically encoded form by the audio.

Although both paradigms successfully showed implicit phonological activation by the picture, they failed to answer the question: To what extent was the implicit phonological representation activated by the visual information?

Among the studies, only the activation of implicit phonological features could be confirmed: The prime and the target were either initial cohort competitors (Mani & Plunkett, 2010; A. S. Meyer & Damian, 2007; Walenchok et al., 2016) or rhyme

cohort competitors (Von Holzen & Mani, 2014). There is no evidence for activation of the entire implicit phonological representation. Thus, it is unclear if there are more candidates activated by phonological information as Dell et al. (1986; 1997, 2014) assumed in the cascaded model.

On the other hand, given that the bottom-up route P -> Word Form -> S exists (Dell et al., 2014), one would expect that the activation of the implicit phonological representation and the semantic meaning would be used in a balanced way to guide the search (Dell et al., 2014; Lesch & Pollatsek, 1993; Salmelin et al., 1994). Nevertheless, the evidence from previous studies was not plausible to evaluate the subsequent activation after the implicit phonological activation.

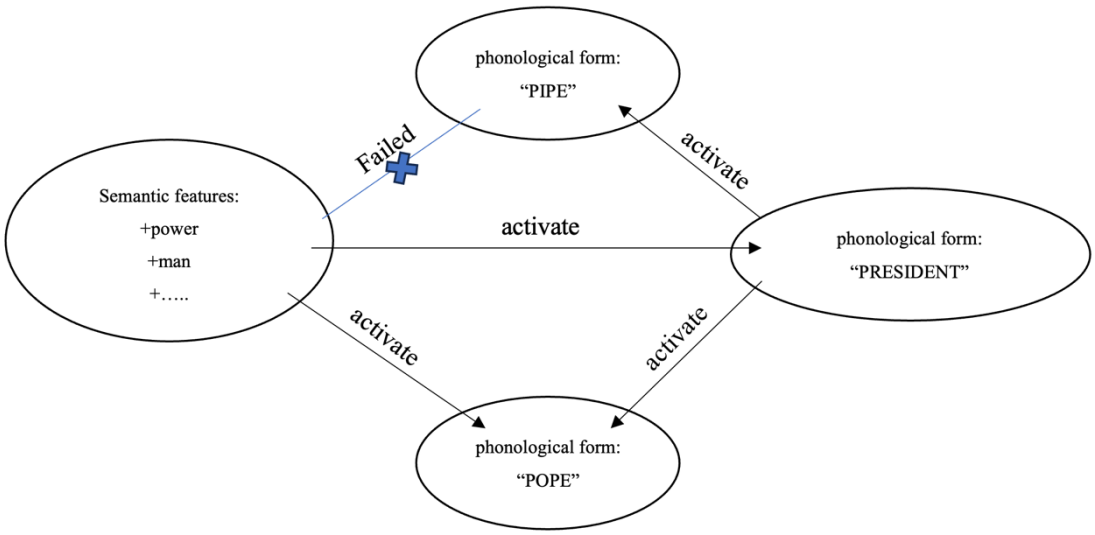
Due to the ambiguity in this area, the current study attempts to investigate activation from phonological to semantic information. To test whether the implicit phonological representation can further activate subsequent information, we attempt to observe the subsequent activation of semantic information from the implicit phonological representation, while ensuring that the subsequent semantic information is not activated by the initial activation of semantic information.

2.3. Interim Summary

According to the assumption of the interactive two-step model, both the phonological representation and the semantic information are activated before lemma selection. Consequently, they both have the chance to nominate the “appropriate” candidates for lemma selection. In other words, the word form could be retrieved not only by the activated semantic features but also by the implicit phonological representation. The two activation pathways should be independent, meaning that subsequently activated information from different types of features could be activated twice or more. For example, the word form "PRESIDENT" could be activated by the semantic feature "+power" and the phonological feature /p/. The

overlapping activation increases the chances of selection, which is why "POPE" was selected by Joe Biden (see Figure 3).

Figure 3 Explanation of Mixed-Error Effect.
A set of semantic features activated the phonological form "PRESIDENT" and the semantic candidate "POPE", while the phonological form "PRESIDENT" also activated its phonological neighbor "POPE", the double activation increasing the chance of slipping.



If the retrieval of implicit phonological information precedes lemma selection, one might expect the activation of semantic information, which is semantic unrelated to the visual stimuli but related to the implicit phonological representation of visual stimuli. To investigate this activation, our study used homophonous words with two irrelevant semantic meanings.

2.4. Why Were Homonyms Chosen?

2.4.1. Definition and Previous Model

Homonyms are defined as a single word or sign that denotes more than one meaning, which don't share semantic properties (L'Homme, 2020). For example, in German, the word "Rock" denotes the meaning of a skirt or a kind of music, although the meanings are unrelated to each other, they share the same word form. The process of lexical access to ambiguous words has attracted many researchers and

generated a great deal of research. A previous review by Simpson (1984) concluded three models that are most relevant to lexical ambiguity: The context-dependent model, the exhaustive access model, and the ordered access model. However, the context-dependent model and ordered access model are supported by only a few studies (e.g., D. E. Meyer & Schvaneveldt, 1971a). Many studies have already shown a primary activation of the context-inappropriate meaning of the homonym. Apart from the studies mentioned by Simpson, several recent ERP studies (Kotchoubey & El-Khoury, 2014; Meade & Coch, 2017) investigated homonym processing at short SOA (< 300 ms). In particular, the main result of Kotchoubey & El-Khoury's (2014) study showed a robust activation elicited by contextual information. In addition, a weak effect of meaning frequency on activation was found. Therefore, they argued that subordinate meaning did activate under special situations. The finding was contrary to the context-dependent model and the ordered access model, suggesting that all meanings of a homonym can be activated, once the word is perceived by people, but that different factors are chosen to order access depending on the variant situation (Duffy et al., 2001; Simpson, 1984).

2.4.2. Simultaneous Activation

In short, the previous model of access to homonyms assumed the activation of meanings by different factors rather than by single factors. Based on this assumption, one might expect the activation of the subordinate meaning of the homonym, when its phonological form is perceived. Previous researchers have provided some evidence for the activation of subordinate meaning with minimal context. For instance, Eckstein et al. (2011) examined the activation of their two semantic meanings out of context. They investigated the time course of activation of semantic meanings with a lexical decision task, in which the visible linguistically encoded form was applied, and their priming task was divided into a subliminal

(masked) priming task and a supraliminal (visible) priming task with different SOAs. In the visible priming task, it was found that the subordinate meaning of the homonym was only activated at 300ms of SOA, while the dominant meaning could be activated at all SOAs. These results are consistent with the simultaneous activation hypothesis. Furthermore, the results of the masked priming task demonstrated that the subordinate meaning was inhibited, and the dominant meaning was facilitated; the inhibition of the subordinate meaning was explained by the negative priming effect, which has been reported within masked priming task (Frings & Eder, 2009), negative priming indexed the inhibition of priming for meaning, as demonstrated by a slower response to target recognition, the reason for which is either that attention is diverted from the non-target item that is being asked to be ignored (Tipper, 2001), or that the prime retrieval process conflicts with the target retrieval process (Neill, 1997). Both reasons assumed that the subordinate meaning was retrieved in homonym processing and then was inhibited, which is why the subordinate meaning was only activated at 300ms of SOA. They then suggested a different access process for the ambiguous word: Participants can retrieve both meanings of the homonym when they perceive the homonym, whereas the dominant meaning will be early selected in the unconscious situation due to the negative priming effect.

Another study that observed the activation of subordinate meanings with minimal context was the ERP study by Meade & Coch (2017), they found a reduced N400 amplitude not only for the dominant associated target but also for the subordinate associated target. This provided evidence for the simultaneous activation of subordinate meaning. They also examined the LPC (Late Positive Component) priming effect, which indicates the awareness of the prime-target relationship. Similar to the N400, the LPC is an ERP component detected in brain activity that occurs about 500 ms after stimulus presentation and can last for several hundred milliseconds thereafter. It is often associated with working memory tasks and other tasks

that require cognitive control (Swaab et al., 1998; Van Petten & Kutas, 1987). In the priming study, the elicitation of the LPC is associated with conscious recollection of the prime-target relationship (Bouaffre & Faïta-Ainseba, 2007; Hill et al., 2005). In previous studies, there was a larger LPC priming effect was reported for the meaning-associated target than unrelated (MacGregor et al., 2015; T. Swaab et al., 2003; Van Petten & Kutas, 1987). Similarly, in this study, Meade and Coch also found a similar LPC priming effect, suggesting that the relationship between the subordinate meaning-associated target and the homonym prime was recognized by the participants.

2.4.3. Interim Summary

Considering all the evidence that the studies above provided, it seems that people tend to activate both meanings of homonym when the homonym was provided out of context, suggesting that the subordinate meaning, i.e. the alternative meaning of the homonym would be activated when the phonological representation of the homonym is activated. Given this, the activation of phonological representation was predicted to activate its alternative meaning, even if the representation is only implicitly activated.

Returning to our study, as we mentioned above, this study aims to investigate whether the implicit phonological representation could further activate its corresponding information, but another question arises: How could we confirm it? When visual information was given, it related to a meaning with a fixed associated phonological information. Although the implicit phonological information and the semantic information were retrieved in parallel, they were just treading different paths that led to the same destination. To confirm the activation process from the visual stimuli to the phonological representation, further to its semantic meaning, the target meaning needs to be isolated from the prime meaning, ensuring that two meanings are only associated through the phonological representation. Thus,

in this study, the alternative meaning activation of the homonym was treated as a tool for observing implicit naming.

But before using the homonym as our tool, we cannot afford to ignore the influence of the associated meaning of the prime picture. The problem is, can the context-inappropriate meaning still be activated by the phonological form in the biased context?

2.4.4. Override the Context Effect

As a representative of the hybrid model, the reordered access model proposed by Duffy et al. (2001) assumed that all meanings of a homonym are accessed exhaustively and that access is accelerated by meaning frequency or disambiguating context. However, it is unclear if the inappropriate meaning was also activated.

On the one hand, it has previously been observed that the response time of both meaning-associated pairs was faster than unrelated pairs (Onifer & Swinney, 1981; Seidenberg et al., 1982; Swinney, 1979; as cited in Morris, 2006). In their studies, the prime word was embedded in a sentence, which provided a biased context: After hearing the sentence with the homonym, a string of letters either related to one of the two meaning-associated primes or as a non-word was shown on the screen, participants were asked to decide whether it was a real word. Their finding suggested that multiple meanings could be initially accessed.

On the other hand, Jones (1991) failed to find the activation of context-inappropriate meaning in the biased sentential context, although his experiment was similar to Swinney (1979). He argued that the difference between their results was led by the heavy processing load in Swinney's study, which was more likely to bring multiple access. This opposed finding required further investigation in this area.

To date, more precise methods, such as EEG studies, have been developed. Elston-Güttler and Friederici (2005) examined the activation of context-inappropriate meaning using a similar lexical decision task but recorded the ERP signal

additionally. In this study, they observed not only the facilitated reaction time for the context-inappropriate target but also the N400 effect at the SOA of 200 ms. Yet the priming effect no longer persisted at the SOA of 500 ms, providing evidence for initial access to multiple meanings, suggesting that context-inappropriate meaning could be activated even in a biased context. These results are also consistent with the results of Seidenberg et al. (1982), finding that the context-inappropriate meaning could be accessed at the SOA of 200 ms.

Overall, the context-inappropriate meaning could be activated initially. More accurately, the activation of the alternative meaning is most likely to occur within 500 ms after the presentation of the prime. Thanks to the possibility of simultaneous activation of the alternative meaning in the biased context, it is possible to observe the implicit phonological representation by observing the activation of the alternative meaning.

2.5. Summary

Taken together, based on the bottom-up route proposed by Dell et al. (2014), an activation flow from implicit phonological information to its corresponding semantic information was assumed. The activation from visual stimuli to implicit phonological information was called the 'Implicit Naming Effect'. In previous studies, the experimenters have used two different paradigms for investigation: Either to prime the picture with a picture or prime the phonological representation with a picture. However, according to Dell's model, the activation flow does not stop at the activation of implicit phonological representation but further activates its subsequent information. The implicit naming effect hypothesized that the semantic information unrelated to the given visual stimuli could also be activated, as long as it corresponded to the implicit phonological information. Thus, it required us to observe the activation of subsequent semantic information from implicit

phonological information, while ensuring that this subsequent information is unrelated to the initial semantic information.

Meanwhile, the picture-related phonological representation is usually firmly associated with the picture-related semantic information. To isolate the implicit phonological activation from the semantic activation, the phonological representation that owns two semantic meanings is required for this study. That is why the process of homonym access was used in this study as an indicator of activation flow. The studies reviewed in Chapter 2.4 have discussed the activation of the alternative meaning of the homonym. Collectively, the finding provides more positive evidence for the initial activation of subordinate meaning, the influence of context is more likely to affect the selection after 500 ms. The provided evidence encourages us to observe the implicit phonological activation by observing the activation of alternative meaning.

3. The Current Study

As mentioned in the literature review, prior studies have evaluated the implicit naming effect with different designs: Either presenting the target word auditorily (cross-modal paradigm) or presenting a non-linguistically coded form as target (picture-picture paradigm) (Mani & Plunkett, 2010; A. S. Meyer et al., 2007; A. S. Meyer & Damian, 2007; Von Holzen & Mani, 2014; Walenchok et al., 2016). Their finding proposed the activation of subsequent information from the implicit phonological representation.

