Cognate facilitation in single- and dual-language contexts in bilingual children's word processing

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We examined the extent to which cognate facilitation effects occurred in simultaneous bilingual children's production and comprehension and how these were modulated by language dominance and language context. Bilingual Dutch-German children, ranging from Dutch-dominant to German-dominant, performed picture naming and auditory lexical decision tasks in single-language and dual-language contexts. Language context was manipulated with respect to the language of communication (with the experimenter and in instructional videos) and by means of proficiency tasks. Cognate facilitation effects emerged in both production and comprehension and interacted with both dominance and context. In a single-language context, stronger cognate facilitation effects were found for picture naming in children's less dominant language, in line with previous studies on individual differences in lexical activation. In the dual-language context, this pattern was reversed, suggesting inhibition of the dominant language at the decision level. Similar effects were observed in lexical decision. These findings provide evidence for an integrated bilingual lexicon in simultaneous bilingual children and shed more light on the complex interplay between lexicon-internal and lexicon-external factors modulating the extent of lexical cross-linguistic influence more generally.

Keywords: simultaneous bilingual children, cross-linguistic influence, cognates, production, comprehension

1. Introduction

Cognates – translation equivalents with similar word forms (e.g., German *Baum* 'tree' and Dutch *boom* 'tree') – are known to be processed faster by bilinguals than

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noncognates (e.g., German *Zwiebel* 'onion' and Dutch *ui* 'onion'), both in production and in comprehension. This cognate facilitation effect, like other forms of lexical cross-linguistic influence, is considered evidence that bilinguals have one integrated lexicon containing words from both languages (e.g., Dijkstra & van Heuven, 2018). This view of the bilingual lexicon is commonly accepted for adults, and emerging evidence suggests that the same processes occur in simultaneous bilingual children (e.g., Bosma & Nota, 2020; Duñabeitia et al., 2016; Koutamanis et al., 2023b; Poarch & van Hell, 2012; Schröter & Schroeder, 2016).

Studies with bilingual adults have shown that cognate effects are modulated by factors like language dominance and language context (e.g., Elston-Güttler et al., 2005; Muntendam et al., 2022; Poort & Rodd, 2017; van Hell & Dijkstra, 2002; van Hell & Tanner, 2012). It is not clear to what extent these factors influence performance in simultaneous bilingual children: Whilst dominance is often included in child studies, not much is known about the role of language context or interactions between these factors. The present study examines to what extent language dominance and language context influence word processing in simultaneous bilingual children.

1.1 The bilingual lexicon

With respect to word representation, most models assume that the bilingual lexicon is integrated. This means that word meaning representations and word forms from both languages are stored in one, interconnected system (e.g., Dijkstra et al., 2019; Dijkstra & van Heuven, 2002). Words from both languages may share representations if there is semantic, phonological, and/or orthographic overlap. For example, translation equivalents are often modeled to share their semantic representation (Dijkstra et al., 2019; Dijkstra & van Heuven, 2002; Shook & Marian, 2013) and cognates additionally share certain form representations. Following the Bilingual Interactive Activation plus (BIA+) model (Dijkstra & van Heuven, 2002), we assume that cognates share some of their phonemic (i.e., sub-lexical phonological) or graphemic (i.e., sub-lexical orthographic) representations;[1] see Figure 1.

In word processing, the integrated bilingual lexicon is accessed in a language-nonselective manner (e.g., Dijkstra & van Heuven, 2002; Kroll et al., 2006). This implies that representations may become activated, irrespective of the language they belong to, and that words from both languages can become co-activated

1. The successor to the BIA+ model, Multilink (Dijkstra et al., 2019), does not specify sub-lexical representations. Instead, lexical representations are directly (co-)activated from the input.

