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# EMPIRICAL STUDY

# The Role of Cognates and Language Distance in Simultaneous Bilingual Children's Productive Vocabulary Acquisition

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**Abstract:** This study examined the influence of cognate status and language distance on simultaneous bilingual children's vocabulary acquisition. It aimed to tease apart effects of word-level similarities and language-level similarities, while also exploring the role of individual-level variation in age, exposure, and nontarget language proficiency. Children simultaneously acquiring two closely related languages ($n = 203$) or two more distant languages ($n = 109$) performed extended versions of the LITMUS Cross-Linguistic Lexical Task (Haman et al., 2015), a productive vocabulary test with words varying in their phonological similarity to their translation equivalents. Children speaking closely related languages obtained higher vocabulary scores than children

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speaking more distant languages, who showed a stronger positive effect of phonological similarity. The effect of language distance on vocabulary was not solely driven by the presence of (near-)identical cognates in the test. These findings show that similarities beyond specific test items and/or beyond the phonological level play a role in vocabulary acquisition.

**Keywords** bilingualism; lexicon; vocabulary; cognates; language distance

## Introduction

Bilingual children can vary considerably when it comes to their vocabulary acquisition; for example, they may have a larger vocabulary in one language than in the other, and their vocabulary size may or may not differ from that of their (monolingual) peers. In accounting for such variation, previous research has mostly focused on individual-level variables, such as the amount of exposure children receive in each language (see e.g., Thordardottir, 2011). There are, however, other variables that also influence bilingual children's vocabulary acquisition, such as word- and language-level variables (e.g., Blom et al., 2020; Bosma et al., 2019). On the word level, meaning and/or form similarities can influence vocabulary acquisition. For example, concepts may be the same across languages: A child who has learned what the word *tree* refers to in English does not need to relearn this concept when acquiring the Dutch translation equivalent *boom* /bom/. However, the child still needs to learn the new word form. This is typically easier when translation equivalents sound similar across languages, that is, when they are cognates, such as Dutch *boom* /bom/ and German *Baum* /baʊm/, both meaning "tree" (e.g., Bosma et al., 2019; Goriot et al., 2021; Tonzar et al., 2009).

On a more general language level, recent studies have shown that vocabulary acquisition is affected by language distance (e.g., Blom et al., 2020; Floccia et al., 2018), which can be operationalized in multiple ways. For example, the degree of phonolexical similarity, that is, the number of cognates two languages share, can influence vocabulary acquisition: As cognates are more easily acquired than noncognates, children acquiring two languages that share many cognates may have larger vocabularies in each of their two languages than children acquiring less similar languages (e.g., Blom et al., 2020). Alternative ways of operationalizing language distance may include language families or typology. For younger bilinguals at least, shared morphosyntactic features have also been found to be related to larger vocabularies (Floccia et al., 2018).

The present study relates the effects of language distance (i.e., phonolexical and/or morphosyntactic similarity) on vocabulary acquisition to psycholinguistic research on the bilingual lexicon and cognate processing, by considering individual-level, word-level, and language-level variation. Specifically, we investigated the influence of word-level phonological similarity (i.e., cognate status) on the productive vocabulary of a large group of bilingual children who were simultaneously acquiring two more closely related or two more distant languages, and who varied in age, language exposure, and proficiency.

In the next section, we first briefly discuss the structure of the bilingual lexicon and bilingual word processing from a psycholinguistic perspective, including the role of individual- and word-level variation. Next, we discuss the role of word- and language-level variation in bilingual children's vocabulary acquisition in more detail, also in relation to individual-level variation.

## Background Literature

### Cognate Effects in the Bilingual Child's Lexicon

Psycholinguistic studies have shown that the bilingual child has one integrated lexicon, containing meaning representations and word-form representations from both languages (e.g., Floccia et al., 2020; Jardak & Byers-Heinlein, 2019; Koutamanis et al., 2024b; Singh, 2014; Von Holzen & Mani, 2012), in much the same way as the bilingual adult (see, e.g., Dijkstra & van Heuven, 2018, for a review). In such a lexicon, meaning representations are largely shared for translation equivalents (Dijkstra et al., 2019; Dijkstra & van Heuven, 2002; Shook & Marian, 2013). In addition, words that overlap in form also share certain representations, for example, grapheme and/or phoneme representations (e.g., Dijkstra & van Heuven, 2002). For cognates, then, meaning representations as well as multiple grapheme and/or phoneme representations are shared (e.g., /b/ and /m/ for *boom* and *Baum*), which leads to cognate word forms becoming strongly coactivated during processing. As a result, they are processed more quickly and accurately than words without phonological overlap with their translation equivalents. This cognate facilitation effect has been found in multiple types of tasks in studies with bilingual adults (e.g., Costa et al., 2000; Dijkstra et al., 2010; Kroll et al., 2006; Lemhöfer et al., 2004) as well as with bilingual children (e.g., Duñabeitia et al., 2016; Koutamanis et al., 2024a, 2024c; Poarch & van Hell, 2012; Schröter & Schroeder, 2016).

The strength of the cognate facilitation effect is influenced by multiple individual- and word-level variables. At the individual level, the more proficient a bilingual is in a language, the more active the word forms from that language are assumed to be in the lexicon and the more influence they exert during processing (Dijkstra et al., 2019; Dijkstra & van Heuven, 2002). As a consequence, any cognate effects should be stronger in bilinguals' less proficient language than in their more proficient language. Indeed, many studies with adult second language learners have found that cognate effects are stronger in the second than in the first language (see van Hell & Tanner, 2012, for a review), with highly proficient second language learners showing bidirectional effects (e.g., Hoshino & Kroll, 2008; van Hell & Dijkstra, 2002). Similarly, in bilingual children, the more dominant language (often expressed in terms of relative proficiency or exposure) has been found to influence the processing of the less dominant language more than vice versa (Bosma et al., 2019; Bosma & Nota, 2020; Poarch & van Hell, 2012; Singh, 2014).

At the word level, not all cognates share the same degree of phonological and/or orthographic similarity: Word forms may be identical (e.g., *hotel* is written and pronounced the same way in multiple languages), or nonidentical but highly similar (e.g., Dutch *boom* and German *Baum*). More similar word forms are assumed to share more grapheme and/or phoneme representations (e.g., Dijkstra & van Heuven, 2002), resulting in stronger coactivation during processing. Indeed, several studies have found stronger cognate facilitation effects for cognates with more similar word forms than for those with less similar word forms (e.g., Bosma et al., 2019; Dijkstra et al., 2010; Von Holzen et al., 2019; but see Gastmann & Poarch, 2022, for no such effects).

## Bilingual Children's Vocabulary Acquisition

### *Phonological Similarity*

Cognate facilitation effects are not found only in psycholinguistic experiments but also in second language word learning, where cognates are typically more easily acquired than noncognates (e.g., de Groot & Keijzer, 2000; Tonzar et al., 2009). Similarly, cognate status has been shown to influence the vocabulary acquisition of simultaneous bilingual children and early second language learners. For example, Lindgren and Bohnacker (2020) examined the productive German and Swedish vocabulary of 4-to-6-year-old German–Swedish bilingual children. The items in the vocabulary tests were classified as cognates or noncognates based on the Crosslinguistic Overlap Scale for Phonology (Kohnert et al., 2004), a 10-point scale combining multiple phonological features, with items scoring 6 or higher being considered cognates. Children were found to know more cognates than noncognates in both languages. Goriot et al. (2021) found similar cognate effects influenced by the degree of word-level phonological similarity (in line with, e.g., Dijkstra et al., 2010). They examined the receptive English vocabulary of school-aged Dutch second language learners of English and used a continuous measure of phonological similarity rather than a categorical distinction between cognates and noncognates. The more phonologically similar test items were to their Dutch translations, the more accurately children responded.