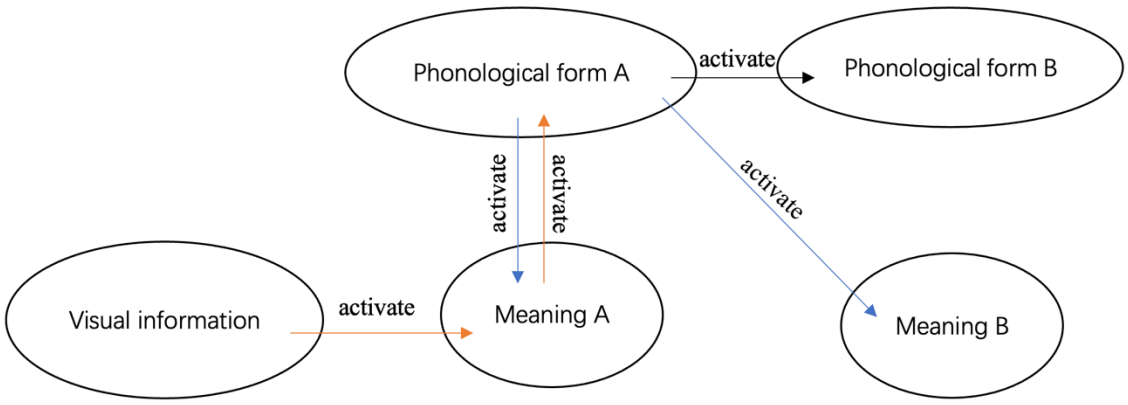
However, previous studies only focused on the activation of the implicit phonological representation and have not addressed the subsequent semantic activation based on the implicit phonological representation, which is the bottom-up route predicted in Dell's (2014) model: The implicit phonological representation was not only activated automatically but also able to retrieve subsequent semantic information.

In reviewing the literature, it is unclear whether the semantic information could be further retrieved based on the implicit phonological representation. Therefore, the activation of the alternative meaning of the implicit phonological representation was investigated in this study, with the expectation that the implicit naming effect could be indirectly confirmed by observing the activation of the alternative meaning.

The aim of the current study was to investigate whether the visual information be named implicitly, if the visual information was implicitly named as we assumed, the activation of the implicit phonological representation would further activate its corresponding semantic information. To separate the meaning as prime and meaning as the target, two irrelevant semantic meanings that share the phonological representation were used.

The hypothesized model of the present study is shown in Figure 4. According to this model, it is predicted that the meaning B could be activated by the implicit phonological representation, although it is irrelevant to the meaning A, which is activated by visual information.

Figure 4 Assumed Activation Flow.
The orange pathway illustrated the first and second steps of lexical access: The visual information could activate the semantic information (meaning A), and further activate the implicit phonological representation (phonological form A). Then the implicit phonological representation could further activate its subordinate information, including phonological neighbors (phonological form B), and the corresponding semantic information (meaning B). The bottom-up route was indicated by the blue path: from phonological form A to meaning A and meaning B.



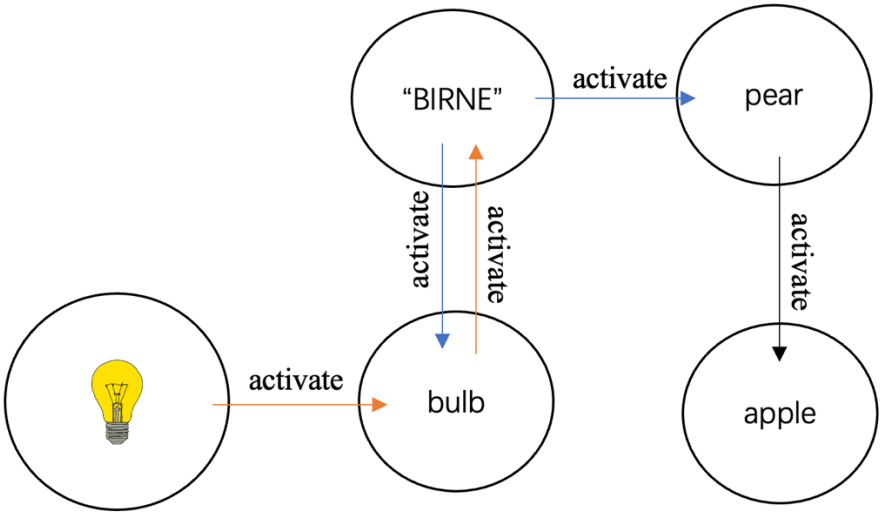
Note that the activation of meaning B (alternative meaning) is independent of the activation of meaning A (biased meaning) due to the different paths they take, as shown in Figure 4, the activation of the biased meaning should be stronger than the activation of the alternative meaning, because it was double activated by visual information and phonological information.

In the present study, a lexical decision task was set up to test the implicit naming effect: A prime picture was presented for 500 ms, followed by the presentation of the target word. Three primes will share a single target word with different conditions: For instance, if the target word is "APFEL" (Eng.: apple), the prime is either with implicit phonological representation that is semantically related to the target word (e.g., bulb, Ger.: "Birne", with an alternative meaning of pear), or with the

phonological representation that identical to the target word (e.g., apple), or unrelated to the target word (e.g., sofa). While the identical pairs own not only the phonological relationship but also the semantic relationship, the prime picture "bulb" is semantically unrelated to the target word, and they are only associated with implicit phonological representation.

It is important to note that the activation pathway we need to observe in our study has one more step than the assumed activation flow (see Figure 5).

Figure 5 Assumed Activation Flow in Current Study.
The orange path indicates the first and second steps of lexical access, and the blue path indicates the bottom-up route. To confirm the activation of "pear" from "BIRNE", we expected to observe the activation from the meaning "pear" to "apple".



Because of the single activation pathway from implicit phonological representation to the alternative meaning, we predicted that this processing load would be heavier than the load for the identical meaning. Thus, the identical pair should yield the shortest reaction time or the highest accuracy. Although the activation of the alternative meaning takes longer, it still facilitates word processing and should result in a shorter reaction time or higher accuracy than the unrelated target.

Based on this prediction, Hypothesis 1 was formulated as follows:

> H1: The target word that is identical to the prime picture yields the highest accuracy and/or the shortest reaction time in the lexical decision task (identity condition). Following the target word that is semantically related to the

implicit phonological representation of prime but unrelated to prime itself (related condition). The unrelated condition yields the lowest accuracy and/or the longest reaction time.

If the processing load of the alternative meaning was too heavy and was abandoned during lexical access, or if we did not observe the implicit naming effect, we might not find a difference between the related and unrelated conditions. However, the priming effect from the meaning-associated target was still predicted to be observed. Therefore, the hypothesis 2 was formed as follows:

H2: The Identity condition yields the highest accuracy and/or the shortest reaction time, the other conditions do not differ from each other.

The experiment might fail because of a failure to control confounding factors, in which case we predicted the situation of hypothesis 0 as follows:

H0: There is no difference in accuracy and/or reaction time among the conditions.

4. Methods

4.1. Lexical Decision Task

Based on the purpose mentioned in the previous chapter, the lexical decision task was applied to test the assumed priming effect between the given picture and the corresponding target word. Lexical Decision Task (LDT) is a popular procedure used in the psychological and psycholinguistics field. This procedure aims to understand the relationship between two elements (e.g., linguistics form) by measuring the accuracy and reaction time of the lexicon decision. The facilitation of target word recognition by relevant stimuli has been investigated by many investigators, previous studies suggested the facilitation of lexical decision could be measured by reaction time. Furthermore, Meyer and Schvaneveldt (1971) showed that the decision error rate for unrelated word pairs was significantly higher than for related word pairs. The results of previous studies indicated that the decision or categorization of the target word could be facilitated by a semantically related word. In addition, word frequency and familiarity were suggested to influence the lexical decision (Monsell et al., 1989; Rubenstein et al., 1970).

4.2. Participants

4.2.1. Participant Recruitment

Participants were recruited through printed flyers, social media posts, and mailing lists, and were given a URL or QR code that linked to the consent form, which explained the purpose and experimental procedure of the study, the inclusion and exclusion criteria, and the potential risks of the experiment. As compensation, they were also entered into a draw to win a Thalia voucher worth €50, which will be sent to them by email.

4.2.2. Inclusion and Exclusion Criteria

Participants were required to be native speakers of German; as for the phonological encoding task required, participants with visual and hearing impairments were excluded, as were participants with increased potential risk of decisional difficulties due to neurological dysfunction, medical treatment, and visual impairment. The effect of age on decision-making was taken into account. Therefore, only the 18-45 age group was included. The exclusion process was carried out using the automatic process set up at the beginning of the online experiment, after participants gave their consent, they were asked to complete the demographic survey which included questions about their first language, gender, and whether they had dyslexia, a history of neurological dysfunction, medical treatment, visual or hearing impairment and whether they were affected by alcohol (See Appendix). Except for the participants who had visual impairment but were corrected by appropriate equipment and a history of neurological dysfunction, other participants were excluded by automatic process, the participants with a history of neurological dysfunction were asked to provide the details of the dysfunction, if there was no detail about the dysfunction or the dysfunction was considered as a risk for the decision task, they will be manually excluded by us.

4.2.3. Participant Overview

Eventually, 61 German native speakers (43 males, 18 females) participated in this study, the age range of participants was limited to 18-45 years old and all of them had a normal or corrected-to-normal vision.

4.3. Equipment

This study was carried out online. The consent form as a PDF document was distributed to participants via u: cloud, the online storage for University of Vienna

staff and students, allowing access to documents from any device with editorial approval.

PsychoPy Builder (v2022.2.5) (Peirce et al., 2019) was applied to set up the experiment. After the construction of the experiment, it was carried out as an online study by JATOS (Lange et al., 2015).

The URL for the online study was attached at the end of the consent form, ensure that the participants have read the consent form completely. After reading the consent form, people who were willing to participate in this experiment would be asked to click on the URL and declare their willingness on the second page of the experiment. Only when the participants clarified their consent, they would be asked to continue with the experiment.

To mitigate the impact of right-handedness, two sets of keyboard layouts were designed. In the first set, pressing the "1" key denoted a real German word, while the "0" key indicated a pseudoword. Conversely, in the second set of layouts, the "1" key represented pseudowords, and the "0" key was assigned to real words.

4.4. Materials

4.4.1. Pictures

The priming pictures we used in this study were selected from the MultiPic database (Duñabeitia et al., 2018). Multipic database is an open access, it includes norming data in 6 different European languages for 750 colored drawings that indicate various concrete objects. All the drawings were created with the same style and from the same source, Duñabeitia et al. measured the naming agreement and the visual complexity of pictures. The participants were asked to provide an appropriate single name to describe the picture and the visual complexity of the pictures were asked to rate. A high degree of naming agreement of pictures in a

single language was confirmed. In this study, 180 pictures were applied, and the naming agreement, visual complexity, and picture names were compared.
In this study, 180 pictures were chosen from a database, and visual complexity and naming agreement were considered as the confounding factors: A higher visual complexity extends the reaction time in the lexicon decision task, while a lower naming agreement results in the failure of implicit naming task (Berman et al., 1989; Snodgrass & Vanderwart, 1980). To lower the risk, the average value and standard deviation in visual complexity and the naming agreement of pictures were considered and controlled. After careful selection, the mean values and standard deviations were summarized in Table 1. According to the results of ANOVA, a significant difference was neither found in naming agreement nor visual complexity among the three conditions of the critical group.

Table 1 Means and Standard Deviation of Naming Agreement and Visual Complexity in Different Groups.
The values in brackets indicate the standard deviations.

	Naming Agreement [%]	Visual Complexity
Prime picture	Mean (SD)	Mean (SD)
All	96.13(7.88)	2.5(0.6)
Critical	93.17(9.61)	2.5(0.63)
Filler	97.61(6.41)	2.47(0.54)
Critical identical	92.16(8.43)	2.72(0.54)
Critical related	90.89(12.15)	2.41(0.58)
Critical unrelated	96.45(6.08)	2.37(0.68)

4.4.2. Target Words

60 target words were used in this study, composed of 30 real German words and 30 pseudowords. As for real words, word properties such as frequency,

familiarity, word length, and syllable length were retrieved from the database dlexDB (Heister et al., 2011). DlexDB was a completed project of the Berlin-Brandenburg Academy of Sciences (BBAW) and is open access. Over 100 million tokens from the core corpus of the Digitales Wörterbuch der Deutschen Sprache (DWDS) have been included in this database, and the properties of the tokens such as word or morpheme frequencies, familiarity, etc. have been computed in their project.

Pseudowords were generated by the Wuggy Pseudoword Generator (Keuleers & Brysbaert, 2010), The generation of pseudowords with the help of this generator was in accordance with the phonotactic constraints of the given language. 30 pseudowords were generated based on the syllable structure of the real words we applied in this study. Consequently, pseudowords had the same syllable structure as real words.

Table 2 illustrates the number of letters, syllables, frequency, and familiarity of the target words. The frequency and familiarity of pseudowords were not applicable because no pseudowords could be searched in the database. In order to avoid the benefits caused by a small number of letters and syllables (Zelinsky & Murphy, 2000), words with similar numbers of letters and syllables were selected. The enormous variation between frequency and familiarity of words leads to a huge number of standard deviations among words. However, given the randomness of the frequency and the familiarity, the results would not be influenced by them.