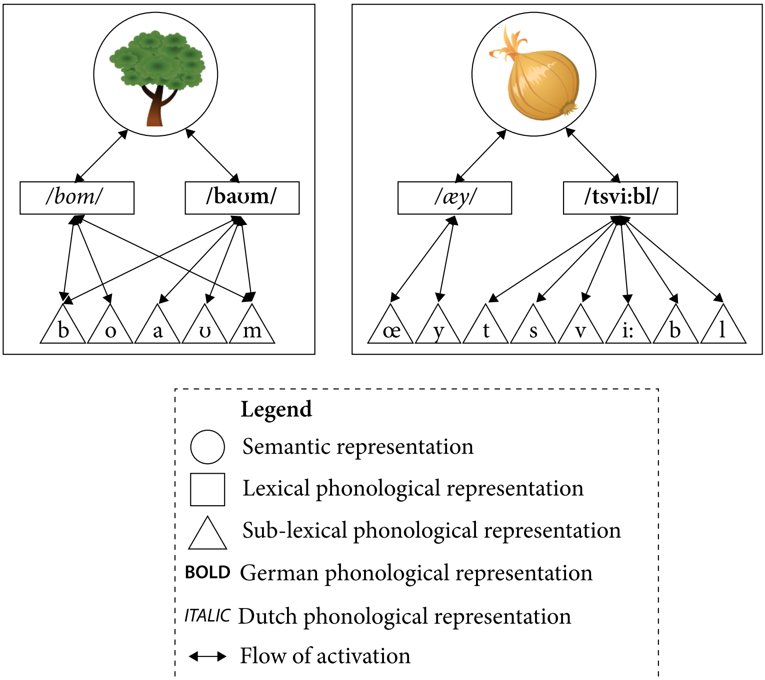

Figure 1. Representation and flow of activation in an integrated Dutch-German bilingual lexicon of a cognate (left: Boom – Baum 'tree') and a noncognate translation pair (right: Ui – Zwiebel 'onion')

if there is enough form and/or meaning overlap. For example, when a Dutch-German bilingual hears the Dutch word *boom*, the corresponding phonemes are activated. As these are largely shared between *boom* and *Baum*, both word form representations become co-activated; see Figure 1. Similarly, in production, activation of the shared semantic representation (tree) leads to co-activation of the two connected word forms.

Importantly, co-activation is not limited to cognates, but also occurs when words have only form overlap (e.g., German *Winkel* 'angle' and Dutch *winkel* 'store') or meaning overlap (e.g., *Zwiebel* 'onion' and *ui* 'onion'). For the cognate facilitation effect to occur, a final assumption is required, namely that activation resonates (i.e., flows back and forth) between form and meaning representations (e.g., Dijkstra & van Heuven, 2002). As cognates share multiple representations, this resonance reinforces their activation levels, leading to cognates being activated more quickly than noncognates. Indeed, many studies, especially with adults, have found cognates to be processed more quickly than noncognates in production (e.g., Costa et al., 2000; Kroll et al., 2006) and comprehension (e.g., Dijkstra et al., 2010; Lemhöfer et al., 2004).

In children, the organization of and processing in the bilingual lexicon has historically been studied less. More recently, however, several studies have found cognate facilitation effects in simultaneous bilingual children (Bosma et al., 2019; Bosma & Nota, 2020; Duñabeitia et al., 2016; Koutamanis et al., 2023b; Poarch & van Hell, 2012; Schröter & Schroeder, 2016). For example, Poarch and van Hell (2012) conducted picture naming tasks with German-English bilingual children and found that pictures depicting cognates were named more quickly and accurately than noncognates, in both languages. Other studies found similar cognate facilitation effects in bilingual children's comprehension, namely word recognition (Duñabeitia et al., 2016; Schröter & Schroeder, 2016), receptive vocabulary (Bosma et al., 2019), and sentence reading (Bosma & Nota, 2020).

More evidence for an integrated lexicon with language-nonselective access in simultaneous bilingual children comes from between-language lexical priming studies (Floccia et al., 2020; Jardak & Byers-Heinlein, 2019; Koutamanis et al., 2023a; Singh, 2014; Von Holzen & Mani, 2012). In such studies, children are presented with a sequence of two (noncognate) words, one from each of their languages, and the relationship between the words is manipulated. For example, several studies found that words were processed faster when preceded by their translation equivalent compared to an unrelated word (Floccia et al., 2020; Jardak & Byers-Heinlein, 2019; Koutamanis et al., 2023a), thus providing evidence for an integrated lexicon. Hearing the first word pre-activated the corresponding form and meaning representations. As translation equivalents share semantic representations, activation then resonated to the corresponding word form representation in the other language. When this second word was subsequently presented to the children, its increased activation facilitated processing.

In sum, evidence from both children and adults supports the view that that the bilingual lexicon is integrated, containing representations of words from both languages in one interconnected system. Access to the integrated bilingual lexicon is assumed to be inherently language-nonselective. In the next section, we discuss how the strength of resulting effects can be modulated by language dominance.