The role of word-level phonological similarity has also been examined in interaction with individual-level variation. In a longitudinal study, Bosma et al. (2019) examined the receptive Frisian vocabulary of Frisian–Dutch bilingual children with differing degrees of exposure to Frisian, at the ages of 5 to 6, 6 to 7, or 7 to 8 years. The vocabulary test contained items of the following kinds:

- identical cognates (e.g., *poes* /pus/, meaning "cat" in both Frisian and Dutch),
- nonidentical cognates with a phonological regularity involving maximally three phonemes (e.g., Frisian *kâld* /kɔːt/ and Dutch *koud* /kɑut/, both meaning "cold," following the same phonological regularity as Frisian *wâld* /wɔːt/ and Dutch *woud* /wɑut/, both meaning "forest"),
- nonidentical cognates without (strong) regularity (e.g., Frisian *skriuwe* /skrjuwə/ and Dutch *schrijven* /sxrɛivən/, meaning "to write"), and
- noncognates (e.g., Frisian *bern* /bɛːn/ and Dutch *kind* /kɪnt/, meaning "child").

Cognate facilitation effects were found for children with low and middle degrees of Frisian exposure, but not for children with high Frisian exposure. For the children with low Frisian exposure, the effect was gradual: They performed better on more regular or identical cognates. These findings are in line with the effects of dominance and phonological similarity found in other studies (e.g., Dijkstra et al., 2010; Poarch & van Hell, 2012).

Bosma et al. (2019) not only observed an interaction between phonological similarity and dominance, but also found that phonological similarity interacted with age: Children performed better as they got older, and this was especially the case for cognates with phonological regularities (e.g., *kâld – koud, wâld – woud*). Their explanation for this age effect was "developing metalinguistic skills," which are defined as the ability to reflect on and manipulate structural features of language (e.g., Nagy, 2007). A similar age effect was found in the study by Goriot et al. (2021), where the phonological similarity effect was stronger for older children (8-to-9-year-olds and 11-to-12-year-olds) than for younger children (4-to-5-year-olds). They offered a similar explanation for this effect to that of Bosma et al. (2019), namely that "older pupils may be more able than younger pupils to make use of phonological similarities between item-translation pairs" (Goriot et al., 2021, p. 563).

Although not explored in these studies, age effects may also be related to the proficiency effects that are often observed in cognate processing studies. Specifically, the older children in the studies by Goriot et al. (2021) and Bosma et al. (2019) were probably more proficient in Dutch than the younger children, leading to Dutch words being more active in the lexicon and exerting a larger influence on the processing of other words during testing. On a related note, the older children probably had better literacy skills in one or both languages. As cognates often overlap both phonologically and orthographically, increased literacy skills may also lead to increased coactivation of cognate word forms in the lexicon.

In sum, multiple studies have shown that phonological similarities between words in two languages influence bilingual children's vocabulary acquisition, probably as the result of coactivation in the bilingual lexicon. In vocabulary testing and cognate processing studies, similar patterns have been found with regard to individual-level and word-level variables. Specifically, there seem to be stronger effects for more similar word forms, and there is evidence for individual differences in proficiency, exposure, and/or age-related changes in metalinguistic skills influencing the strength of such effects.

*Language Distance*

In addition to phonological similarities between specific words, similarities between languages on a more general level have also been found to influence bilingual children's vocabulary. For example, in a large-scale study with 2-year-old bilingual children, Floccia et al. (2018) examined the vocabulary (based on parental reports) of toddlers from diverse language backgrounds: All children were simultaneously acquiring English and one of 13 additional languages. Similarities in morphological complexity and in word order typology positively affected children's receptive vocabulary, whereas phonolexical similarity (i.e., the average phonological similarity of translation equivalents on a word list) positively affected productive vocabulary.

In a study with older children, Blom et al. (2020) considered language distance in terms of both phonolexical similarity and morphosyntactic similarities (pro-drop, morphological richness, and basic word order) and found an influence of language distance on vocabulary acquisition. The children, aged between 6 and 7 years old, were simultaneously acquiring Dutch and either a closely related language (Frisian or Limburgish) or a more distant language (Polish, Turkish, or Moroccan). Children acquiring closely related languages were found to have comparable receptive Dutch vocabulary sizes to a monolingual Dutch control group, whereas children acquiring distant languages obtained lower vocabulary scores. Importantly, this language distance effect remained even when the groups were matched on various individual-level background characteristics, such as parents' Dutch proficiency, and even though the children acquiring distant languages received more Dutch exposure than the children acquiring closely related languages.

The role of individual-level variation and language distance in vocabulary acquisition was also explored by Bohnacker et al. (2016). They studied the productive German and Turkish vocabulary of bilingual German–Swedish and Turkish–Swedish children between 4 and 7 years old who were growing up in Sweden. Even though the bilingual Turkish–Swedish children received more exposure to their home language than the bilingual German–Swedish children, there were no differences in vocabulary scores between the two language groups. The authors suggested that this null effect may have resulted from an interaction between exposure and language distance, whereby the German–Swedish children benefited more from word-level similarities than the Turkish–Swedish children, thus compensating for lower amounts of exposure.

In sum, several studies have shown that language distance affects bilingual children's vocabulary size, possibly in interaction with individual differences in language exposure. It remains unclear, however, what drives these language distance effects. More specifically, it is not known to what extent such effects result from phonological similarities between specific vocabulary items in the tests employed, leading to coactivation in the lexicon. In addition, it is not clear whether language-level variation plays a role in the extent to which children benefit from word-level phonological similarity, as found in studies such as that of Goriot et al. (2021). The present study aims to fill this gap.

Examining the relationship between general language distance effects and well-researched word-level and individual-level variables, such as phonological similarity or proficiency, can contribute to a better theoretical understanding of the mechanisms underlying variation in bilingual children's language processing and acquisition. It also has practical implications, for example with respect to comparing children from multiple language groups using the same vocabulary test. On the basis of their study with Dutch-speaking children acquiring English as a second language, Goriot et al. (2021) argued that variation in phonological similarity should be taken into account in such a comparison. Whether this is indeed appropriate may depend on the research question (see also Blom et al., 2020), but also on exactly how this phonological similarity influences the performance of different groups of bilingual children, that is, children simultaneously acquiring different language combinations.

## The Present Study

The aim of the present study was to tease apart the effects of similarities between languages on a general level (i.e., language distance effects) and phonological similarities between specific items (i.e., cognate effects) in simultaneous bilingual children's vocabulary, while also exploring the role of individual differences in age, exposure, and proficiency. By investigating interactions between individual-level, word-level, and language-level variation, we shed more light on the extent to which the phonological similarity of specific words drives the effects of language distance on vocabulary acquisition and the extent to which phonological similarity has the same effect in children with different language backgrounds.