As we introduced earlier, this study aims to investigate implicit naming, in which participants were expected to name the pictures implicitly. As a result, the word properties of picture names would be concerned. In Table 3, the word properties of the picture names were summarized. As with the target words, the picture names with similar numbers of letters and syllables were selected for our study. Among the word groups in the different conditions, there was no significant difference in average value and standard deviation.

Table 2 Summary of Different Characteristics of the Target Groups.
SD = standard deviation. NA = not applicable.

	word length	syllable length	frequency	familiarity
Target	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
All	5.1(1.28)	1.7(0.7)	NA	NA
real	5.18(1.32)	1.73(0.72)	3913.43(5358.47)	13515.53(22756.18)
pseudoword	5.27(1.56)	1.91(0.83)	NA	NA
Filler target	5.18(1.36)	1.75(0.78)	NA	NA
Critical target	4.9(1.25)	1.55(0.69)	4770.75(6590.52)	8465(7897.54)

Table 3 Summary of Mean Word Properties of Picture Names Indicated by Pictures.

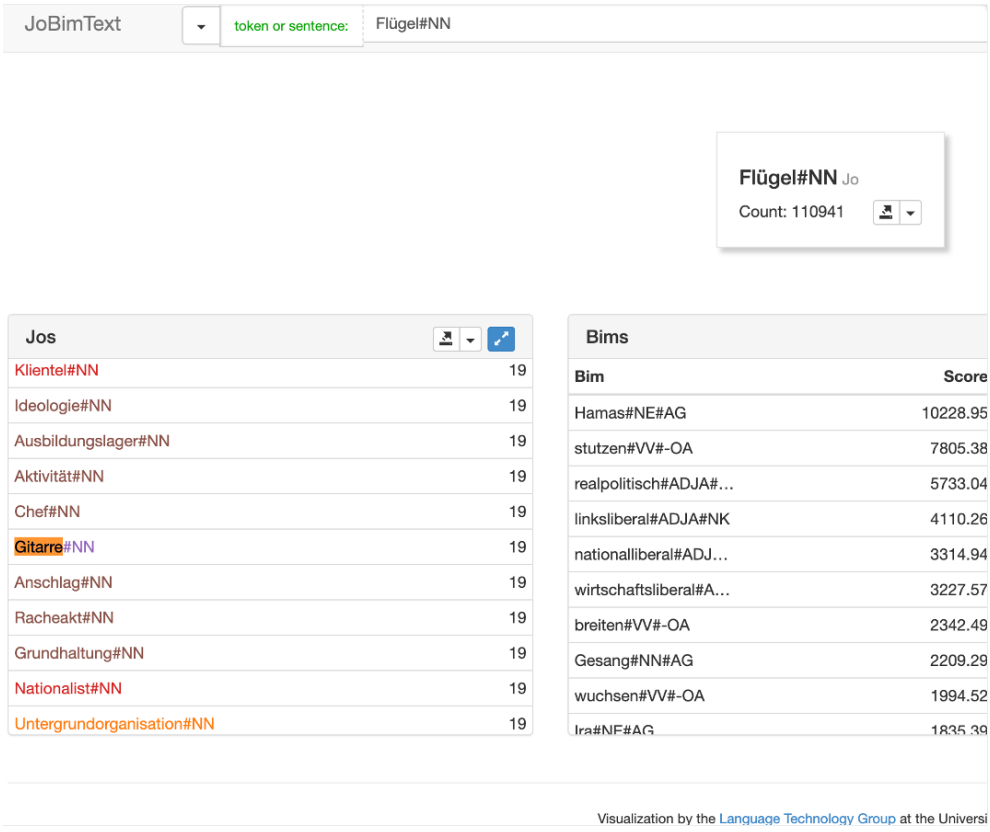
	Word length	Syllable length	Frequency	Familiarity
Picture names	Mean (SD)	Mean (SD)	Mean (SD)	Mean (SD)
Critical	5.05(1.24)	1.67(0.66)	3709.78(5695.82)	11474.58(21608.32)
Critical identical	4.9(1.25)	1.55(0.69)	4770.75(6590.52)	7707.25(7897.94)
Critical related	5.2(1.1)	1.6(0.5)	3444.8(6922.8)	16253.5(32397.95)
Critical unrelated	5.05(1.39)	1.85(0.75)	2913.8(2730.59)	10463(17258.2)

4.4.3. Semantic Relationship

The semantic relationship between the target and prime was a confounding variable that could strongly affect the results. Therefore, we used JoBimText to test the semantic relationship within word-picture pairs. JoBimText is an open-source

framework that utilizes the principles of distributional semantics and lexicalized features to automatically expand text. It achieves this by computing contextual distributional similarity. The words with a closer semantic relationship could be determined based on the frequency of co-occurrence (Biemann & Riedl, 2013). Figure 6 presents an example of using JoBimText. The clusters Bims and Jos list the words with first and second-order co-occurrence, respectively. JoBimText defines each word by a set of up to 1000 highly significant 1st-order features, the closeness of the semantic relationship is defined by the number of shared 1st-order features, resulting in similarity points in the 2nd-order co-occurrence. To find out the semantic relationship within words, the 2nd-order co-occurrence of picture name and target was checked using JoBimText. The significant closer relationship between the words was confirmed, and each identical and related pair was confirmed as a 2nd order co-occurrence.

Figure 6 The Example of Using JoBimText



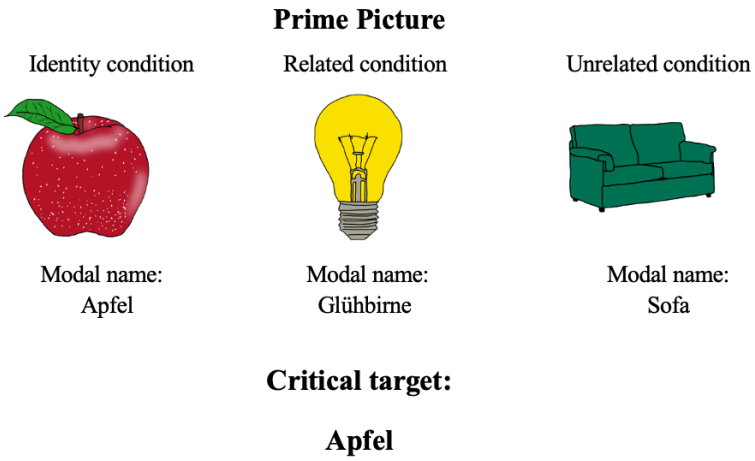
4.5. Experimental Design

4.5.1. Experiment Conditions

The patterns were lists of 180 word-picture pairs with 180 pictures as prime stimuli and 60 real words as target words. Target words were divided into two target groups: critical targets (20 words) and filler targets (40 words). Critical targets were real words that were semantically related to one of the semantical meanings of selected homonyms, while filler targets were just the randomized real words and pseudowords.

The critical target group consisted of 20 real target words and 60 pictures, each target was associated with a picture per condition: identical, related, and unrelated. As a result, 60 word-picture pairs were conducted. For example, in the identical condition, the target word "Apfel" (Eng.: Apple) was paired with the picture indicating an apple; in the related condition, the same target word was paired with the picture that indicating a bulb (Ger.: Birne, also meaning pear); in the unrelated condition, the same target word was paired with the picture that was neither semantically nor phonologically related to the target word (see Figure 7).

Figure 7 A Target Word Paired with a Prime Picture by Condition.
The pictures used were from the MultiPic database (Duñabeitia et al., 2018)



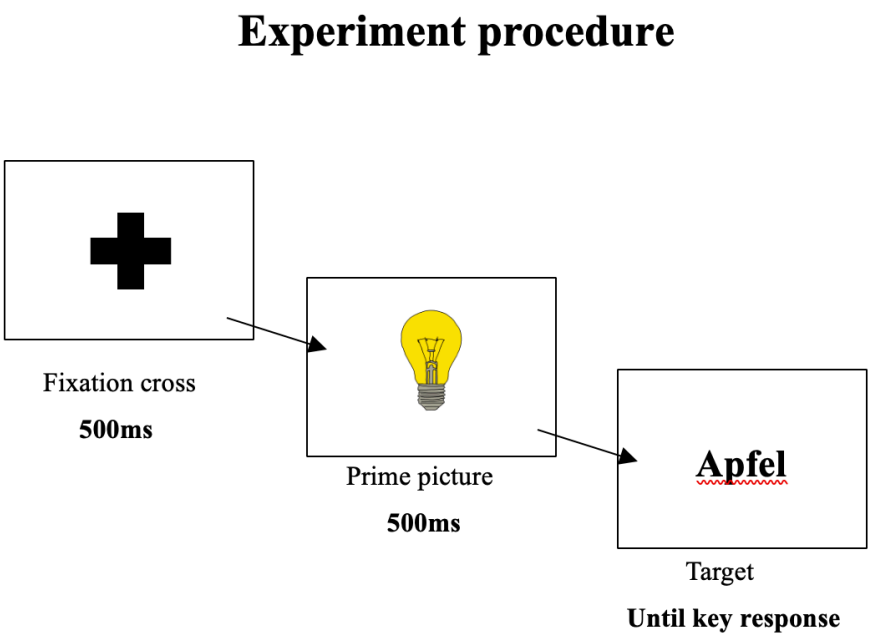
Similar to the pairs in the critical target group, 40 filler targets were paired with 120 unrelated pictures, and all the word-picture pairs were neither semantically

nor phonologically relevant. 10 filler targets were real words, and the remaining 30 targets were pseudowords.

4.5.2. Experiment Procedure

In total, 180 word-picture pairs would be shown, and participants would be asked to judge the lexical statuses of the target words. The procedure for each trial was as follows: First, a fixation was shown for 500 ms to ensure the participant's concentration. A picture was then shown as prime for 500 ms, followed by a written word as target (See Figure 8). Once the target was shown, participants were asked to decide whether the word was a real German word or a pseudoword by pressing '1' or '0' on the keyboard. Decision time and accuracy were recorded and measured.

Figure 8 The Scheme of Experiment Procedure.
The picture used was from the MultiPic database (Duñabeitia et al., 2018)



The study was conducted online. After reading the consent form in the form of a PDF document and clicking on the links to the experiment, participants were shown a welcome page, then they were asked to confirm their agreement to participate in this experiment and to complete their demographic questionnaire. After

that, a basic explanation of this experiment was displayed in text form: Participants were instructed to click the 'space' button to continue after reading the instructions. 10 probe trials had to be completed before the actual experiment started. Another page of instruction for the actual experiment was presented at the end of the probe trials. After the actual experiment with 180 trials, participants were asked to answer the questions in the final questionnaire, which included questions about awareness of identical or other associations between words and pictures, and the helpfulness of the associations for the lexical decision task.

4.6. Statistical Analysis

In this study, R (R Studio Team, 2020) was applied for the analysis. The mean, median, and standard deviation of recorded accuracy and reaction time for the lexical decision task were measured. To confirm the statistical difference among conditions, ANOVA was employed for both accuracy and reaction time measures. Moreover, the normal distribution of reaction time was also measured.

Due to the impact of outliers on the mean and standard deviation, values 1.5 times the interquartile range outside the upper quartile and below the lower quartile were considered outliers and excluded from the data analysis. Reaction time outliers were first excluded. Next, the participant's accuracy in the lexical decision task was calculated in percent. Then the outliers of accuracy were also excluded, followed by a recalculation of accuracy due to the change in amount.

One participant's accuracy (Nr: 943196) was only 3%. It could be possible that this participant used the contrary set of layouts that we asked for. To use the data that matched the real situation, we measured his/her data with the other set of layouts, which was appropriate to his/her answer. The accuracy of this participant was then 97% after manual manipulation.

5. Results

5.1. Accuracy

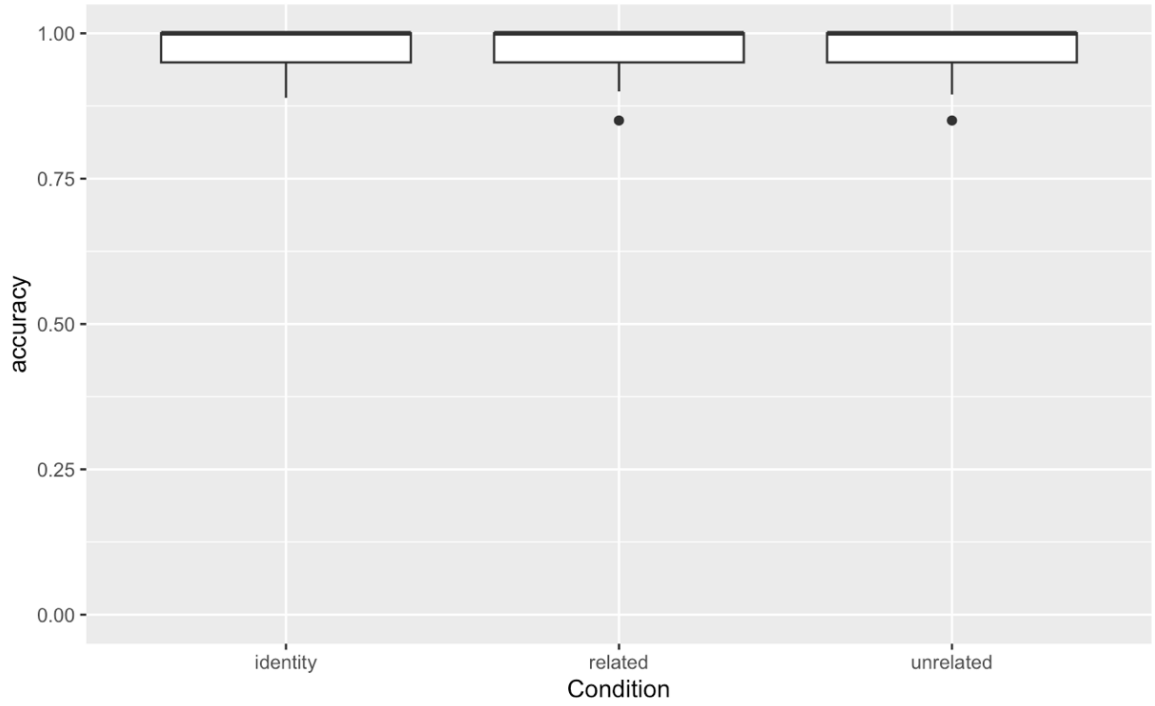
The mean accuracy of lexical decision and t-test were displayed in Table 4. Overall, although the mean accuracy was the highest for identical pairs (mean = 0.98, SD = 0.032), followed by related pairs (mean = 0.97, SD = 0.037), and then unrelated pairs (mean = 0.97, SD = 0.042), both the ANOVA (df = 2, F = .659, p=0.194) and the t-test ($p > 0.05$) suggested that there was no significant difference within groups.