1.2 Language dominance

Language dominance refers to the relative prominence of a language in an individual bilingual speaker. It is often operationalized using a relative proficiency or exposure measure, in a categorical (e.g., Dutch-dominant vs. German-dominant) or continuous (e.g., more Dutch-dominant to more German-dominant) manner. A continuous view on dominance is in line with models of the bilingual lexicon such as BIA+ (Dijkstra & van Heuven, 2002) and Multilink (Dijkstra et al., 2019). According to these models, the more frequently a person is exposed to a specific word, the higher the resting-level activation of the corresponding representations. Words with higher resting-level activation are more easily (co-)activated and therefore exert more influence over the processing of other words. Extrapolated to the language level, the more exposure to a particular language a bilingual receives, the higher the resting-level activation of the words from that language and the more influence these words have on the processing of words from the non-dominant language.

Returning to our earlier example, if a German-dominant bilingual hears the Dutch word *boom* 'tree', the level of activation of the co-activated *Baum* 'tree' will be high and will strongly reinforce the activation of *boom*. In contrast, for a Dutch-dominant bilingual, the activation of *Baum* will remain relatively low, with less activation resonating between representations, and ultimately little to no effect of *Baum* on the processing of *boom*. Indeed, many studies with adults (e.g., Muntendam et al., 2022; van Hell & Dijkstra, 2002; van Hell & Tanner, 2012) and children (Bosma et al., 2019; Bosma & Nota, 2020; Poarch & van Hell, 2012; Singh, 2014) have found stronger effects in speakers' non-dominant language than in their dominant language. In addition to such lexicon-internal processes, the cognate facilitation effect may be influenced by lexicon-external factors, such as language context.

1.3 Language context

According to Green and Abutalebi (2013), naturalistic interactions often take place in one of three types of language context: single-language, dual-language, and dense codeswitching. In single-language contexts, only one language is used, for instance because the interlocutor is monolingual. Dual-language contexts may occur when a bilingual has multiple interlocutors speaking different languages and therefore frequently switches languages depending on the addressee. Dense codeswitching contexts, in which there is frequent and free switching, may occur when all interlocutors understand the same multiple languages.

Language context affects bilinguals' language processing. For example, dual-language contexts are cognitively demanding for bilingual adults, as they involve multiple cognitive control processes, such as interference suppression and selective response inhibition (Green & Abutalebi, 2013; see e.g., Misra et al., 2012). Similarly, Gross and Kaushanskaya (2020) found effects of language context, modulated by several cognitive control abilities, in Spanish-English bilingual children between four and seven years old. Children with lower cognitive control abilities had more difficulty in maintaining the target language in interactions in dual-language contexts than in single-language contexts, producing more codeswitches and blends (see also Gross & Kaushanskaya, 2018).

Language context effects have been found to interact with dominance (see e.g., Bobb & Wodniecka, 2013, for a review). For example, in dual-language contexts, inhibiting a dominant language and then again overcoming this inhibition has been argued to be especially cognitively demanding, leading to longer processing times when switching from a non-dominant language to a dominant language than the other way around (see e.g., Bobb & Wodniecka, 2013; Misra et al., 2012). It has also been suggested that a dominant language may be more globally inhibited depending on task and context (e.g., Gollan & Ferreira, 2009; Gross & Kaushanskaya, 2015).

Using a different perspective on language context, studies have also found effects on the strength of cognate facilitation (e.g., Brenders et al., 2011; Poort & Rodd, 2017). These studies manipulated the stimulus list composition, that is, which languages are used as stimuli. According to the BIA+ model (Dijkstra & van Heuven, 2002), stimulus list composition influences later stages of word processing. After words have been activated in the lexicon, they are further processed by the Task/Decision subsystem to create a task-appropriate response (Dijkstra & van Heuven, 2002). For example, in a single-language lexical decision task, the appropriate response would be 'yes' to a real word and 'no' to a pseudoword. If the stimulus list also contains words from the non-target language, the Task/Decision subsystem adapts: In this case, the response would be 'yes' to a target-language word and 'no' to a non-target-language word. Interestingly, Poort and Rodd (2017) found that, after encountering a non-target-language word, bilingual adults responded more slowly to cognates than to noncognates. Similarly, Brenders et al. (2011) found that child second-language learners processed cognates faster than noncognates, but not when the stimulus list included interlingual homographs ('false friends'). Apparently, in the presence of non-target-language words and/or interlingual homographs, more processing time is needed to decide to which language cognates belong and which response is required.