Bilingual children simultaneously acquiring Dutch and one additional language performed a picture-naming vocabulary test in Dutch. The children's other language was either closely related to Dutch (German or English) or more distant (Spanish, Greek, or Turkish). The items in the vocabulary test varied in how phonologically similar they were to their translation equivalent in the children's other language. We followed Goriot et al. (2021) and Floccia et al. (2018) in adopting a continuous measure of phonological similarity (see also Schepens, Dijkstra, et al., 2013), and we followed Blom et al. (2020) in using a binary categorization of language distance, which allowed us to examine the effects of phonological similarity in detail across more generally defined language distance groups. The children in our sample varied in age (between 3.4 and 11 years old) and furthermore differed in terms of language exposure and proficiency. This allowed us to explore the role of individual-level variation and to examine the generalizability of language distance and phonological similarity effects over children of different ages and with different exposure and proficiency levels.

First, we predicted that children would perform more accurately on more phonologically similar (i.e., more cognatelike) words, in line with the growing literature on the simultaneous bilingual child's lexicon. Specifically, this prediction follows from the assumption that the bilingual lexicon is shared, so when words overlap in form and meaning, they become coactivated during processing. Second, we predicted that children speaking more closely related languages would score higher on the vocabulary task than children speaking more distant languages, in line with studies such as those of Blom et al. (2020) and Floccia et al. (2018). If language distance effects are (mostly) driven by the phonological similarity of the specific items in a vocabulary test, we would expect no interaction between language distance and phonological similarity on children's accuracy. Alternatively, language distance on more general levels may modulate the effects of phonological similarity: For example, when two languages are closely related and share many cognates, children speaking these languages may become better trained in detecting regularities and similarities, and better able to use these in a vocabulary task. This is in line with the explanations given by Goriot et al. (2021) and Bosma et al. (2019) for the observed age effects in their studies. Our third prediction therefore was that children speaking more closely related languages would show a stronger positive effect of phonological similarity than children speaking distant languages, even after controlling for variables like age and proficiency, both of which we expected to modulate the effects of phonological similarity as well (in line with, e.g., Poarch & van Hell, 2012).

## Method

### Participants

The participants in this study were 312 bilingual children (169 girls, 143 boys) aged between 3.4 and 11 years ($M = 7.6$, $SD = 1.7$), who were growing up with Dutch and one additional language: German, English, Spanish, Greek, or Turkish. Most of the children lived in the Netherlands ($n = 280$), but five were residents of Greece and 27 of Germany. All children had received substantial exposure to both Dutch and the other language, defined as minimally half a day per week, since before age 4, and for the majority ($n = 249$) since birth. No children had received substantial exposure to any other languages for at least 3.5 years prior to testing, and in most cases, they had received none at all.

Following Blom et al. (2020), we grouped children into two language distance groups: a close group, comprising the bilingual Dutch–German and Dutch–English children, and a distant group, comprising the bilingual Dutch–Spanish, Dutch–Greek, and Dutch–Turkish children; see the next section for details.

Table 1 summarizes the children's background characteristics. Socioeconomic status (SES) was based on parental education, and more specifically, the average education level of both parents on a binary scale (no higher than secondary education vs. higher education).[1] The children in the close group were older, $t(198) = 2.92$, $p = .004$, and came from a higher SES background, $\chi^2(1) = 15.24$, $p < .001$, than the children in the distant group. We tested for the existence of nonverbal differences in short-term memory and working memory between the groups by using the Alloway Working Memory Assessment – Forward and Backward Digit Span Tests (Alloway, 2012) in Dutch. There were no significant differences between the close and distant groups on either the forward digit span, $t(149) = 1.56$, $p = .121$, or backward digit span, although the difference between the groups for the latter was approaching significance, $t(154) = 1.95$, $p = .053$.

**Table 1** Overview of participant characteristics

| Group | *n* | Age *M* (*SD*) | Girls / Boys | SES (parental education): *n* secondary / *n* higher | Working memory: digit span forward / backward *M* (*SD*) |
|---|---|---|---|---|---|
| Close | 203 | 7.8 (1.6) | 109 / 94 | 4 / 199 | 98.5 (14.1) / 103.9 (13.1) |
| Dutch–German | 99 | 8.7 (1.2) | 50 / 49 | 3 / 96 | 96.2 (14.7) / 99.8 (12.9) |
| Dutch–English | 104 | 6.9 (1.6) | 59 / 45 | 1 / 103 | 101.5 (12.8) / 109.2 (11.6) |
| Distant | 109 | 7.1 (1.9) | 60 / 49 | 15 / 94 | 95.2 (14.5) / 100.2 (12.7) |
| Dutch–Spanish | 54 | 6.3 (1.5) | 28 / 26 | 4 / 50 | 104.4 (15.1) / 107.5 (11.9) |
| Dutch–Greek | 39 | 7.5 (1.9) | 23 / 16 | 3 / 36 | 93.4 (13.8) / 97.9 (12.7) |
| Dutch–Turkish | 16 | 9.0 (1.2) | 9 / 7 | 8 / 8 | 89.4 (11.0) / 98.1 (10.9) |

*Note*. For 85 children in the close group and 36 children in the distant group, digit span scores were not available. Digit span scores are standard scores and can fall between 47 and 153. SES = socioeconomic status.

Table 2 summarizes the children's language exposure and literacy skills in both languages, which were both assessed through an extensive parental questionnaire (Bilingual Language Exposure Calculator, BiLEC; Unsworth, 2013). Language exposure was operationalized as cumulative exposure, meaning that not only the length of exposure (i.e., the age of first exposure subtracted from the child's age) was taken into account, but also the proportion of language exposure that was provided to the child in each language for each year of their life (see Unsworth, 2013, for more details). Following Thordardottir (2011), cumulative Dutch exposure was expressed as a percentage of the child's age. For example, a 7-year-old with a total of 4 years of Dutch exposure (as calculated using the BiLEC) had 57% cumulative Dutch exposure. There were no differences between the close and distant groups on cumulative Dutch exposure, $t(220.83) = -0.66$, $p = .513$. Literacy was assessed for the children's two languages separately on a 4-point scale: 1 = *not (really) literate*, 2 = *literate, but not as good as peers*, 3 = *literate, as good as peers*, or 4 = *literate, better than peers*. There were no differences between the close and distant groups on Dutch literacy, $\chi^2(3) = 5.68$, $p = .128$, but the children in the close group had better literacy skills in their other language than the children in the distant group, $\chi^2(3) = 8.74$, $p = .033$.

Participant information, stimulus lists, data, and analysis scripts for this study are publicly available via the Open Science Framework (https://osf.io/kx6zp/).