Table 4 Summary of Accuracy on Lexical Decision.

Accuracy				**T-Test Accuracy**	
Condition	**Mean**	**SD**	**Median**	**Condition**	**p_value**
Identical	0.9795434	0.032	1	Identical vs Related	0.474
Related	0.9746851	0.036	1	Unrelated vs Related	0.287
Unrelated	0.9664717	0.041	1	Identical vs Unrelated	0.076

In addition, the boxplot showed the extremely high performance of each group (Figure 9), the median accuracy of each group was 100%. This revealed a generally high performance of the participants. Nevertheless, the accuracy of the identical associated pair was more intensive than the other two conditions, no outliers appeared under the identical condition.

Figure 9 Accuracy Among Conditions (In Fraction).



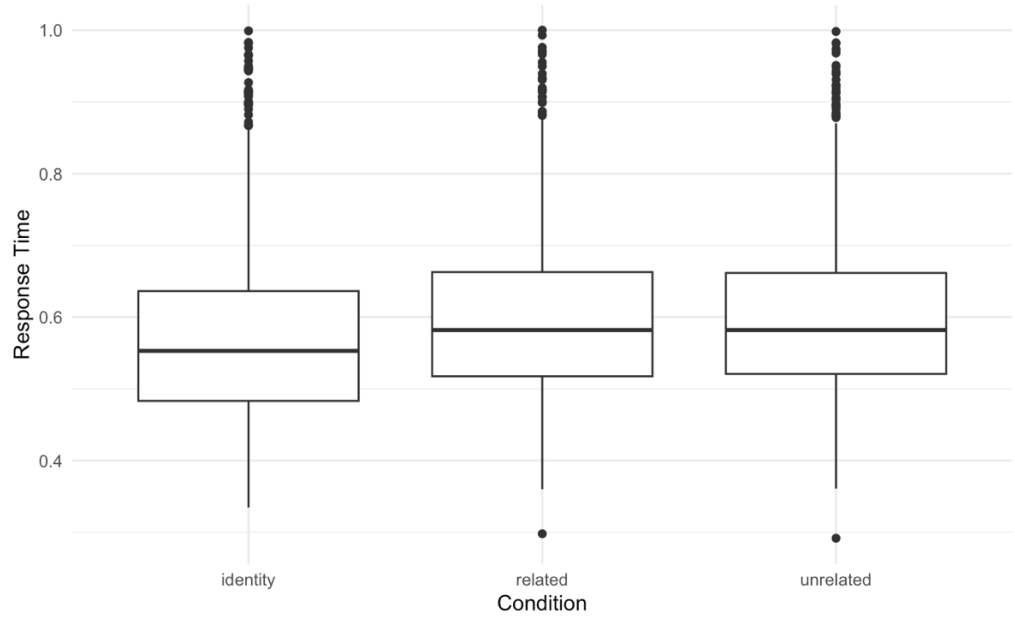
5.2. Reaction Time

In contrast to accuracy, a significant difference in reaction time (RT) within groups was suggested by the ANOVA ($df = 2$, $F = 21.22$, $p < 0.05$). As shown in Table 5 and Figure 10, the mean reaction time of identical pairs was significantly shorter than that of related and unrelated pairs, while the RT of related pairs was not statistically confirmed to be shorter than that of unrelated pairs.

Table 5 Summary of Reaction Time on Lexical Decision.

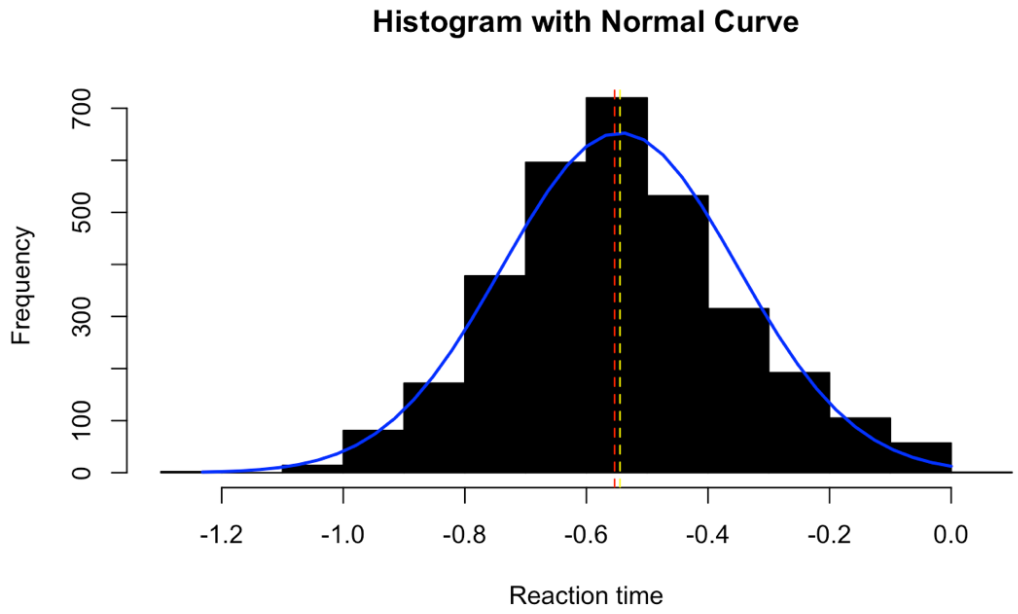
reaction time				**t-test rt**	
condition	**mean**	**SD**	**median**	**Condition**	**p_value**
identical	0.5721128	0.1203512	0.553	identical vs related	1.754e-07
related	0.5988796	0.1141570	0.582	unrelated vs related	0.4866
unrelated	0.6023775	0.1163127	0.582	Identical vs unrelated	4.684e-09

Figure 10 Boxplot for Reaction Time for Lexical Decision



A normal distribution is the fundament of the results of the statistical analysis. To ensure the plausibility of the t-test and ANOVA, the distribution of reaction time was also tested. Figure 11 displays the normal distribution of RT for the lexical decision. As the figure shows, the mean of RT is equal to the median of RT, it indicates the normal distribution of RT and suggests the plausibility of results of ANOVA and t-test.

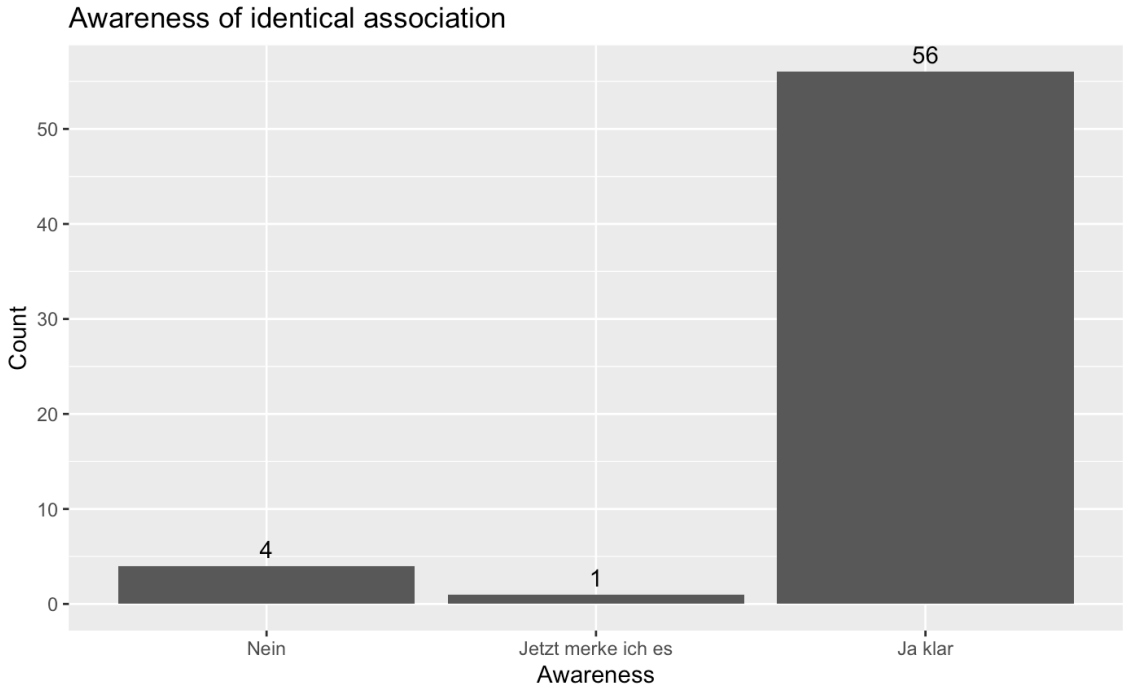
Figure 11 Normal Distribution of Reaction Time for Lexical Decision.
Yellow straight line = mean. Red straight line = median.



5.3. Final Questionnaire

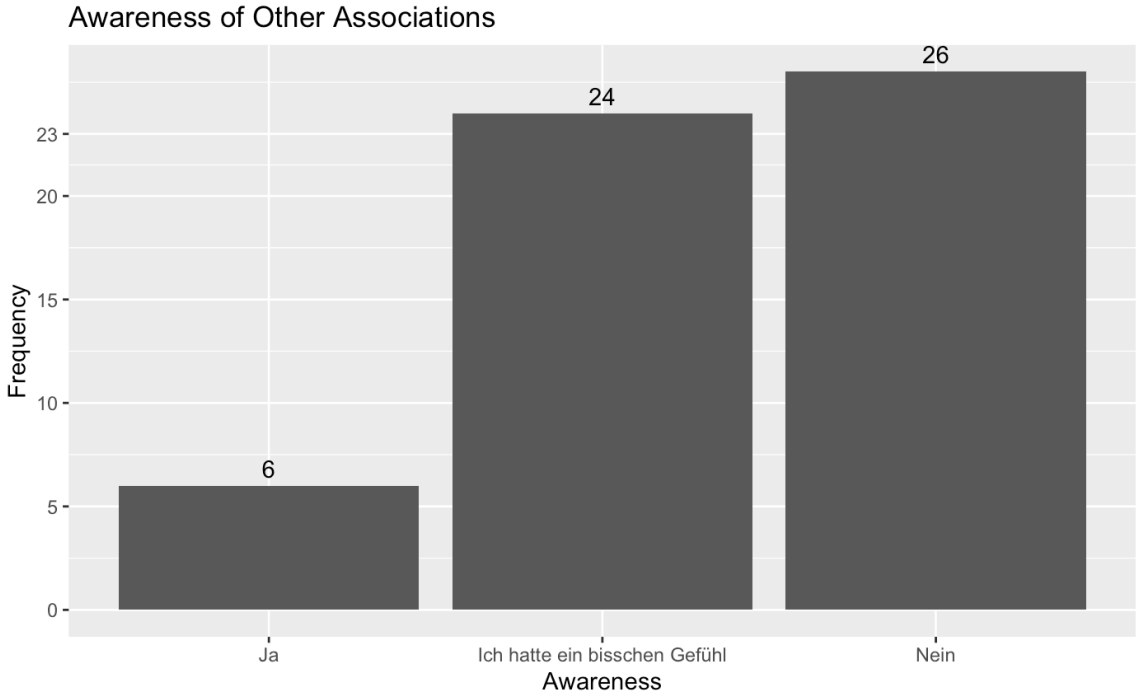
After the experiment, the participants were asked about their awareness of the associations between words and pictures. The results revealed that 56 participants could perceive the identical associations of word-picture pairs, while only 4 participants failed to perceive the associations (See Figure 12).

Figure 12 Awareness of Identical Association.
"Nein" (Eng.: No) = The participant did not notice the identical association. "Jetzt merke ich es" (Eng.: Now I noticed that) = The identical association was not perceived during the experiment but was reminded by the experimenter in the final questionnaire. "Ja klar"(Eng.: Yes, clearly) = The participant could perceive the identical association.



By contrast, only 6 participants perceived the associations other than identical (see Figure 13), and another 24 participants had only a vague feeling and were unsure whether other associations existed. 26 participants rejected the possibility of the existence of other associations between the target and the picture. These results showed a lower awareness of the associations other than identical.