Stimulus list composition may be viewed as a more local operationalization of language context, which could provide insights into the mechanisms behind the more global language context effects as in Gross and Kaushanskaya (2020). However, whilst Green and Abutalebi's (2013) view on language context was developed around language production in naturalistic interactions, studies into stimulus list composition have mostly involved (cognate and/or interlingual homograph) word recognition in strictly experimental settings. There have been (adult) studies bringing the two perspectives together. For example, Elston-Güttler and colleagues (2005) investigated to what extent between-language priming was influenced by global language context, that is, language use throughout the entire experimental session. German-English bilinguals performed a priming task in English after watching a twenty-minute film in either English or German, creating either a single-language (English) or a dual-language context. In the priming task, participants read sentences containing interlingual homographs and then performed lexical decision trials. In critical trials, the German interpretation of the interlingual homograph was related to the lexical decision item (e.g., *gift*, which means ‘poison’ in German, and *poison*). Priming effects between these words emerged only for participants in the dual-language context, and only in the first half of the experiment. According to Elston-Güttler et al. (2005), this suggests that the Task/Decision subsystem gradually shifted towards (globally) inhibiting or ignoring German word meanings, after the switch from the German film to the English task. In the single-language session, German was inhibited from the start of the task, leading to no between-language priming effects.

To our knowledge, there have not yet been any studies systematically investigating the role of (global) language context on cognate processing in simultaneous bilingual children. Importantly, effects of language context would not imply that access to the lexicon is language-selective: Studies with adults have found evidence for interactions between the languages even in fully single-language contexts (Dijkstra & van Hell, 2003; Lauro & Schwartz, 2017; Paulmann et al., 2006; Thierry & Wu, 2007), and most aforementioned cognate processing studies with children have taken place in (mostly) single-language contexts as well. Rather, comparing lexical cross-linguistic influence in multiple language contexts can provide insight into control processes occurring after words have become activated in the lexicon.

1.4 Present study

We investigated the effect of global language context on word processing by simultaneous bilingual children with varying language dominance. Dutch-German bilingual children performed picture naming and auditory lexical decision tasks containing cognates and noncognates. Both tasks were conducted twice: first in a single-language context, and later in a dual-language context; see Table 1. In the single-language context, the target language of the experimental tasks was also the context language used throughout the session; in the dual-language context, the context language was different from the target language, so participants had to switch. We increased the frequency of language switches compared to Elston-Güttler et al. (2005), as context effects were short-lived in their study. In our study, the context language was used in instructional videos shown throughout the experiment, in communication between experimenter and participant, and in proficiency tasks conducted in between blocks of the main tasks (see Procedure).

To fully understand the effect of language context on cognate processing, we also took children’s language dominance into account (following e.g., Gross &

Kaushanskaya, 2020). Dominance effects and context effects stem from different processes – respectively, lexicon-internal differences in activation and lexicon-external (specifically, decision-level) differences in inhibition. As both processes can influence the strength of cognate facilitation effects, it is possible that, for example, dominance effects might obscure language context effects or vice versa. This is precisely why we investigated language context in interaction with dominance. In line with the BIA+ model (Dijkstra & van Heuven, 2002) and Multilink (Dijkstra et al., 2019), dominance was operationalized in terms of relative exposure.

To ensure that our sample covered a range from Dutch-dominant to German-dominant children, we recruited in the Netherlands and in Germany. Half of the children performed the tasks in Dutch and half in German, with both subgroups containing children from both countries (see Appendix: https://osf.io/9agup for details). This resulted in a wide range of target language dominance, allowing us to test to what extent cognate effects and language context effects were influenced by dominance.

Table 1. Study design

	Single-language context	**Dual-language context**
Main tasks	Picture Naming Task Lexical Decision Task	Picture Naming Task Lexical Decision Task
Context language: – language of instructional videos – language of communication – language of proficiency tasks	Same language as main tasks (i.e., target language)	Different language than main tasks (i.e., other language)*

* For the children who performed the main tasks in Dutch, the context language of the dual-language session was German. For the children who performed the main tasks in German, the context language of the dual-language session was Dutch.