## Language Distance

As this study focuses on the lexicon, our operationalization of language distance was based on measures of phonolexical similarity from previous studies,

**Table 2** Overview of participants' language exposure and literacy skills

| Group | Cumulative Dutch exposure *M* (*SD*) | Literacy in Dutch *n* per level | | | | Literacy in other language *n* per level | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Not (really) literate | Less than peers | As good as peers | Better than peers | Not (really) literate | Less than peers | As good as peers | Better than peers |
| Close | 53% (19%) | 23 | 21 | 90 | 61 | 43 | 56 | 50 | 44 |
| Dutch–German | 56% (20%) | 1 | 18 | 43 | 34 | 8 | 33 | 25 | 29 |
| Dutch–English | 51% (18%) | 22 | 3 | 47 | 27 | 35 | 23 | 25 | 29 |
| Distant | 55% (19%) | 13 | 10 | 22 | 16 | 21 | 21 | 13 | 5 |
| Dutch–Spanish | 55% (17%) | 4 | 1 | 9 | 4 | 7 | 2 | 5 | 3 |
| Dutch–Greek | 52% (23%) | 9 | 8 | 11 | 11 | 14 | 16 | 7 | 2 |
| Dutch–Turkish | 62% (13%) | 0 | 1 | 2 | 1 | 0 | 3 | 1 | 0 |

*Note*. For 10 (out of 203) children in the close group and 49 (out of 109) in the distant group, literacy information was not available for one or both languages.

but we also included measures of language distance based on other linguistic features. This is not only because different measures can be expected to correlate to some extent (see, e.g., Dunn et al., 2011; Schepens, van der Slik, & van Hout, 2013), but also because the study by Floccia et al. (2018) showed that language distance, when operationalized in terms of morphosyntactic features, predicted children's vocabulary scores, at least for young children.

Regarding phonolexical similarity, Schepens and colleagues (e.g., Schepens, Dijkstra, et al., 2013; Schepens, van der Slik, & van Hout, 2013) discussed various measures of language distance based on phonolexical similarity, showing that Dutch was closest to German, and after that to English, Spanish, and Greek (Turkish was not included in these studies). On these grounds, they also categorized both Dutch–German and Dutch–English as closely related language pairs, but Dutch–Spanish as less closely related. Relatedly, Eden (2018) presented a measure of language distance based on syllable structure and phoneme inventory, where Dutch was closest to German and English, but more distant from Greek and Spanish. Furthermore, Dutch, German, and English are all Germanic languages, which suggests they are typologically similar on other linguistic (e.g., morphosyntactic) levels as well (see, e.g., Dunn et al., 2011), whereas Spanish is a Romance language, Greek is a Hellenic language, and Turkish is a Turkic language (Dryer & Haspelmath, 2013).

Based on these similarities and differences, in this study we considered German and English to be closely related to Dutch (close languages) and Spanish, Greek, and Turkish to be more distant from Dutch (distant languages). In line with this categorization, the test items used in this study differed in their average phonolexical similarity across the close and distant groups, but not for specific language pairs within those groups (see the section on phonological similarity below).

An important advantage of this binary categorization was that it increased the amount of data per group and allowed us to examine phonological similarity in more detail both within and across groups. As sample sizes varied per language combination (see Table 1), direct comparisons between the language groups would be complicated. A disadvantage of such a categorical distinction, however, is that it may introduce variation within language distance groups. In the present study, for example, the distant languages were more varied in terms of language families, and Turkish was arguably more distant from Dutch than Spanish or Greek, leading to more potential variation within the distant group compared to the close group (see Appendix S3 in the Supporting Information online for additional analyses addressing this issue).

## Materials

### *Vocabulary Tests*

The main vocabulary test used in this study was the Cross-Linguistic Lexical Task (CLT; Haman et al., 2015) from the Language Impairment Testing in Multilingual Settings (LITMUS) test battery (https://www.bi-sli.org/litmus-tools). This test is designed for multilingual children and allows for crosslinguistic comparison. Children's scores on the Dutch version (CLT-NL; van Wonderen & Unsworth, 2021) were used as the dependent variable in this study; see the section below on scoring and analysis. Other versions of the CLT were used to assess children's proficiency in their other language, namely in German (Rinker & Gagarina, 2017), English (Haman et al., 2013), Spanish (van Wonderen & Unsworth, 2021), or Turkish (Ünal-Logacev et al., 2012). Importantly, these different CLTs are not translations of each other, but have been developed separately according to the same criteria (see Haman et al., 2015, for more information). For Greek, we used the Child Object and Action Test (COAT; Kambanaros et al., 2013), as no CLT was available.

The original CLT, which was aimed at younger children, consisted of 30 nouns and 30 verbs. Because we tested older children, 20 extra items (10 nouns, 10 verbs) were added following the same criteria as used to design the original task. The adaptations of the CLTs used for this study thus consisted of 80 color drawings, 40 depicting objects and 40 depicting events or actions, corresponding to 40 target nouns and 40 target verbs. The COAT consisted of 75 color photographs, 36 depicting objects and 39 depicting events or actions.

The images were shown one by one on a laptop, or, for children who were tested remotely (see the Procedure section below), via an online testing platform. The child's task was to name the object or action using a single noun or verb, respectively. For nouns, the experimenter prompted the child by asking (in the target language) "What is this?", and for verbs, by asking (in the target language) "What is he/is she/are they doing?" If a child did not understand what was depicted or provided an incorrect answer, prespecified elicitation questions were asked. For example, if a child called a lemon an orange, the experimenter would ask the child "And if it is yellow, do you know what it is called?" The experimenter could also ask the child if they knew another word for the object, event or action in question.

### *Phonological Similarity*

Following studies such as those of Goriot et al. (2021), Floccia et al. (2018), and Schepens, Dijkstra, et al. (2013), a continuous phonological similarity measure (PhonSim) was calculated for each CLT-NL target word and its translation in each of the five other languages (see Appendix S1 in the Supporting Information online for a table of items and translations). PhonSim ranged from 0 (no phonological overlap) to 1 (full phonological overlap) and reflected the Levenshtein distance between the phonological transcriptions of the translation pairs, normalized for word length. Details and examples can be found in Appendix S1. For Dutch–German and Dutch–English, we also obtained subjective judgments on phonological overlap from bilingual adults, similarly to Goriot et al. (2021), and these correlated strongly with PhonSim ($r = .82$ and $r = .83$, respectively; see Appendix S1).

The average PhonSim for all CLT-NL items differed between languages, Dutch–German: .27, Dutch–English: .20, Dutch–Spanish: .08, Dutch–Greek: .10, Dutch–Turkish: .06; $F(4, 395) = 23.23$, $p < .001$, $\eta^2 = 0.19$. A post hoc Tukey test showed that PhonSim did not differ between the languages within the close group (Dutch–German vs. Dutch–English: $p = .088$), nor within the distant group (Dutch–Spanish vs. Dutch–Greek: $p = .907$; Dutch–Spanish vs. Dutch–Turkish: $p = .897$; Dutch–Greek vs. Dutch–Turkish: $p = .391$), but there were significant differences for each language combination across language distance groups, that is, between Dutch–German and Dutch–Spanish ($p < .001$), Dutch–Greek ($p < .001$), and Dutch–Turkish ($p < .001$), respectively; and between Dutch–English and Dutch–Spanish ($p = .002$), Dutch–Greek ($p < .001$), and Dutch–Turkish ($p < .001$), respectively.

## Procedure

The CLTs and the COAT were administered as part of a larger test battery in eight separate studies within one project (see Koutamanis et al., 2024a, 2024b, 2024c; Unsworth, 2023; van Dijk, 2021; van Wonderen & Unsworth, 2021). All children were tested individually at home. In most cases, an experimenter was physically present with the child, but in some cases ($n = 64$), testing took place remotely via a video call because of COVID-19-related restrictions.

The nouns and verbs in the tests were administered using the same procedure in separate blocks. Each block was preceded by two practice items. The order between the noun block and the verb block was counterbalanced across participants within each individual study, except for 64 children who participated in the studies by Koutamanis et al. (2024a, 2024c), as the setup of these particular studies meant that the verb block was always administered before the noun block. For these children, there was also a break between the two blocks during which another task was administered. Note that these were the same children who were tested remotely.[2] There were no time limits, but typically each test took between 10 and 20 min to complete.