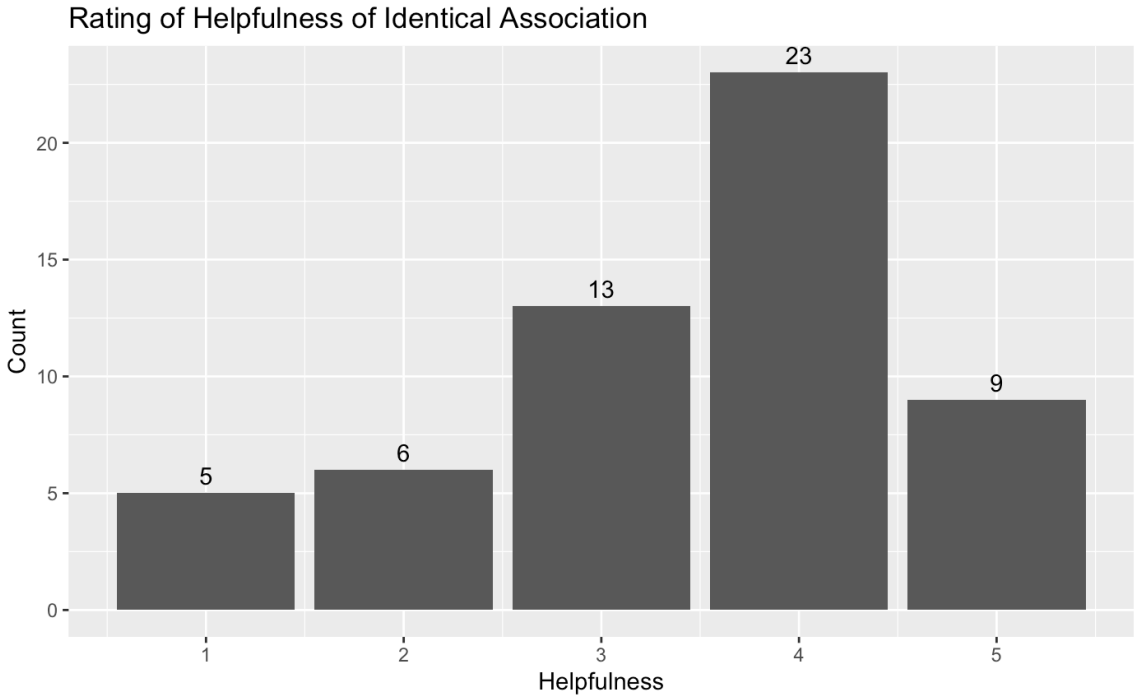
Figure 13 Awareness of Other Associations.
"Nein" (Eng.: No) = The participant did not notice the other associations. "Ich hatte ein bisschen Gefühl" (Eng.: I had some feeling) = The participant had some intuition about other associations, but they could not confirm them. "Ja" (Eng.: Yes) = The participant could clearly perceive the other associations.



Participants who were aware of other associations were asked to indicate the type of other associations. A single choice with three options was provided; the options were "homonymous relationship," "semantic relationship," and "other. Please write down _____". Both the homonymy relationship and the semantic relationship had three supporters. However, due to the lower awareness of other associations, the results could not be treated as plausible.

Moreover, the participants were asked to rate the helpfulness of identical associations for their decision. As shown in Figure 14, the number of participants who gave a rating of 5 (very helpful) and a rating of 4 (gave a lot of help), which taken together make up more than 50%. The population gave a rating of 1 (completely unhelpful) and a rating of 2 (hardly helpful), together accounting for 17%. Additionally, 13% of participants admitted the identical association provided some help for their lexical decision (rating of 3).

Figure 14 Rating of Helpfulness of Identical Associations.
The scale from 1 to 5 indicates the range from "completely unhelpful" to "very helpful".



6. Discussion

The present study investigates the activation of alternative meanings in a lexical decision task. By measuring the accuracy and reaction time of the participants in the three conditions, no significant difference was found in the accuracy of their response. In contrast, the time taken to make the decision in the identity condition was significantly shorter than in the other two conditions, while the reaction time in the other two conditions did not differ from each other significantly. These results support our second hypothesis, which assumes that the identity condition gives the highest accuracy and/or the shortest reaction time, the other conditions do not differ from each other. This finding could be discussed in terms of two different approaches: the implicit naming effect and homonym processing.

6.1. Implicit Naming Effect

The significantly shorter reaction time in the identity condition demonstrates the priming effect of the non-linguistically encoded form: The visual stimulus activated the semantic information, which then led to the activation of the phonological representation. The activation flow displayed in the current study was aligned with the model of lexical access proposed by Levelt et al. (1989; 1991, 1998) and Dell et al. (1986; 1997). Nevertheless, because the prime picture and the target word in the identity condition share the same semantic meaning and phonological information, no retrieval from implicit phonological representations to subsequent semantic information could be confirmed, so there is no evidence for the bottom-up route claimed by Dell et al. (2014).

As same as the results of Von Holzen & Mani (2014) and Mani & Plunkett (2010), the identical condition in the current study also yields the shortest reaction time.

But contrary to our expectation, no significant difference was found in reaction time when comparing the related and unrelated conditions. Therefore, our results are more consistent with the finding of Walenchok et al. (2016), which found that phonological competitors could only affect target recognition when the prime stimuli were verbal rather than visual. The consistent outcome might demonstrate the conclusion: Either there is no bottom-up route in lexical access, or the visual priming effect works only through semantic activation.

6.2. Homonym Processing

The indistinguishable reaction times for the related and unrelated conditions suggest that the alternative meaning of the homonym was not activated, which is consistent with the results of Jones (1991), who failed to find activation of context-inappropriate meaning in a biased context. However, it is not that fair to compare our study with Jones's because of the difference in the type of stimuli. We have considered the following possibilities, which could be attributed to the following reasons:

1) As shown in Figure 5 (see Chapter 3), the processing load from the visual stimuli to the alternative meaning is too heavy, because our task required an additional process from the alternative meaning to its related meaning. Although the study by Lesch & Pollatsek (1993) also used homonyms to examine the activation of alternative meaning of implicit phonological representation and found the activation of alternative meaning, they used linguistic coded form as prime, which reduced the process from visual stimuli to implicit phonological representation. If the process is overloaded, it may either break off or the long processing load takes the same time as in the reprocessing of the unrelated linguistically encoded form. In either case, this processing load does not improve performance.

2) According to the post-test questionnaire, few participants noticed the prime-target relationship in the related condition, the unconscious situation might be explained by the negative priming effect, which is in line with the conclusion of Eckstein et al. (2011). Unfortunately, due to the limited number of participants who were aware of the association, the data collected in this study is not plausible to support this conclusion. Yet it might be interesting to think about the influence of the negative priming effect: If the negative priming effect worked in our study and slowed down the activation of the alternative meaning, the longer reaction time in the related condition could be explained. This would suggest that the indistinguishable reaction times in the related and unrelated conditions were the results of different attributions.
3) The time to present the prime picture was too short, limiting the participants' chance to name the picture implicitly. The setting of the presentation time for the current study is based on considerations for the finding of Elston-Güttler and Friederici (2005), which noted that no more activation of context-inappropriate meaning was found at the 500 ms. No more activation of the alternative meaning could be observed after the 500ms from stimuli onset, considering the aim of the current study, the present time should not be longer than 500 ms. Yet, in their study, the stimuli were presented in the written, linguistically coded form, which is thought to provide phonological cues that speed up the time to name the picture. Meanwhile, in the visual search paradigm of Meyer and Belke (2007), the target picture was presented for 1 s, with enough time to activate the object names, the SOA in their study is much longer than the presentation time in Elston-Güttler and Friederici, the longer SOA was predicted to miss the time window of alternative meaning activation. Taking this into account, the presentation time of the prime picture in the current study was set at 500 ms, including the time for implicit naming and for alternative meaning activation. Nevertheless, it is difficult to find the optimal

SOA that is not only sufficient for naming the picture but also catches the time window of alternative meaning activation.

6.3. Limitations of the Study

A note of caution is due here: None of the above possibilities has ruled out the appearance of an implicit naming effect; it must be admitted that the processing load in our task was too heavy and it might be the main reason for the unexpected outcome. In the study of Meyer et al. (2007), participants were asked to study a booklet containing all the pictures that showed up later, along with their names. This preparation has not only unified the object name indicated by the picture but also closely linked the phonological representation and picture. By providing a closer association between the picture and its name, the processing load might be reduced and speed up the process of implicit naming. In that way, the implicit naming effect is more likely to be observed. Nonetheless, the present study is somewhat limited by the experiment method, as a web-based experiment, it is unpractical to ask participants to study the association between the object and its name. This is why the post-test questionnaire was used to detect the association between prime and target. However, with a small sample size, our post-test questionnaire didn't play the role as anticipated, so it's unclear whether participants benefited from recognising the association.

As mentioned in 6.2., the unanticipated finding might result from a mismatch in the time window of phonological activation and alternative meaning activation. However, to determine the optimal time window, the alternative meaning activation in the context of visual stimuli should be determined first. If the study by Elston-Güttler and Friederici (2005) could be repeated with visual stimuli, it is expected that more would be known about alternative meaning activation.

6.4. Summary

Notwithstanding the unanticipated result, this study showed the priming effect of non-linguistically coded form, ensuring the activation flow from visual stimuli to linguistically coded form.

Nonetheless, the current study failed to find the evidence of implicit naming effect by observing the activation of the alternative meaning of homonym. The unexpected result could be led by the failure of the implicit naming process or the failure of activation of alternative meaning. further studies should attempt to reduce the load of processing visual stimuli into alternative meanings in ways such as strengthening the association between the picture and its phonological representation and ensuring the semantic relationship of prime-target pairs in the related condition. Further consideration of SOA may only be meaningful if both the phonological and the semantic association in the related condition are sufficiently close.

On the other hand, further investigators should get more information from the lexical access of the homonym, the understanding of activation of alternative meaning is also the key to understanding the unexpected results of our study.

7. Conclusion

Overall, our findings provide evidence for the priming effect in the cross-modal paradigm, while no evidence of implicit naming effect was offered. Despite the results in this study failed to support the prediction of Dell 's (2014) model, it offers some insight into the activation processing of phonological features. To our knowledge, the pilot study conducted by Hönig and Müller (2022) and the current study are the first attempts to test implicit naming with alternative meaning activation. Yet the activation flow of the homonym remains to be elucidated. As we are limited to the undefined process in the homonym, a considerable amount of research is needed to explain our results.

In spite of its limitation, the current study provides a new perspective on the study of implicit naming and sheds new light on the study of the implicit naming effect. As a master's thesis, this study is constrained by time and other environmental factors. Further work is needed to strengthen the prime-target association and understand more about homonym processing. For instance, a pre-study of the name of the picture could tighten the association between the prime picture and its phonological representation. Furthermore, we can expect interesting results by comparing the groups of participants who are aware of the homonym association and those who are not. Last but not least, it is essential to understand more about the time course of homonym processing with the help of EEG. A deeper understanding of homophone processing may better explain our study. Anyway, further efforts need to be made towards the development of the implicit naming effect.

8. Reference

Berman, S., Friedman, D., Hamberger, M., & Snodgrass, J. G. (1989). Developmental picture norms: Relationships between name agreement, familiarity, and visual complexity for child and adult ratings of two sets of line drawings. *Behavior Research Methods, Instruments, & Computers*, *21*(3), 371–382. https://doi.org/10.3758/BF03202800

Biemann, C., & Riedl, M. (2013). Text: Now in 2D! A framework for lexical expansion with contextual similarity. *Journal of Language Modeling*, *1*(1), Article 1. https://doi.org/10.15398/jlm.v1i1.60

Bouaffre, S., & Faïta-Ainseba, F. (2007). Hemispheric differences in the time-course of semantic priming processes: Evidence from event-related potentials (ERPs). *Brain and Cognition*, *63*(2), 123–135. https://doi.org/10.1016/j.bandc.2006.10.006

Butterworth, B. (1989). Lexical access in speech production. In *Lexical representation and process* (pp. 108–135). The MIT Press.

Cutting, J. C., & Ferreira, V. S. (1999). Semantic and phonological information flow in the production lexicon. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *25*(2), 318–344. https://doi.org/10.1037/0278-7393.25.2.318

Dell, G. S. (1986). A spreading-activation theory of retrieval in sentence production. *Psychological Review*, *93*(3), 283–321. https://doi.org/10.1037/0033-295X.93.3.283

Dell, G. S., Nozari, N., & Oppenheim, G. (2014). Word production: Behavioral and computational considerations. *The Oxford Handbook of Language Production*, 88–104.