In line with research on bilingual adults (e.g., Costa et al., 2000; Dijkstra et al., 2010; Lemhöfer et al., 2004) and children (Bosma et al., 2019; Bosma & Nota, 2020; Duñabeitia et al., 2016; Koutamanis et al., 2023b; Poarch & van Hell, 2012; Schröter & Schroeder, 2016) and models of the bilingual lexicon (e.g., Dijkstra et al., 2019; Dijkstra & van Heuven, 2002), we predicted cognate facilitation effects in both tasks. Furthermore, we predicted that language context and dominance would influence these effects. In line with the BIA+ model (Dijkstra

& van Heuven, 2002) and Multilink (Dijkstra et al., 2019), cognate effects were expected to be stronger in children's less dominant language, as a result of individual differences in the resting-level activation of words from both languages. Specifically, more exposure to words from one language would lead to higher resting-level activation, which in turn would lead to faster activation during processing and more influence on word processing in the other language. In line with Elston-Güttler et al. (2005), cognate effects were expected to be stronger in the dual-language context, which would suggest contextual differences in the strength of decision-level inhibition of words from the two languages. We also predicted interactions between language context and dominance, as a result of different possible mechanisms. Language context may affect global inhibition, as in Elston-Güttler et al. (2005; see also e.g., Gollan & Ferreira, 2009). In the dual-language context, then, we would expect that children would not be, in terms of Elston-Güttler and colleagues (2005), 'zoomed in' on either language. As such, in the dual-language context, both languages would be highly likely to influence each other, regardless of language dominance, whereas we would expect dominance effects in the single-language context. At the same time, the switching between languages across the tasks in the dual-language context may also lead to a relatively strong inhibition of the dominant language (see e.g., Misra et al., 2012), resulting in weaker influence of the dominant language on the non-dominant language and smaller cognate effects.

2. Method

2.1 Participants

The participants were 63 Dutch-German bilingual children (37 girls, 26 boys), aged between 7.1 and 10.6 years old ($M = 8.7$, $SD = 1.1$), living either in the Netherlands ($n = 36$) or in Germany ($n = 27$). All children had received substantial exposure to both German and Dutch, defined as minimally half a day per week, since before age three and for the majority ($n = 50$) since birth. No children had received substantial exposure to any other languages than Dutch or German for at least 3.5 years prior to testing. Most children ($n = 59$) had at least one parent who had completed (applied) university, indicating a higher socio-economic status.

Table 2 summarizes children's scores on a range of background variables: working memory (Dutch version of Alloway Working Memory Assessment: Forward and Backward Digit Span Tests; Alloway, 2012), Dutch and German lexical proficiency (LITMUS Cross-linguistic Lexical Task; Haman et al., 2015; Rinker & Gagarina, 2017; van Wonderen & Unsworth, 2021) and Dutch and German syntactic proficiency (LITMUS Sentence Repetition Task; Marinis & Armon-Lotem, 2015). Children's current relative exposure to Dutch was assessed using the Bilingual Language Experience Calculator (Unsworth, 2013). Details of the proficiency tasks can be found in Section 2.2.3: Background Tasks.

Table 3 shows how the various proficiency and exposure measures are correlated. Dutch and German lexical proficiency correlated moderately to strongly with language exposure. There was a weaker correlation between language exposure and Dutch syntactic proficiency. In addition, Dutch lexical and syntactic proficiency were moderately correlated.

Table 2. Overview of participant characteristics

Background variable	*M*	*SD*	**Range**
Working Memory:*			
- Forward Digit Span Test score	96	16	65–130
- Backward Digit Span Test score	100	13	68–127
Dutch Proficiency:			
- Lexical proficiency score	84%	15%	21%–100%
- Syntactic proficiency score	85%	18%	3%–100%
German Proficiency:			
- Lexical proficiency score	82%	13%	32%–98%
- Syntactic proficiency score	71%	27%	3%–100%
Percentage Dutch Exposure**	57%	21%	16%–92%

* Scores are standard scores, with possible scores ranging from 47 to 153.
** Percentages reflect how much of children's language exposure around the time of testing was in Dutch compared to German.

Table 3. Correlations between proficiency scores and exposure

	1	2	3	4	5
1. Percentage Dutch Exposure	–				
2. Dutch lexical proficiency score	0.73***	–			
3. Dutch syntactic proficiency score	0.43***	0.67***	–		
4. German lexical proficiency score	−0.59***	−0.24	0.03	–	
5. German syntactic proficiency score	0.04	−0.09	−0.04	0.02	–

* $p<.05$. ** $p<.01$. *** $p<.001$

2.2 Materials

2.2.1 *Picture naming*

The picture naming stimuli consisted of 144 full-color drawings, corresponding to nouns selected from word lists for young Dutch children (Dunn et al., 2005; Mulder et al., 2009; Schlichting & Lutje Spelberg, 2002; Zink & Lejaegere, 2002), and their German translations.