Children's parents or caregivers gave informed consent before the testing session. The children received a book as thanks for their participation.

**Scoring and Analysis**

The CLTs in German, English, Spanish, and Turkish and the Greek COAT were scored according to the guidelines given by Bohnacker et al. (2016). In addition to exact target responses, these guidelines also allow certain alternatives, such as (comprehensible) mispronunciations, synonyms, or more specific responses, if they are adultlike and correspond to the picture. Children's other-language vocabulary scores were then expressed as the proportion of items answered correctly.

For the CLT-NL, only trials in which a child gave the exact target response were scored as correct, as PhonSim was only available for target words. For each of the studies in which these data were originally collected, (subsets of) children's responses were checked by a second scorer using audio recordings, and any discrepancies were resolved by a third scorer if needed. When the child was unable to provide an answer, the trial was scored as incorrect. Trials where no answer was given because of technical (e.g., software) issues or where the experimenter or someone else (e.g., a sibling who entered the room) said the target word before the child answered were excluded. This was the case for 80 of the total 24,960 CLT-NL trials (i.e., 0.3%).

Children's accuracy on the CLT-NL items was analyzed using a generalized linear mixed-effects model with the glmer function from the lme4 package (Version 1.1-27.1; Bates et al., 2015). The model contained the following predictors: PhonSim, language distance (close vs. distant), other-language vocabulary (i.e., children's scores on the CLT or COAT in their other language), and age, as well as interactions between PhonSim and each of the other predictors. The model also contained SES and cumulative Dutch exposure (as a percentage of age) as covariates, to control for differences between the groups and variation within the groups that might influence children's Dutch vocabulary.[3] Finally, the model contained random intercepts for participant and item. Random slopes were not included, as this led to convergence issues.

The continuous predictors PhonSim, cumulative Dutch exposure, and other-language vocabulary were mean-centered. Orthogonal sum-to-zero contrast coding was applied to the categorical predictor language distance, with distant coded as −0.5 and close as 0.5. Helmert coding was applied to the covariate SES, where primary education (coded as −0.67) was first compared to

**Table 3** Mean percentage correct on the Cross-Linguistic Lexical Task or Child Object and Action Test in their other language, per language group and per language distance group

| Group | % correct *M* (*SD*) | 95% CI for *M* |
|---|---|---|
| Close | 72% (18%) | [69, 74] |
| Dutch–German | 79% (15%) | [76, 81] |
| Dutch–English | 65% (19%) | [61, 69] |
| Distant | 52% (22%) | [48, 56] |
| Dutch–Spanish | 51% (19%) | [46, 56] |
| Dutch–Greek | 50% (25%) | [41, 58] |
| Dutch–Turkish | 61% (21%) | [50, 72] |

secondary and higher education (both coded as 0.33), and next secondary education (coded as −0.5) was compared to higher education (coded as 0.5). The alpha for interpreting statistical significance was set at .05.

In addition to this analysis of the full data set, a subset of the data was analyzed to address differences in PhonSim between the two language distance groups; see the section Additional Analysis below for details. Appendices S3 and S4 in the Supporting Information online also contain several additional (subset) analyses addressing differences between participant characteristics in the two language distance groups and differences in testing procedures, as well as the fact that the language combinations in the distant group were more varied than the language combinations in the close group. These additional analyses revealed the same outcome patterns as the main analysis.

## Results

### Other-Language Vocabulary

Table 3 shows children's vocabulary scores in their other (i.e., non-Dutch) language, which were added to the analyses as the predictor other-language vocabulary. These were significantly higher for children in the close group than for children in the distant group, $t(190.47) = 8.02, p < .001$.[4]

Table 4 shows the correlations between children's other-language vocabulary scores and other predictors (see Appendix S4 in the Supporting Information online for analyses with other-language literacy). Other-language vocabulary correlated moderately and positively with age and other-language literacy, and negatively with cumulative Dutch exposure.

**Table 4** Correlations between the participant variables included in the analysis

| Variable | 1 | 2 | 3 | 4 |
|---|---|---|---|---|
| 1. Other-language vocabulary | — | | | |
| 2. Other-language literacy[a] | **.54** | — | | |
| 3. Cumulative Dutch exposure | **−.40** | **−.26** | — | |
| 4. Age | **.46** | **.40** | .01 | — |

*Note*. Significant correlations are shown in boldface.
[a]Literacy is treated on a continuous scale here, but it was in fact measured and analyzed on a categorical scale. Boxplots illustrating the relation between literacy on a categorical scale and the other variables are given in Appendix S2 in the Supporting Information online.

**Table 5** Mean accuracy on the Dutch version of the Cross-Linguistic Lexical Task per language distance group, for children with higher and lower other-language vocabulary, on words with higher or lower phonological similarity (based on a median split for other language proficiency and PhonSim for illustrative purposes)

| | Close group | | Distant group | |
|---|---|---|---|---|
| | *M* (*SD*) | 95% CI for *M* | *M* (*SD*) | 95% CI for *M* |
| Higher other-language vocabulary | 0.77 (0.42) | [0.76, 0.78] | 0.64 (0.48) | [0.61, 0.66] |
| Higher PhonSim | 0.80 (0.40) | [0.79, 0.84] | 0.69 (0.46) | [0.65, 0.73] |
| Lower PhonSim | 0.72 (0.45) | [0.70, 0.73] | 0.62 (0.49) | [0.59, 0.64] |
| Lower other-language vocabulary | 0.72 (0.45) | [0.70, 0.73] | 0.65 (0.48) | [0.64. 0.66] |
| Higher PhonSim | 0.73 (0.44) | [0.72, 0.75] | 0.69 (0.46) | [0.66, 0.71] |
| Lower PhonSim | 0.69 (0.46) | [0.67, 0.71] | 0.64 (0.48) | [0.62, 0.65] |

## Main Analysis

Descriptive results of the CLT-NL for both language distance groups are presented in Table 5. Although both other-language vocabulary and PhonSim were treated continuously in the analysis, for illustrative purposes, the data in Table 5 are presented separately for children with higher and lower percentages of other-language vocabulary, and for words with higher and lower PhonSim (both based on a median split).

Table 6 shows the results of the analysis. The final model had a marginal $R^2$ of .12 and a conditional $R^2$ of .62. It revealed a main effect of PhonSim, whereby children responded more accurately to items that were more phonologically similar to their translation equivalent. There was also a main effect of language distance, whereby children speaking closely related languages responded more accurately than children speaking more distant languages, and an interaction between PhonSim and language distance. As illustrated in Figure 1, the effect of phonological similarity was stronger for the distant group

**Table 6** Parameter estimates from the accuracy model for the full data set

| Predictor | Estimate | 95% CI for Estimate | *SE* | *z* | *p* |
|---|---|---|---|---|---|
| (Intercept) | −1.724 | [−2.424, −1.026] | 0.355 | −4.852 | < .001 |
| PhonSim | 1.677 | [0.851, 2.804] | 0.572 | 2.932 | .003 |
| Language distance | 0.409 | [0.175, 0.642] | 0.119 | 3.441 | .001 |
| Other-language vocabulary | 0.003 | [−0.004, 0.009] | 0.003 | 0.817 | .414 |
| Age | 0.433 | [0.369, 0.498] | 0.033 | 13.171 | < .001 |
| Cumulative Dutch exposure | 0.024 | [0.018, 0.03] | 0.003 | 8.271 | < .001 |
| SES | 0.129 | [−0.282, 0.54] | 0.209 | 0.618 | .537 |
| PhonSim × Language Distance | −0.641 | [−1.271, −0.014] | 0.321 | −1.998 | .046 |
| PhonSim × Other-Language Vocabulary | 0.031 | [0.019, 0.043] | 0.006 | 5.165 | < .001 |
| PhonSim × Age | −0.077 | [−0.122, −0.013] | 0.076 | −1.013 | .311 |

*Note*. SES = socioeconomic status.