Dell, G. S., & Reich, P. A. (1981). Stages in sentence production: An analysis of speech error data. *Journal of Verbal Learning and Verbal Behavior*, *20*(6), 611–629. https://doi.org/10.1016/S0022-5371(81)90202-4

Dell, G. S., Schwartz, M. F., Martin, N., Saffran, E. M., & Gagnon, D. A. (1997). Lexical access in aphasic and nonaphasic speakers. *Psychological Review*, *104*(4), 801–838. https://doi.org/10.1037/0033-295X.104.4.801

Duffy, S. A., Kambe, G., & Rayner, K. (2001). The effect of prior disambiguating context on the comprehension of ambiguous words: Evidence from eye movements. In *On the consequences of meaning selection: Perspectives on resolving lexical ambiguity* (pp. 27–43). American Psychological Association. https://doi.org/10.1037/10459-002

Duñabeitia, J. A., Crepaldi, D., Meyer, A. S., New, B., Pliatsikas, C., Smolka, E., & Brysbaert, M. (2018). MultiPic: A standardized set of 750 drawings with norms for six European languages. *Quarterly Journal of Experimental Psychology (2006)*, *71*(4), 808–816. https://doi.org/10.1080/17470218.2017.1310261

Eckstein, D., Kubat, M., & Perrig, W. J. (2011). Visible homonyms are ambiguous, subliminal homonyms are not: A close look at priming. *Consciousness and Cognition*, *20*(4), 1327–1343. https://doi.org/10.1016/j.concog.2011.05.010

Elston-Güttler, K. E., & Friederici, A. D. (2005). Native and L2 processing of homonyms in sentential context. *Journal of Memory and Language*, *52*(2), 256–283. https://doi.org/10.1016/j.jml.2004.11.002

Frings, C., & Eder, A. B. (2009). The time-course of masked negative priming. *Experimental Psychology*, *56*(5), 301–306. https://doi.org/10.1027/1618-3169.56.5.301

Garrett, M. F. (1975). The Analysis of Sentence Production11The research reported here was supported in part by NIMH grant HD 05/68-02,03,04. Some of the work was done in collaboration with S. R. Shattuck and her contribution is gratefully acknowledged. This paper was written while the author was a Senior Research Fellow of the Australian-American Educational Foundation (Fulbright-Hayes

program) at Monash University, Melbourne. In G. H. Bower (Ed.), *Psychology of Learning and Motivation* (Vol. 9, pp. 133–177). Academic Press. https://doi.org/10.1016/S0079-7421(08)60270-4

Heister, J., Würzner, K.-M., Bubenzer, J., Pohl, E., Hanneforth, T., Geyken, A., & Kliegl, R. (2011). dlexDB – eine lexikalische Datenbank für die psychologische und linguistische Forschung. *Psychologische Rundschau*, *62*(1), 10–20. https://doi.org/10.1026/0033-3042/a000029

Hill, H., Ott, F., & Weisbrod, M. (2005). SOA-dependent N400 and P300 semantic priming effects using pseudoword primes and a delayed lexical decision. *International Journal of Psychophysiology: Official Journal of the International Organization of Psychophysiology*, *56*(3), 209–221. https://doi.org/10.1016/j.ijpsycho.2004.12.004

Hönig, B., & Müller, J. (2022). *Priming from the other side of the homonym: A tentative pilot study* [Master thesis]. University of Vienna.

Huettig, F., & McQueen, J. M. (2007). The tug of war between phonological, semantic and shape information in language-mediated visual search. *Journal of Memory and Language*, *57*(4), 460–482. https://doi.org/10.1016/j.jml.2007.02.001

Indefrey, P., & Levelt, W. J. M. (2004). The spatial and temporal signatures of word production components. *Cognition*, *92*(1), 101–144. https://doi.org/10.1016/j.cognition.2002.06.001

Jescheniak, J. D., & Schriefers, H. (1998a). Discrete Serial Versus Cascaded Processing in Lexical Access in Speech Production: Further Evidence From the Coactivation of Near-Synonyms. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *24*(5), 1256–1274. https://doi.org/10.1037/0278-7393.24.5.1256

Jescheniak, J. D., & Schriefers, H. (1998b). Discrete serial versus cascaded processing in lexical access in speech production: Further evidence from the coactivation of near-synonyms. *Journal of*

Experimental Psychology: Learning, Memory, and Cognition, *24*(5), 1256–1274. https://doi.org/10.1037/0278-7393.24.5.1256

Jones, J. L. (1991). Early integration of context during lexical access of homonym meanings. *Current Psychology*, *10*(3), 163–181. https://doi.org/10.1007/BF02686773

Kemmerer, D. (2022). *Cognitive neuroscience of language, 2nd edition*.

Keuleers, E., & Brysbaert, M. (2010). Wuggy: A multilingual pseudoword generator. *Behavior Research Methods*, *42*(3), 627–633. https://doi.org/10.3758/BRM.42.3.627

Kotchoubey, B., & El-Khoury, S. (2014). Event-related potentials indicate context effect in reading ambiguous words. *Brain and Cognition*, *92C*, 48–60. https://doi.org/10.1016/j.bandc.2014.10.007

Lange, K., Kühn, S., & Filevich, E. (2015). "Just Another Tool for Online Studies" (JATOS): An Easy Solution for Setup and Management of Web Servers Supporting Online Studies. *PLOS ONE*, *10*(6), e0130834. https://doi.org/10.1371/journal.pone.0130834

Lesch, M. F., & Pollatsek, A. (1993). Automatic access of semantic information by phonological codes in visual word recognition. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *19*(2), 285–294. https://doi.org/10.1037//0278-7393.19.2.285

Levelt, W. J. M. (1989). *Speaking: From intention to articulation* (pp. xiv, 566). The MIT Press.

Levelt, W. J. M., Praamstra, P., Meyer, A. S., Helenius, P., & Salmelin, R. (1998). An MEG Study of Picture Naming. *Journal of Cognitive Neuroscience*, *10*(5), 553–567. https://doi.org/10.1162/089892998562960

Levelt, W. J. M., Schriefers, H., Vorberg, D., Meyer, A. S., Pechmann, T., & Havinga, J. (1991). The time course of lexical access in speech production: A study of picture naming. *Psychological Review*, *98*(1), 122–142. https://doi.org/10.1037/0033-295X.98.1.122

Levelt, W., & Maasen, B. (1981). Lexical Search and Order of Mention in Sentence Production. In W. Klein & W. Levelt (Eds.), *Crossing the Boundaries in Linguistics: Studies Presented to Manfred Bierwisch* (pp. 221–252). Springer Netherlands. https://doi.org/10.1007/978-94-009-8453-0_12

L'Homme, M.-C. (2020). *Lexical Semantics for Terminology: An introduction*. John Benjamins. https://doi.org/10.1075/tlrp.20

MacGregor, L. J., Bouwsema, J., & Klepousniotou, E. (2015). Sustained meaning activation for polysemous but not homonymous words: Evidence from EEG. *Neuropsychologia*, *68*, 126–138. https://doi.org/10.1016/j.neuropsychologia.2015.01.008

Mani, N., & Plunkett, K. (2010). In the Infant's Mind's Ear: Evidence for Implicit Naming in 18-Month-Olds. *Psychological Science*, *21*(7), 908–913.

Meade, G., & Coch, D. (2017). Word-pair priming with biased homonyms: N400 and LPC effects. *Journal of Neurolinguistics*, *41*, 24–37. https://doi.org/10.1016/j.jneuroling.2016.09.002

Meyer, A. S., Belke, E., Telling, A. L., & Humphreys, G. W. (2007). Early activation of object names in visual search. *Psychonomic Bulletin & Review*, *14*(4), 710–716. https://doi.org/10.3758/BF03196826

Meyer, A. S., & Damian, M. F. (2007). Activation of distractor names in the picture-picture interference paradigm. *Memory & Cognition*, *35*(3), 494–503. https://doi.org/10.3758/BF03193289

Meyer, D. E., & Schvaneveldt, R. W. (1971). Facilitation in recognizing pairs of words: Evidence of a dependence between retrieval operations. *Journal of Experimental Psychology*, *90*(2), 227–234. https://doi.org/10.1037/h0031564

Monsell, S., Doyle, M. C., & Haggard, P. N. (1989). Effects of frequency on visual word recognition tasks: Where are they? *Journal of Experimental Psychology: General*, *118*(1), 43–71. https://doi.org/10.1037/0096-3445.118.1.43

Morris, R. (2006). Lexical Processing and Sentence Context Effects. In *Handbook of Psycholinguistics* (pp. 377–401). https://doi.org/10.1016/B978-012369374-7/50011-0

Morsella, E., & Miozzo, M. (2002). Evidence for a cascade model of lexical access in speech production. *Journal of Experimental Psychology. Learning, Memory, and Cognition*, *28*(3), 555–563.

Neill, W. T. (1997). Episodic retrieval in negative priming and repetition priming. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *23*(6), 1291–3105. https://doi.org/10.1037/0278-7393.23.6.1291

Onifer, W., & Swinney, D. A. (1981). Accessing lexical ambiguities during sentence comprehension: Effects of frequency of meaning and contextual bias. *Memory & Cognition*, *9*(3), 225–236. https://doi.org/10.3758/BF03196957

Peirce, J., Gray, J. R., Simpson, S., MacAskill, M., Höchenberger, R., Sogo, H., Kastman, E., & Lindeløv, J. K. (2019). PsychoPy2: Experiments in behavior made easy. *Behavior Research Methods*, *51*(1), 195–203. https://doi.org/10.3758/s13428-018-01193-y

Peterson, R. R., & Savoy, P. (1998). Lexical selection and phonological encoding during language production: Evidence for cascaded processing. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, *24*(3), 539–557. https://doi.org/10.1037/0278-7393.24.3.539

R Studio Team. (2020). *RStudio: Integrated Development Environment for R* [Computer software]. RStudio, PBC. http://www.rstudio.com/

Righi, G., Blumstein, S. E., Mertus, J., & Worden, M. S. (2010). Neural systems underlying lexical competition: An eye tracking and fMRI study. *Journal of Cognitive Neuroscience*, *22*(2), 213–224. https://doi.org/10.1162/jocn.2009.21200

Rubenstein, H., Garfield, L., & Millikan, J. A. (1970). Homographic entries in the internal lexicon. *Journal of Verbal Learning and*

Verbal Behavior, *9*(5), 487–494. https://doi.org/10.1016/S0022-5371(70)80091-3

Salmelin, R., Hari, R., Lounasmaa, O. V., & Sams, M. (1994). Dynamics of brain activation during picture naming. *Nature*, *368*(6470), Article 6470. https://doi.org/10.1038/368463a0

Schriefers, H., Meyer, A. S., & Levelt, W. J. M. (1990). Exploring the time course of lexical access in language production: Picture-word interference studies. *Journal of Memory and Language*, *29*(1), 86–102. https://doi.org/10.1016/0749-596X(90)90011-N

Seidenberg, M. S., Tanenhaus, M. K., Leiman, J. M., & Bienkowski, M. (1982). Automatic access of the meanings of ambiguous words in context: Some limitations of knowledge-based processing. *Cognitive Psychology*, *14*(4), 489–537. https://doi.org/10.1016/0010-0285(82)90017-2

Simpson, G. B. (1984). Lexical ambiguity and its role in models of word recognition. *Psychological Bulletin*, *96*(2), 316–340.

Skeide, M. A., & Friederici, A. D. (2016). The ontogeny of the cortical language network. *Nature Reviews Neuroscience*, *17*(5), Article 5. https://doi.org/10.1038/nrn.2016.23

Snodgrass, J. G., & Vanderwart, M. (1980). A standardized set of 260 pictures: Norms for name agreement, image agreement, familiarity, and visual complexity. *Journal of Experimental Psychology: Human Learning and Memory*, *6*(2), 174–215. https://doi.org/10.1037/0278-7393.6.2.174

Swaab, D. F., Lucassen, P. J., Salehi, A., Scherder, E. J., van Someren, E. J., & Verwer, R. W. (1998). Reduced neuronal activity and reactivation in Alzheimer's disease. *Progress in Brain Research*, *117*, 343–377. https://doi.org/10.1016/s0079-6123(08)64027-3

Swaab, T., Brown, C., & Hagoort, P. (2003). Understanding words in sentence contexts: The time course of ambiguity resolution. *Brain and*

Language, *86*(2), 326–343. https://doi.org/10.1016/S0093-934X(02)00547-3

Swinney, D. A. (1979). Lexical access during sentence comprehension: (Re)consideration of context effects. *Journal of Verbal Learning & Verbal Behavior*, *18*(6), 645–659. https://doi.org/10.1016/S0022-5371(79)90355-4

Tipper, S. P. (2001). Does Negative Priming Reflect Inhibitory Mechanisms? A Review and Integration of Conflicting Views. *The Quarterly Journal of Experimental Psychology Section A*, *54*(2), 321–343. https://doi.org/10.1080/713755969

Twain, M. (2011). *Eve's diary*. Floating Press,. http://search.ebscohost.com/login.aspx?direct=true&scope=site&db=nlebk&AN=385502

Van Petten, C., & Kutas, M. (1987). Ambiguous words in context: An event-related potential analysis of the time course of meaning activation. *Journal of Memory and Language*, *26*(2), 188–208. https://doi.org/10.1016/0749-596X(87)90123-9

Von Holzen, K., & Mani, N. (2014). Bilinguals implicitly name objects in both their languages: An ERP study. *Frontiers in Psychology*, *5*. https://www.frontiersin.org/articles/10.3389/fpsyg.2014.01415

Walenchok, S. C., Hout, M. C., & Goldinger, S. D. (2016). Implicit object naming in visual search: Evidence from phonological competition. *Attention, Perception, & Psychophysics*, *78*(8), 2633–2654. https://doi.org/10.3758/s13414-016-1184-6

Zelinsky, G. J., & Murphy, G. L. (2000). Synchronizing visual and language processing: An effect of object name length on eye movements. *Psychological Science*, *11*(2), 125–131. https://doi.org/10.1111/1467-9280.00227

9. Appendix

9.1. Participant Consent Form

Teilnehmer*inneninformation und Einwilligungserklärung zur Teilnahme an der Studie:

DUOLINO

Sehr geehrte*r Teilnehmer*in,

wir laden Sie ein, an der oben genannten Studie teilzunehmen.

Ihre Teilnahme an dieser Studie erfolgt freiwillig. Sie können jederzeit, ohne Angabe von Gründen, Ihre Bereitschaft zur Teilnahme ablehnen oder auch im Verlauf der Studie zurückziehen. Die Ablehnung der Teilnahme oder ein vorzeitiges Ausscheiden aus dieser Studie hat keine nachteiligen Folgen für Sie.