The 144 target words consisted of 36 cognates, 36 matched noncognates, and 72 fillers (see https://osf.io/9agup for the full stimulus list). Noncognates were matched to cognates based on frequency (Keuleers et al., 2010), AoA (in Dutch; Brysbaert et al., 2014), concreteness (Brysbaert et al., 2014), onset phoneme category, and length (in syllables) ($ps > .05$). The fillers were non-matched noncognate words, meaning that they could differ from the cognates on these features. The same images were used for both target language subgroups (Dutch and German), but some items were matched noncognates in one target language and fillers in the other.

Images were selected from Multipic (Duñabeitia et al., 2018) and Rossion and Pourtois (2004), complemented with clip-art images in similar styles if no suitable option was available from either database. We consulted with adult native speakers of Dutch and German to find which picture would be most recognizable for children and whether any adaptations were necessary.

The selected and adapted set of images was pre-tested for naming consistency by five native speakers of German and five native speakers of Dutch (all women, aged between 22 and 64). They were presented with the pictures in an online questionnaire and were asked to type one word describing the picture. If alternative responses were given (especially to the cognates and matched noncognates), we checked whether these responses differed from the target response in cognate status, length, onset phoneme, and frequency. Based on this pre-test, we made some final changes to the images to optimize the naming consistency.

Within target languages, the stimuli were evenly divided over the single- and dual-language sessions. Within sessions, they were divided into two blocks of 36 items: nine cognates, their nine matched noncognates, and 18 fillers. Each block was preceded by four practice items: two cognates and two noncognates. Blocks and sessions did not differ from each other in terms of frequency, AoA, onset phoneme category, and length of the cognates ($ps > .05$). Block-internal stimulus order was pseudorandomized for each participant, with no more than two subsequent trials from the same condition.[2] All individual stimulus order lists were checked for form or meaning overlap between subsequent trials, to avoid unwanted interactions with phonological or semantic priming.

2.2.2 *Lexical decision*

The lexical decision stimuli consisted of 216 pre-recorded Dutch (pseudo)words and 216 German (pseudo)words, pre-recorded by female native speakers of Dutch and German, respectively. In both target languages, there were 36 cognates, 36 matched noncognates, 36 fillers, and 108 pseudowords (see https://osf.io/9agup). The real words were selected and matched following the same criteria as in the picture naming task, but different words were used between the two tasks. Translation equivalents were used between the target languages.

The pseudowords were created with Wuggy (Keuleers & Brysbaert, 2010), based on words not used in the experiment. Adult native speakers were consulted to ensure that no homophones of any real words were included. Onset phoneme category and length (in syllables) of pseudowords were kept as similar as possible to the cognates.

Similar to picture naming, the stimuli were divided over the sessions, and further divided into blocks: two blocks of 30 items (five cognates, their five matched noncognates, five fillers, and 15 pseudowords) and two blocks of 24 items (four cognates, their four matched noncognates, four fillers, and 12 pseudowords). The first 30-item block was preceded by twelve practice items (three cognates, three noncognates, and six pseudowords); the other blocks were preceded by four practice items (one cognate, one noncognate, and two pseudowords). Block matching, block-internal stimulus order randomization, and session matching were performed in the same way as in the picture naming task.

2.2.3 *Background tasks*

The proficiency tasks were used to assess participants' proficiency in both languages and to increase our manipulation of language context. For this second purpose, the proficiency tasks were administered in between the blocks of the main tasks (see Procedure). All proficiency tasks were production tasks.

Lexical proficiency was measured using adapted versions of the production subsets of the LITMUS Cross-linguistic Lexical Task in Dutch (CLT-NL; Haman et al., 2015; van Wonderen & Unsworth, 2021) and in German (CLT-DE; Haman et al., 2015; Rinker & Gagarina, 2017). These picture naming vocabulary tasks

2. To increase comparability between target language subgroups and sessions, the same set of pseudorandomized stimulus orders was used across sessions and across groups, although they contained different items.

consisted of full-color drawings depicting (in our adaptation) 40 nouns and 40 verbs. The CLTs were administered and scored according to the guidelines by Bohnacker et al. (2016).