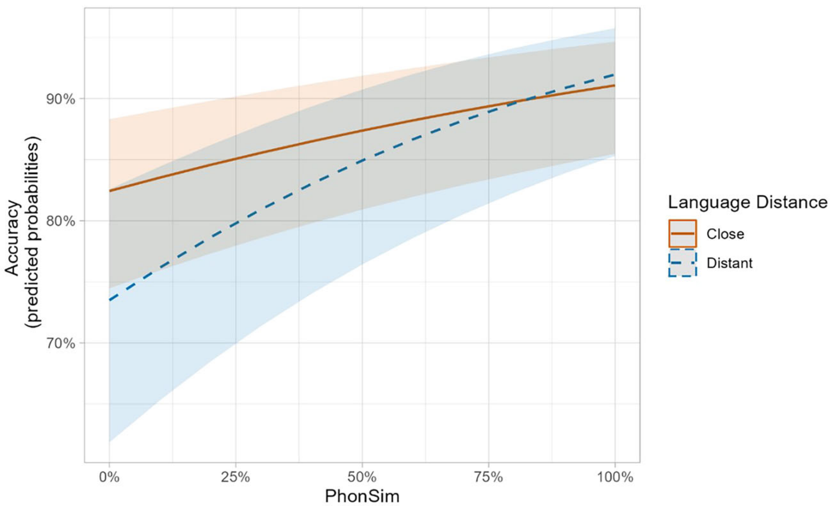


**Figure 1** Interaction between language distance and PhonSim. The shaded areas represent 95% confidence intervals.

than for the close group. In addition, there were positive main effects of cumulative Dutch exposure and age on accuracy, but no interaction between age and PhonSim. Finally, there was an interaction effect between PhonSim and other-language vocabulary. As illustrated in Figure 2, the effect of phonological similarity was stronger for children with higher proficiency in their other language.

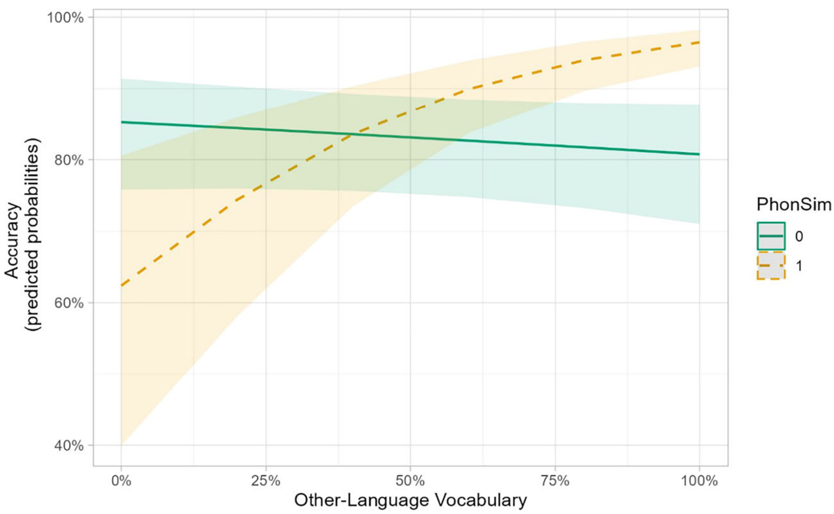


**Figure 2** Interaction between other-language vocabulary and PhonSim. For PhonSim, the lowest and highest values are plotted, with 0 meaning no phonological overlap and 1 meaning full phonological overlap. The shaded areas represent 95% confidence intervals.

## Additional Analysis

Because average PhonSim differed between the language groups, with more highly phonologically similar words in the close languages than in the distant languages (as discussed earlier in the Materials section), we performed an additional analysis to gain more insight into the role of such highly phonologically similar words in the effects of phonological similarity and language distance. Specifically, we excluded words with a Levenshtein distance of no more than 3, as these are often considered (near-)identical cognates and may lead to stronger facilitation effects than words that are similar but not to the same extent (see, e.g., Dijkstra et al., 2010). We removed 53 items (Dutch–German: $n = 24$, Dutch–English: $n = 22$, Dutch–Spanish: $n = 2$, Dutch–Greek: $n = 4$, Dutch–Turkish: $n = 1$), leaving 347 of the total 400 items; see Appendix S1 in the Supporting Information online for the included and excluded items.[5] The remaining items consisted of both nouns and verbs (close languages: 51 nouns, 63 verbs; distant languages: 114 nouns, 119 verbs). The PhonSim (i.e., Levenshtein distance normalized for word length) of the remaining items ranged from 0 to 0.6.

The results for this cognate-reduced subset are presented in Table 7. This model had a marginal $R^2$ of .12 and a conditional $R^2$ of .63. As for the full data

**Table 7** Parameter estimates from the accuracy model of the cognate-reduced subset

| Predictor | Estimate | 95% CI for Estimate | *SE* | *z* | *p* |
|---|---|---|---|---|---|
| (Intercept) | −1.887 | [−2.608, −1.168] | 0.366 | −5.152 | < .001 |
| PhonSim | −0.267 | [−2.060, 0.486] | 0.906 | −0.295 | .768 |
| Language distance | 0.550 | [0.311, 0.789] | 0.122 | 4.515 | < .001 |
| Other-language vocabulary | −0.0002 | [−0.007, 0.006] | 0.003 | −0.047 | .963 |
| Age | 0.444 | [0.377, 0.512] | 0.034 | 12.947 | < .001 |
| Cumulative Dutch exposure | 0.025 | [0.020, 0.031] | 0.003 | 8.394 | < .001 |
| SES | 0.126 | [−0.300, 0.551] | 0.216 | 0.581 | .561 |
| PhonSim × Language Distance | −0.106 | [−1.028, 0.814] | 0.470 | −0.226 | .821 |
| PhonSim × Other-Language Vocabulary | 0.039 | [0.020, 0.058] | 0.010 | 4.043 | < .001 |
| PhonSim × Age | 0.112 | [0.022, 0.190] | 0.118 | 0.949 | .343 |

*Note*. SES = socioeconomic status.