Diese Art von Studien ist notwendig, um verlässliche neue *wissenschaftliche* Forschungsergebnisse zu gewinnen. Unverzichtbare Voraussetzung für die Durchführung von Studien ist jedoch, dass Sie Ihr Einverständnis zur Teilnahme an dieser Studie schriftlich erklären. Bitte lesen Sie den folgenden Text sorgfältig durch und wenn Fragen zum Inhalt oder Ablauf des Experiments aufkommen, schreiben Sie mir gerne ein E-Mail (a11734106@unet.univie.ac.at) und kehren Sie über den Link zu diesem Experiment zurück, sobald Ihre Fragen beantwortet sind.

Bitte unterschreiben Sie die Einwilligungserklärung nur

- wenn Sie Art und Ablauf der Studie vollständig verstanden haben,
- wenn Sie bereit sind, der Teilnahme zuzustimmen und
- wenn Sie sich über Ihre Rechte als Teilnehmer*in an dieser Studie im Klaren sind.

1. Was ist der Zweck der Studie?

Durch diese Studie wollen wir verstehen, wie gut und schnell Wörter wahrgenommen werden, wenn sie in engem Zusammenhang mit Bildern präsentiert werden.

2. Wie läuft die Studie ab?

Dieses Experiment dauert 10 bis 15 Minuten und wird online durchgeführt. Vor dem Experiment füllen Sie einen kurzen Fragebogen zu Ihren demographischen Daten aus. Anschließend startet das Experiment. Während des Experiments werden 180 Foto-Zielwort-Paare gezeigt. Zuerst sehen Sie ein Fixationskreuz für 500 ms, dann wird ein Bild für 500 ms gezeigt. Danach wird Ihnen ein Wort gezeigt, bei dem Sie schnell entscheiden sollen, ob es sich um ein echtes deutsches Wort handelt. (z.B. echtes Deutsche Wort: Tisch, pseudowort: heru) Wenn Sie glauben, dass es sich um ein echtes deutsches Wort handelt, drücken Sie bitte eine bestimmte Taste („1"/"0", die nach Instruktion im Experiment gefördert wird), wenn nicht, drücken Sie bitte die andere bestimmte Taste. Bitte drücken Sie die Tasten so schnell und genau wie möglich. Wenn Sie Ihre Entscheidung getroffen haben, erscheint das Fixationskreuz wieder und der Vorgang wird wiederholt. Am Anfang gibt es eine kurze Übungsphase, in der Sie sich an den Ablauf gewöhnen können. Nach dem Experiment beantworten Sie ein paar kurze Fragen zu Ihrer Wahrnehmung von den gezeigten Bildern und Wörtern.

3. Welche Vorteile haben Sie durch die Teilnahme an dieser Studie?

Da es sich bei der Studie um ein Einzelprojekt im Zuge einer Masterarbeit handelt, kann es keine monetäre Kompensation für alle TeilnehmerInnen geben. Als Entschädigung können Sie an der Verlosung eines Thalia-Gutscheins im Wert von 50€ teilnehmen.

4. Gibt es Risiken bei der Durchführung der Studie und ist mit Beschwerden oder anderen Begleiterscheinungen zu rechnen?

Da es sich um eine Online-Studie handelt, ist die Teilnahme mit keinen Risiken verbunden, die über die üblichen Auswirkungen der Nutzung von Computern und Bildschirmen hinausgehen, wie z.B. leichte Ermüdung.

Wenn Sie eine bekannte Hörschwäche, eine unbehandelte/nicht korrigierbare Sehschwäche oder eine diagnostizierte neurologische oder psychiatrische Erkrankung haben, sollten Sie nicht an dieser Studie teilnehmen.

5. Was können Sie tun, wenn sie ungewollte Nebenwirkungen, Beschwerden oder gesundheitliche Beschwerden haben?

Sollten während des Versuchs Schmerzen oder Unwohlsein auftreten, können Sie sofort abbrechen.

6. Wann wird die Studie vorzeitig beendet?

Sie können Ihre Teilnahme an der Studie jederzeit ohne Angabe von Gründen widerrufen und die Studie aus persönlichen Gründen abbrechen.
Sollten während des Versuchs körperliche oder seelische Schmerzen oder Beschwerden auftreten, unabhängig davon, ob sie mit dem Versuch zusammenhängen oder nicht, brechen Sie den Versuch bitte ab.

7. In welcher Weise werden die im Rahmen dieser Studie gesammelten Daten verwendet?

Während der Studie werden folgende Daten von Ihnen erhoben: Ihr Alter, Ihr Geschlecht, Ihre Erstsprache sowie das Vorhandensein von Seh- oder Hörbeeinträchtigungen, neurologischen oder psychischen Erkrankungen.
Darüber hinaus werden Ihre Entscheidungen in einer lexikalischen Entscheidungsaufgabe und die entsprechenden Reaktionszeiten erfasst und gespeichert. Alle Daten werden von Anfang an anonymisiert, so dass keine Rückschlüsse auf Ihre Person möglich sind.
Die anonymisierten Daten werden im Rahmen der Masterarbeit von Qingyun Yu ausgewertet und für 10 Jahre auf den Servern des Babelfisch-Labors gespeichert und im Falle einer Veröffentlichung ebenfalls anonymisiert publiziert.
Da Ihre Daten von Anfang an anonymisiert werden, könne Ihre Daten nicht mehr auf Wunsch gelöscht werden.

***8.* Entstehen für die Teilnehmer*innen Kosten? Gibt es einen Kostenersatz oder eine Vergütung?**

Da es sich um eine Online-Studie handelt, fallen keine Reisekosten an. Als Dankeschön können Sie am Ende des Experiments an der Verlosung eines Thalia-Gutscheins im Wert von 50 € teilnehmen.

9. Möglichkeit zur Diskussion weiterer Fragen

Falls Sie vor oder nach dem Experiment weitere Fragen haben, zögern Sie bitte nicht, mich (Qingyun Yu) zu kontaktieren.

9.2. Demographic Survey

Fragebogen

Alter: ____

Geschlecht:
☐ Weiblich ☐ männlich ☐ divers

Is Ihre Muttersprache Deutsch?
☐ Ja ☐ Nein

Ich habe/hatte eine Lese-Rechtschreibschwäche.

☐ ja ☐ nein

Ich kann auf einem/beiden Augen schlecht sehen.

☐ ja ☐ nein

Wenn ja: Wird die Sehschwäche durch Sehhilfe ausgeglichen?

☐ ja ☐ nein

Ich habe Probleme beim Hören oder Verstehen von gesprochener Sprache.

☐ ja ☐ nein

Ich nehme aktuell Medikamente, die auf das zentrale Nervensystem wirken (z.B. Ritalin, Psychopharmaka wie Antidepressiva, Anxiolytika, Antipsychotika).

☐ ja ☐ nein

Ich stehe akut unter dem Einfluss von Alkohol?

☐ ja ☐ nein

Ich leide unter einer neurologischen/psychiatrischen Erkrankung.

☐ ja ☐ nein

Wenn ja, welche? _____ (optional)

9.3. Final Questionnaire

Frage nach dem Experiment:

Super! Sie haben den Hauptteil dieser Studie bereits abgeschlossen!
Vielleicht ist Ihnen aufgefallen, dass in einigen Trials (jeder Trial enthält nur eine Fixation, ein Bild und Wort) das Wort die gleiche Bedeutung wie das Bild, das vor dem Wort stand, hatte.
Bilder und Wörter waren also manchmal in einer identischen Beziehung zueinander.

Ist Ihnen diese identische Beziehung schon einmal aufgefallen?

☐ Ja, klar. Ich habe es während des Experiments schon gemerkt.

☐ Oh, das stimmt! Jetzt merke ich es!

☐ Nein, ist mir nicht aufgefallen.

Wenn Sie es bemerkt haben. Bewerten Sie bitte, wie hilfreich diese identische Beziehung für Ihre Entscheidung bei der Beurteilungsaufgabe mit dem identischen Bild-Wort Paar war:

	1	2	3	4	5	
Gar nicht hilfreich	☐	☐	☐	☐	☐	Sehr hilfreich

Sind Ihnen außer dieser identischen Beziehung noch andere Zusammenhänge zwischen Wort und Bild aufgefallen?

☐ Nein, mir sind keine weiteren Beziehungen aufgefallen.

☐ Vielleicht, manchmal hatte ich das Gefühl eines Zusammenhangs. Ich kann aber nicht sagen welcher.

☐ Ja, ich habe einige Male bestimmte Zusammenhänge entdeckt.

Wenn ja, welche Zusammenhänge haben Sie wahrgenommen? Bitte kreuzen Sie an, was sie während des Experimentes wahrgenommen haben und nicht was Sie im Nachhinein entdeckt haben (Mehrfachauswahl möglich).

☐ Semantische Beziehung (z.B. Tisch und Stuhl)

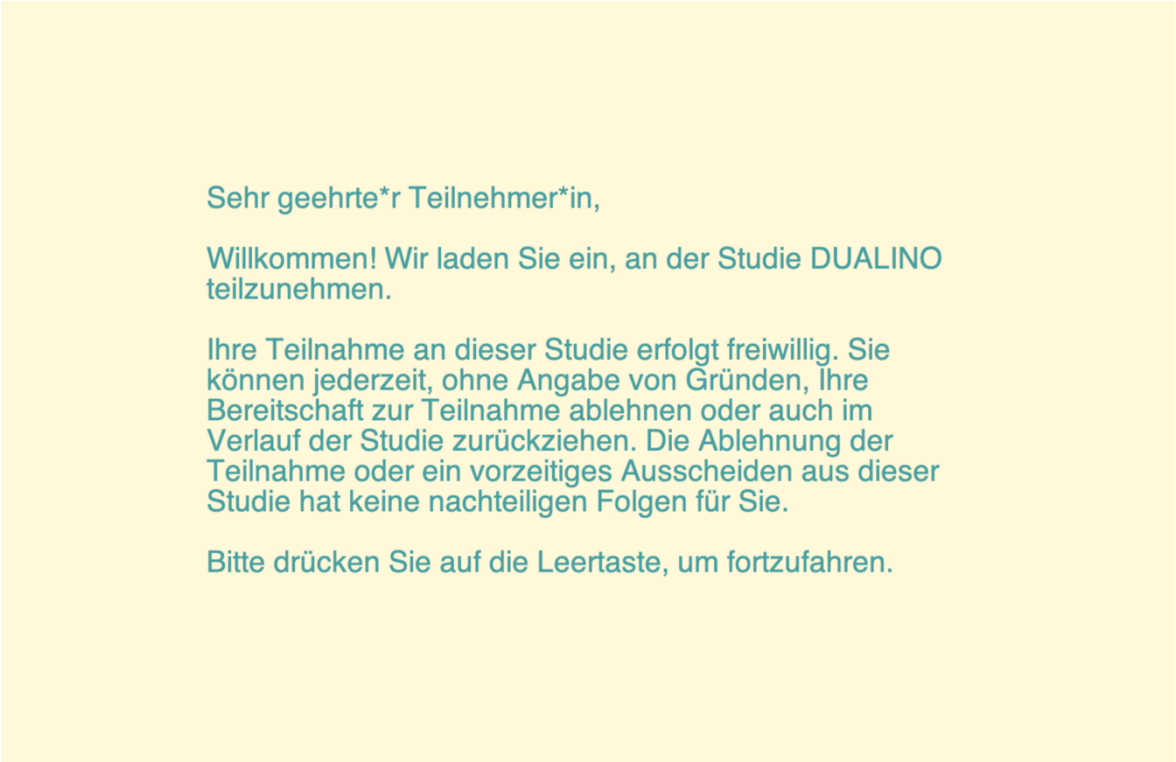
☐ Homonyme Beziehung (z.B. Maus (Tier) und Maus (Gerät))

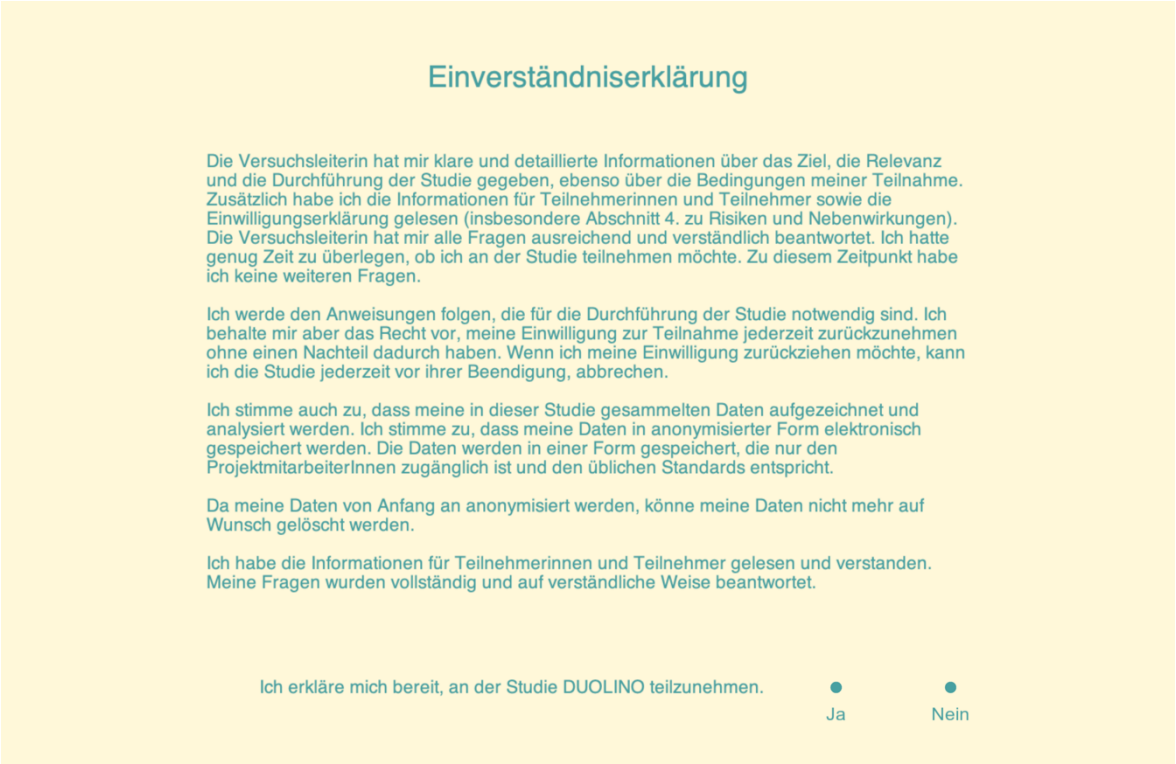
☐ Sonst _____ (optional)

Bewerten Sie bitte, wie hilfreich diese Zusammenhänge für Ihre Entscheidung bei der Beurteilungsaufgabe bei in den entsprechenden Bild-Wort Paaren war:

	1	2	3	4	5	
Gar nicht hilfreich	☐	☐	☐	☐	☐	Sehr hilfreich

9.4. Welcome page and Instruction





Der Probeversuch ist vorbei.