Syntactic proficiency was measured using the Dutch and German versions of the LITMUS Sentence Repetition Task (SRT-NL and SRT-DE; Marinis & Armon-Lotem, 2015). In the SRT, participants hear 30 pre-recorded sentences, varying in syntactic complexity, that they need to repeat verbatim after hearing them once. For the current experiment, we divided both SRTs into three blocks of 10 sentences.

2.2.4 *Overlap between tasks*

As Dutch and German are closely related, there are many (near-)cognates and false friends between the two languages, and there was a relatively small number of strict noncognates that could be used as matched noncognates and fillers in our main tasks. We did not repeat any items between the main tasks, but a small amount of overlap between the main tasks on the one hand and the proficiency tasks on the other hand was unavoidable. To ensure reliable measurements and avoid priming effects between tasks, main task items were assigned to a session such that overlap with the proficiency tasks of that session was avoided. For example, if a noun or its translation appeared in the CLT-NL, which was administered in the sessions with Dutch as the context language, that noun could only be used in the main tasks of the sessions with German as the context language.

For two picture naming items, within-session overlap could not be avoided. In those cases, to avoid priming effects in the main task, the items were always presented in a picture naming block before the proficiency tasks.

2.3 Procedure

All children were tested individually, in their homes, over two sessions of 60–70 minutes each: first the single-language session, followed by the dual-language session after one to three weeks. Testing took place online using Radboud Online Linguistic Experiment Generator (ROLEG), an in-house testing platform.[3] Caregivers received a link to access the experiment and were instructed to help the child set up, but leave the room during the session. Instructions for all tasks were embedded in short animation videos shown throughout the session. An experimenter was also present via a video call to give feedback and additional instructions where needed. The two sessions were conducted by two different experimenters, who were native speakers of the context language of the session.

3. Because of COVID-19-related restrictions, testing could not take place face-to-face.

To maintain the context language throughout the session, the different tasks were administered in a fast rotation. All main tasks and proficiency tasks had been divided into two or more blocks. As the context effects in Elston-Güttler et al. (2005) were quite short-lived, the blocks in our study were aimed to last approximately five minutes each. The order between these blocks was such that participants switched back and forth between main tasks and proficiency tasks, between production and comprehension tasks, and, in the dual-language sessions, between languages; see Figure 2.

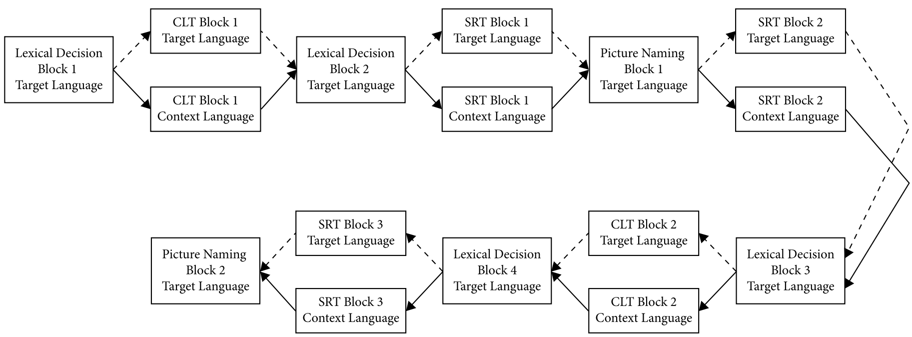

Figure 2. Order between blocks of different tasks. Dashed arrows indicate the order in the single-language sessions, solid arrows indicate the order in the dual-language sessions

A picture naming trial started with a 50 ms beep sound, followed by a 250 ms pause.[4] Then, the image appeared on the screen for participants to name. After 2000 ms, the image disappeared and a new trial started. Accuracy and reaction times (RTs) were obtained from audio recordings (see Scoring), which were made on a separate recording device on the participant's end.

A lexical decision trial also started with a 50 ms beep and 250 ms pause, after which the item was played. Participants responded by pressing a key on their keyboard: For real words, they pressed a key labeled with a smiley face, and for pseudowords, a key with a frowny face. The smiley-face key was always on the side of their dominant hand, the frowny face on the side of their non-dominant hand. A new trial started after a keypress. Accuracy and RTs were recorded in ROLEG.