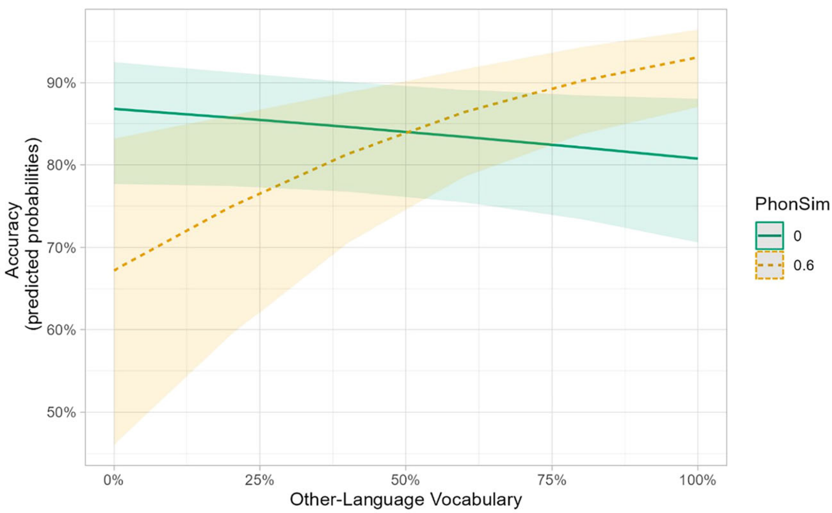


**Figure 3** Interaction between other-language vocabulary and PhonSim in the model of the cognate-reduced subset. For PhonSim, the lowest and highest values in this subset are plotted. The shaded areas represent 95% confidence intervals.

set, the subset analysis revealed main effects of language distance, age, and cumulative Dutch exposure, but there was no main effect of PhonSim and no interaction between PhonSim and language distance. The interaction between PhonSim and other-language vocabulary revealed a similar pattern to that for the full data set, as illustrated in Figure 3.

## Discussion

The present study investigated how individual-level, word-level, and language-level variation affect bilingual children's vocabulary acquisition. By including both phonological similarity of specific words and language distance on a more general level, we aimed to gain a better understanding of the extent to which the effects of phonological similarity between specific words and their translations drive language distance effects and to what extent such phonological similarity effects are generalizable across children with different language backgrounds. To this end, we examined the productive Dutch vocabulary of bilingual children simultaneously acquiring Dutch alongside either a closely related or a more distant language, using a vocabulary test containing items that varied in phonological similarity to their translation equivalent in the children's other language. We first discuss the effects of phonological similarity and language distance, before considering the role of individual differences on phonological similarity effects.

### Phonological Similarity and Language Distance

In line with our first prediction, there was an effect of phonological similarity: Children performed more accurately on words that were more phonologically similar to their translation equivalent. This prediction was based on the widely accepted view of the bilingual lexicon whereby the two languages are represented in an integrated lexicon and can become coactivated during processing (Dijkstra et al., 2019; Dijkstra & van Heuven, 2002; Kroll et al., 2006; Shook & Marian, 2013). The resulting cognate facilitation effects have been found in many word processing studies (see Dijkstra & van Heuven, 2018) as well as in second language word learning studies (e.g., de Groot & Keijzer, 2000; Tonzar et al., 2009) and in studies examining bilingual children's vocabulary (Bosma et al., 2019; Goriot et al., 2021; Lindgren & Bohnacker, 2020). The results of the present study add more evidence for cognate effects in simultaneous bilingual children's vocabulary, in more language combinations and age ranges.

In the cognate-reduced analysis, where we excluded (near-)identical cognates, children's accuracy on the vocabulary test was no longer predicted by phonological similarity. This shows that the phonological similarity effect in the full data set was indeed a cognate effect; that is, it was driven by the words in the vocabulary test that were phonologically the most similar to their translation equivalents (in line with, e.g., Dijkstra et al., 2010). A limitation of our study with respect to this issue is that phonological similarity was not manipulated to be evenly distributed across items and languages, because the CLT is a test designed to assess vocabulary acquisition and not cognate effects. Future studies with bilingual children could further examine the role of phonological similarity in cognates versus noncognates by conducting controlled experiments, manipulating the degree of overlap in a balanced manner.

In addition to phonological similarities between specific test items, we tested for effects of general language distance. This was defined based on phonolexical similarity as well as features on other linguistic levels that were shared between the languages. In line with our second prediction and with Blom et al. (2020) and Floccia et al. (2018), children speaking closely related languages obtained higher Dutch vocabulary scores than children speaking more distant languages. The language combinations in our study were different from those in previous studies, suggesting that language distance effects on vocabulary acquisition are generalizable over languages. For example, in Blom et al.'s (2020) study, the close language combinations were Dutch–Frisian and Dutch–Limburgish, where the languages involved are all national or regional languages of the Netherlands, whereas in our study all close languages originated from different countries. Despite the languages in our study being less closely related than those in Blom et al.'s, we still found similar results for language distance.

A limitation of the present study concerning language distance was that the distant languages were more of a mixed bag than the close languages: Greek, Spanish, and Turkish come from different language families. Additional analyses excluding the most distant language, Turkish (see Appendices S3 and S4 in the Supporting Information online), suggested that any differences between these three languages in terms of their distance to Dutch did not affect our findings. However, further research with more language combinations is needed to confirm whether this is indeed the case, perhaps operationalizing language distance using a continuous rather than a categorical variable (e.g., based on average PhonSim as in, e.g., Floccia et al., 2018).

A key question in the present study was whether the effects of language distance on bilingual children's accuracy in vocabulary tests are purely driven by the presence of cognates. Two findings indicate that this is not the case. First, in the main analysis language distance significantly interacted with phonological similarity, and second, and crucially, in the cognate-reduced analysis language distance still influenced children's vocabulary. Taken together, our results show that language distance effects are not solely driven by the presence of cognates, but that language distance influences children's knowledge of noncognates as well as the strength of the cognate facilitation effect.

At the same time, the direction of the interaction differed from our predictions. Specifically, our third prediction was that phonological similarity would have a stronger effect for children acquiring closely related languages, as a result of more experience with cognates. Our results, in contrast, showed that phonological similarity had a stronger effect for children acquiring more distant languages. A possible explanation for this finding is that experience with phonologically similar words influences children's sensitivity to and/or awareness of cognates, but in a different way than we expected: For children speaking combinations of languages that are more distant, cognates may stand out more compared to other words, whereas for children speaking closely related languages, the difference between words with and without (strong) phonological similarity may be less striking (see also Broersma, 2009, for a similar argument in a study focusing on how cognates trigger code-switching in bilinguals speaking distant languages). Thus, children speaking distant languages may develop more awareness of cognates, leading to stronger cognate effects. The lack of a significant interaction between language distance and phonological similarity in the cognate-reduced subset supports our interpretation in terms of cognate processing, again showing that effects were driven by highly phonologically similar items.

The apparent difference between words with and without (strong) phonological similarity may be influenced by similarities on other levels, such as the phonetic or morphological level. For example, English *saw* /sɔː/ and its Dutch translation *zaag* /zax/ have a low phonological similarity, but share phonetic features, as do Dutch *duiken* /ˈdœykən/ and German *tauchen* /ˈtaʊ̯xn̩/ "to dive," which also share morphological elements. Thus, children may perceive these words to be as comparable to each other in form as cognates with a higher phonological similarity (e.g., Dutch *lamp* /lɑmp/ and English *lamp* /læmp/ or German *Lampe* /lampə/), causing the latter to stand out less. As similarities of this kind are probably more common between words from closely related languages than between words from distant languages, children speaking closely related languages may become less aware of cognates. Note that cognate awareness has also been related to metalinguistic skills (see, e.g., Bosma et al., 2023; Chen et al., 2012), a topic we discuss in the next section.