Für das Experiment gelten die gleichen Regeln wie für das Probeexperiment:
Wenn Sie entscheiden, dass ein gezeigtes Wort ein echtes deutsches Wort ist, dann drücken Sie als Antwort die Taste '0' auf Ihrer Tastatur.
Wenn Sie entscheiden, dass es sich bei einem gezeigten Wort nicht um ein echtes deutsches Wort handelt, dann drücken Sie als Antwort die Taste '1' auf Ihrer Tastatur.
Bitte legen Sie Ihren linken Zeigefinger auf die Taste '1' und Ihren rechten Zeigefinger auf die Taste '0'.

Um das Experiment zu starten, drücken Sie bitte die Leertaste.

Der Probeversuch ist vorbei.

Für das Experiment gelten die gleichen Regeln wie für das Probeexperiment:
Wenn Sie entscheiden, dass ein gezeigtes Wort ein echtes deutsches Wort ist, dann drücken Sie als Antwort die Taste '1' auf Ihrer Tastatur.
Wenn Sie entscheiden, dass es sich bei einem gezeigten Wort nicht um ein echtes deutsches Wort handelt, dann drücken Sie als Antwort die Taste '0' auf Ihrer Tastatur.
Bitte legen Sie Ihren linken Zeigefinger auf die Taste '1' und Ihren rechten Zeigefinger auf die Taste '0'.

Um das Experiment zu starten, drücken Sie bitte die Leertaste.

9.5. Experiment Stimuli

Target	Wordtyp	Target-typ	Condi-tion	Prime
Apfel	Real	Critical	identity	Apfel
Apfel	Real	Critical	related	Glühbirne
Apfel	Real	Critical	unre-lated	Sofa
Baby	Real	Critical	identity	Baby
Baby	Real	Critical	related	Mutter
Baby	Real	Critical	unre-lated	Küche
Berg	Real	Critical	identity	Berg
Berg	Real	Critical	related	Kamm
Berg	Real	Critical	unre-lated	Tasse
Boot	Real	Critical	identity	Boot
Boot	Real	Critical	related	Käfer
Boot	Real	Critical	unre-lated	Spiegel
Com-puter	Real	Critical	identity	Computer
Com-puter	Real	Critical	related	Maus
Com-puter	Real	Critical	unre-lated	Speer
Dach	Real	Critical	identity	Dach
Dach	Real	Critical	related	Bogen
Dach	Real	Critical	unre-lated	hose
Dusche	Real	Critical	identity	Dusche
Dusche	Real	Critical	related	Hahn
Dusche	Real	Critical	unre-lated	Herz
Gehirn	Real	Critical	identity	Gehirn
Gehirn	Real	Critical	related	Geist
Gehirn	Real	Critical	unre-lated	Telefon
Geige	Real	Critical	identity	Geige

Geige	Real	Critical	related	Flügel
Geige	Real	Critical	unre-lated	Baum
Geld	Real	Critical	identity	Geld
Geld	Real	Critical	related	Bank
Geld	Real	Critical	unre-lated	Kinn
Gitarre	Real	Critical	identity	Gitarre
Gitarre	Real	Critical	related	Rock
Gitarre	Real	Critical	unre-lated	Nadel
Haare	Real	Critical	identity	Haare
Haare	Real	Critical	related	Nagel
Haare	Real	Critical	unre-lated	Zigarette
Hemd	Real	Critical	identity	Hemd
Hemd	Real	Critical	related	Fliege
Hemd	Real	Critical	unre-lated	Pferd
Knopf	Real	Critical	identity	Knopf
Knopf	Real	Critical	related	Feder
Knopf	Real	Critical	unre-lated	Chor
König	Real	Critical	identity	König
König	Real	Critical	related	Schloss
König	Real	Critical	unre-lated	Seife
Schuh	Real	Critical	identity	Schuh
Schuh	Real	Critical	related	Ball
Schuh	Real	Critical	unre-lated	Zeitung
Stuhl	Real	Critical	identity	Stuhl
Stuhl	Real	Critical	related	Brille
Stuhl	Real	Critical	unre-lated	Löwe
Sessel	Real	Critical	identity	Sessel
Sessel	Real	Critical	related	Aufzug
Sessel	Real	Critical	unre-lated	Nase

Tür	Real	Critical	identity	Tür
Tür	Real	Critical	related	Angel
Tür	Real	Critical	unre-lated	Gabel
Uhr	Real	Critical	identity	Uhr
Uhr	Real	Critical	related	Schlange
Uhr	Real	Critical	unre-lated	Rose
Brunnen	Real	Filler	unre-lated	Pizza
Brunnen	Real	Filler	unre-lated	Löffel
Brunnen	Real	Filler	unre-lated	Kreis
Hase	Real	Filler	unre-lated	Nacht
Hase	Real	Filler	unre-lated	Zwiebel
Hase	Real	Filler	unre-lated	Feuer
Tomate	Real	Filler	unre-lated	Tasche
Tomate	Real	Filler	unre-lated	Zebra
Tomate	Real	Filler	unre-lated	Mann
Lineal	Real	Filler	unre-lated	Schlagzeug
Lineal	Real	Filler	unre-lated	Arm
Lineal	Real	Filler	unre-lated	Robbe
Fenster	Real	Filler	unre-lated	Hafen
Fenster	Real	Filler	unre-lated	Teufel
Fenster	Real	Filler	unre-lated	Geschenk
Mädchen	Real	Filler	unre-lated	Harfe

Mädchen	Real	Filler	unre-lated	Puzzle
Mädchen	Real	Filler	unre-lated	Geier
Pullover	Real	Filler	unre-lated	Spinne
Pullover	Real	Filler	unre-lated	Briefmarke
Pullover	Real	Filler	unre-lated	Fluss
Eis	Real	Filler	unre-lated	Besen
Eis	Real	Filler	unre-lated	Schnecke
Eis	Real	Filler	unre-lated	Kerze
Zahn	Real	Filler	unre-lated	Taube
Zahn	Real	Filler	unre-lated	Skorpion
Zahn	Real	Filler	unre-lated	Hocker
Kleid	Real	Filler	unre-lated	Knochen
Kleid	Real	Filler	unre-lated	Schwan
Kleid	Real	Filler	unre-lated	Lama
Ahnel	Pseudo	Filler	unre-lated	sonne
Ahnel	Pseudo	Filler	unre-lated	Seil
Ahnel	Pseudo	Filler	unre-lated	sarg
Badü	Pseudo	Filler	unre-lated	birne
Badü	Pseudo	Filler	unre-lated	saege
Badü	Pseudo	Filler	unre-lated	schatten

Befs	Pseudo	Filler	unre-lated	ellenbogen
Befs	Pseudo	Filler	unre-lated	gesicht
Befs	Pseudo	Filler	unre-lated	schluessel
Boor	Pseudo	Filler	unre-lated	Mikrofon
Boor	Pseudo	Filler	unre-lated	roboter
Boor	Pseudo	Filler	unre-lated	steckdose
Cetzuter	Pseudo	Filler	unre-lated	Raupe
Cetzuter	Pseudo	Filler	unre-lated	kuerbis
Cetzuter	Pseudo	Filler	unre-lated	kiwi
Dast	Pseudo	Filler	unre-lated	zitrone
Dast	Pseudo	Filler	unre-lated	anzug
Dast	Pseudo	Filler	unre-lated	feuerzeug
Zosche	Pseudo	Filler	unre-lated	pfeife
Zosche	Pseudo	Filler	unre-lated	tablett
Zosche	Pseudo	Filler	unre-lated	kokosnuss
Geforn	Pseudo	Filler	unre-lated	guertel
Geforn	Pseudo	Filler	unre-lated	dreieck
Geforn	Pseudo	Filler	unre-lated	toaster
Reide	Pseudo	Filler	unre-lated	zirkel
Reide	Pseudo	Filler	unre-lated	bumerang

Reide	Pseudo	Filler	unre-lated	waage
Gehr	Pseudo	Filler	unre-lated	hammer
Gehr	Pseudo	Filler	unre-lated	knie
Gehr	Pseudo	Filler	unre-lated	hut
Gigalde	Pseudo	Filler	unre-lated	pinsel
Gigalde	Pseudo	Filler	unre-lated	bonbon
Gigalde	Pseudo	Filler	unre-lated	wurzeln
Weere	Pseudo	Filler	unre-lated	kartoffel
Weere	Pseudo	Filler	unre-lated	schal
Weere	Pseudo	Filler	unre-lated	pfeil
Heml	Pseudo	Filler	unre-lated	trommel
Heml	Pseudo	Filler	unre-lated	stein
Heml	Pseudo	Filler	unre-lated	tunnel
Knorf	Pseudo	Filler	unre-lated	briefkasten
Knorf	Pseudo	Filler	unre-lated	wuerfel
Knorf	Pseudo	Filler	unre-lated	muschel
Sörig	Pseudo	Filler	unre-lated	kuh
Sörig	Pseudo	Filler	unre-lated	tomate
Sörig	Pseudo	Filler	unre-lated	buestenhalter
Schud	Pseudo	Filler	unre-lated	waschbecken

Schud	Pseudo	Filler	unre-lated	medaille
Schud	Pseudo	Filler	unre-lated	rucksack
Stuls	Pseudo	Filler	unre-lated	hexe
Stuls	Pseudo	Filler	unre-lated	paprika
Stuls	Pseudo	Filler	unre-lated	schmetter-ling
Kassel	Pseudo	Filler	unre-lated	auto
Kassel	Pseudo	Filler	unre-lated	messer
Kassel	Pseudo	Filler	unre-lated	delfin
Tär	Pseudo	Filler	unre-lated	batterie
Tär	Pseudo	Filler	unre-lated	faecher
Tär	Pseudo	Filler	unre-lated	erdbeere
Urz	Pseudo	Filler	unre-lated	anker
Urz	Pseudo	Filler	unre-lated	faust
Urz	Pseudo	Filler	unre-lated	dudelsack
Blennen	Pseudo	Filler	unre-lated	daumen
Blennen	Pseudo	Filler	unre-lated	ananas
Blennen	Pseudo	Filler	unre-lated	stern
Wane	Pseudo	Filler	unre-lated	schere
Wane	Pseudo	Filler	unre-lated	schnabel
Wane	Pseudo	Filler	unre-lated	handschuh

Nuwate	Pseudo	Filler	unre-lated	elefant
Nuwate	Pseudo	Filler	unre-lated	buegeleisen
Nuwate	Pseudo	Filler	unre-lated	spritze
Funeol	Pseudo	Filler	unre-lated	wolke
Funeol	Pseudo	Filler	unre-lated	pullover
Funeol	Pseudo	Filler	unre-lated	frosch
Kencher	Pseudo	Filler	unre-lated	schlitten
Kencher	Pseudo	Filler	unre-lated	trichter
Kencher	Pseudo	Filler	unre-lated	schublade
Säkchen	Pseudo	Filler	unre-lated	saeule
Säkchen	Pseudo	Filler	unre-lated	pinguin
Säkchen	Pseudo	Filler	unre-lated	kirsche
Pinzower	Pseudo	Filler	unre-lated	feuer-loescher
Pinzower	Pseudo	Filler	unre-lated	schwimmer
Pinzower	Pseudo	Filler	unre-lated	Kegel
Eig	Pseudo	Filler	unre-lated	Banane
Eig	Pseudo	Filler	unre-lated	bus
Eig	Pseudo	Filler	unre-lated	korb
Gahn	Pseudo	Filler	unre-lated	schokolade
Gahn	Pseudo	Filler	unre-lated	rasenmaeher

Gahn	Pseudo	Filler	unre-lated	fee
Dreid	Pseudo	Filler	unre-lated	welle
Dreid	Pseudo	Filler	unre-lated	treppe
Dreid	Pseudo	Filler	unre-lated	kalender