A practical implication of the finding that word-level and language-level variation interact concerns the comparison of multiple language groups using a single vocabulary test, as discussed by Goriot et al. (2021). As some language pairs share more cognates than others, the distribution of phonological similarity in a test should be representative of these languages. If cognates are over- or underrepresented in a test, children's vocabulary size may be over- or underestimated. The stronger phonological similarity effect for children speaking distant languages implies that a close examination of test items with consideration of possible effects of cognates is especially important when comparing multiple distant language groups to each other or to close language groups.

In sum, our findings show that both language distance effects and cognate effects are generalizable across language combinations. Moreover, they suggest that language distance effects on vocabulary size are not solely driven by phonological similarity of specific test items, but that similarities on other linguistic levels and/or differences in bilingual children's cognate experience and awareness may play a role as well. Future studies are needed to further explore the variables that may contribute to language distance effects on vocabulary acquisition, for example by testing for effects of children's cognate awareness in word processing experiments in which similarities on multiple linguistic levels are manipulated.

## Individual Differences

In addition to examining the relationship between phonological similarity and language distance, our study also provided insights into several individual-level variables influencing vocabulary size and phonological similarity effects. As expected, children's vocabulary scores were positively influenced by their age and the amount of exposure they had received to Dutch (expressed as a percentage of age). Our study also revealed interaction effects between phonological similarity and children's proficiency in their other language, but no interaction effects between phonological similarity and age.

The interaction between phonological similarity and other-language vocabulary, where the effect of phonological similarity was stronger for children with higher proficiency in the nontarget language, is in line with the literature on cognate processing: Many studies with adults (see van Hell & Tanner, 2012) and children (e.g., Bosma & Nota, 2020; Poarch & van Hell, 2012) have found stronger cognate effects in participants' weaker language. This may be explained in terms of both representation and activation: The more words children know in their other language and the more active these words are in the lexicon, the more they influence the processing of other words (Dijkstra et al., 2019; Dijkstra & van Heuven, 2002). For children with low other-language proficiency, it may be that no cognate effects emerge because the cognate word forms are not (well-)represented and/or not sufficiently active in their lexicon.

Similarly to our findings with regard to language distance, the role of other-language proficiency has implications for using vocabulary tests with different groups of children. Not only should the number of cognates in the test be examined, especially—as discussed above—for children acquiring more distant languages, but also, preferably, some measure of children's proficiency in their other language should be included. This was not the case in previous studies (e.g., in Bosma et al., 2019; Goriot et al., 2021). Ideally, in future studies both overall other-language vocabulary size and children's knowledge of the translations of the specific test items should be assessed, as both the levels of activation and the extent to which specific word forms are represented in the lexicon may influence bilingual word processing.

A limitation of the present study with regard to other-language proficiency was that there were between-group differences: The children speaking closely related languages obtained higher scores on the vocabulary tests in their other language than the children speaking more distant languages. This difference remained when the groups were matched on age, SES, and other-language literacy (see Appendix S3 in the Supporting Information online). We did not investigate which other variables predicted these other-language vocabulary scores, although we did test for correlations with other participant characteristics. It is possible that the difference in other-language proficiency reflected a mutual effect of language distance, similar to the effect of language distance on Dutch CLT accuracy. In addition, although the different CLTs were designed according to the same principles, it is possible that there were some differences between the tests (van Wonderen & Unsworth, 2021). Note, furthermore, that for Greek we used a different vocabulary test as no CLT was available.

In contrast to the studies by Goriot et al. (2021) and Bosma et al. (2019), we did not find the strength of the phonological similarity effect to be sensitive to age. It is possible that the age effects in previous studies were in fact other-language proficiency effects in disguise. Especially in Goriot et al.'s study, where effects were examined in English and the "other language" was the children's native language Dutch, age and Dutch proficiency were probably highly correlated. In our study, where effects were examined in Dutch and most children grew up in the Netherlands, their proficiency in their other language was only moderately correlated with age. For future research, we recommend including not only age but also other-language proficiency, as well as variables such as exposure and literacy skills (see also Quirk & Cohen, 2022, for a cognate study addressing the role of both age and exposure), to better account for variation between children as well as the different role that each of these variables may play.

The different individual-level variables discussed in this study are not only related to each other, but also to metalinguistic skills. For example, older children typically have larger vocabularies than younger children, as well as more developed metalinguistic skills (as referred to by Bosma et al., 2019, and Goriot et al., 2021; see also, e.g., Bialystok et al., 2014), and metalinguistic skills have been found to play a role in both vocabulary acquisition and literacy skills (Nagy, 2007). In addition, as discussed above, cognate awareness, which has also been related to metalinguistic skills (Bosma et al., 2023; Chen et al., 2012), may be influenced by language distance. Metalinguistic skills were not assessed directly in the present study, but future studies could include these to arrive at a more comprehensive understanding of bilingual children's cognate processing.

## Conclusion

By testing productive vocabulary in a diverse group of over 300 simultaneous bilingual children, this study has shown that language distance influences bilingual children's vocabulary acquisition as well as the strength of phonological similarity effects. Specifically, children speaking more closely related languages obtained higher vocabulary scores, and children speaking more distant languages showed a stronger positive effect of phonological similarity. Importantly, the effect of language distance on vocabulary scores was not purely driven by the presence of cognates in the vocabulary test. Furthermore, by repeating our analysis with and without cognates and by examining the role of individual differences between children, we have shown that phonological similarity effects in vocabulary tests are cognate facilitation effects, driven by coactivation within the integrated bilingual lexicon and influenced by children's proficiency.

To our knowledge, this study is the first to include both item-specific phonological similarity and general language distance, as well as individual differences in age, exposure, proficiency, and literacy. By considering these different sources of variation in a large and diverse sample, we not only shed more light on the relationship between these variables and the mechanisms underlying their effects on cognate and noncognate acquisition and processing, but also demonstrated the robustness and generalizability of both cognate facilitation and language distance effects on bilingual children's vocabulary acquisition.

Final revised version accepted 5 June 2024

## Open Research Badges

This article has earned an Open Data badge for making publicly available the digitally-shareable data necessary to reproduce the reported results. The data are available at https://osf.io/kx6zp/.

## Notes

1 Because most parents were highly educated, we grouped several levels of higher education together, resulting in a more meaningful contrast (for this sample) between parents with and without higher education.
2 We reran the analyses without these 64 children, which generally revealed the same pattern of results; see Appendices S3 and S4 in the Supporting Information online.
3 The groups also differed on other-language literacy, but because this information was not available for all children and because it was a relatively crude measure compared to the other variables, it was not included in the main analysis; however, it was included in additional analyses (see Appendix S4 in the Supporting Information online).
4 This difference remained significant in a subset of the data in which the language distance groups were matched on age, SES, and other-language literacy (see Appendix S3 in the Supporting Information online).
5 This criterion also led to the exclusion of a few short noncognate words, such as the verb *pet* (Dutch: *aaien* /ajə/).

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## Supporting Information

Additional Supporting Information may be found in the online version of this article at the publisher's website:

**Accessible Summary**
**Appendix S1.** Phonological Similarity.
**Appendix S2.** Boxplots for Other-Language Literacy.
**Appendix S3.** Additional Subset Analyses.
**Appendix S4.** Additional Analyses With Other-Language Literacy.