To increase children's engagement, the tasks were embedded in an overarching story, told through the instructional videos. There were two stories: In one story, an inventor was trying to fix a talking robot, and in the other, aliens were trying to speak with an astronaut who visited their planet. In the dual-language sessions, the robot or aliens would use a language (i.e., the target language) that

4. Exact timing differed depending on participants' computer and internet connection.

the inventor or astronaut did not know very well, so they needed the child's help. In the lexical decision blocks, the child checked if the robot or alien was speaking correctly in the target language, and in picture naming, they taught the robot or alien new target-language words. In the single-language sessions, all characters spoke the same language as the target language, so the child helped for other reasons (e.g., the inventor could not properly hear the robot, or the aliens were too shy to learn words from the astronaut). Which story was told in which session was counterbalanced between participants. The proficiency tasks and other background tasks were also embedded in the overarching story.

2.4 Scoring

While lexical decision accuracy and RTs were automatically recorded, the picture naming data were scored manually using audio recordings. Two (near-)native speakers of both Dutch and German transcribed children's responses and labeled the onset of the beeps (auditory markers of stimulus onset) and of the response in Praat (Boersma & Weenink, 2022). The time between beep onset and response onset was the RT. All data from the same participant was annotated by the same scorer. A subset (10% of participants) was annotated by both scorers. Inter-rater reliability was 0.85, indicating excellent agreement between the scorers (Hallgren, 2012).

Picture naming accuracy was based on the scorers' transcriptions, following a lenient scoring scheme and a strict scoring scheme. Lenient scores were used in accuracy analysis, strict scores for RT analysis. In the lenient scoring scheme, a response was correct if it contained the target word or a derived form such as a plural or diminutive.[5] Late responses, after the beep indicating the start of the next trial, were also correct. Cognates that were pronounced in the non-target language (e.g., *kangoeroe* /kɑn.χə.ru/ instead of *Känguru* /ˈkɛŋguʁu/) were coded as 'other'. In the strict scoring scheme, false starts and late responses were incorrect, as well as non-target language pronunciations of cognates.

5. For one Dutch cognate, the target word was changed post-hoc. Because the intended target word was produced much less often than a synonym, which was also a cognate, the synonym was scored as correct. Four Dutch and five German matched noncognates were swapped with fillers, because the pictures were unclear to most children. These changes did not affect matching between cognates and matched noncognates; see https://osf.io/9agup/.

2.5 Analysis

Accuracy scores and RTs of both tasks were analyzed separately, in mixed effects logistic regression models and linear mixed effects models, respectively, using the glmer and lmer functions from the lme4 package version 1.1–27.1 (Bates et al., 2015). We used the Anova function of the package car (Fox & Weisberg, 2019) to obtain *p*-values in the RT-models, using Type 2 conditional *F*-tests with Kenward-Roger approximation for degrees of freedom as implemented in the function. RTs were log-transformed, approaching a normal distribution (Baayen & Milin, 2010). Orthogonal sum-to-zero contrast coding was applied to the categorical predictors *Cognate Status* (noncognate vs. cognate) and *Language Context* (single-language vs. dual-language). Our dominance measure, *Other-Language Exposure*, reflected children's relative exposure to the non-target language: For children performing the tasks in Dutch, it reflected their percentage of current exposure to German; for children performing the tasks in German, it reflected their exposure to Dutch. This continuous predictor (from fully dominant in the target language to fully dominant in the other language) was mean-centered.

Prior to the main analyses, we ran preliminary analyses to test for differences in cognate processing between children who performed the task in Dutch and those who performed the task in German (for details, see Appendix: https://osf.io/9agup). If the preliminary analyses revealed no interactions between *Cognate Status* and *Target Language* (Dutch vs. German), they were pooled together for the main analyses. As the main aim of the present study was to examine cognate processing, effects of *Target Language* that did not involve *Cognate Status* were not considered directly relevant for our research questions or for the decision to pool the groups together. Such effects are discussed in the Appendix (https://osf.io/9agup).

In the main analyses, we tested for effects of *Cognate Status*, *Language Context*, *Other-Language Exposure*, and their interactions. The models also contained random intercepts for *Participant* and *Target Word*. Task-related covariates were added in a stepwise manner, namely *Trial Number*, *Previous Trial Accuracy*, and *Previous Trial logRT*. These variables were included to control for their potential influence on response outcomes as much as possible (see e.g., Lemhöfer et al., 2008). To avoid overfitting, however, only those covariates that significantly improved the model were included, as was established through Likelihood Ratio Tests using the anova function in the base package (R Core Team, 2020).

3. Results

3.1 Data exclusion

3.1.1 *Picture naming*

Because we did not receive audio recordings from all children, picture naming data were available for 55 of the 63 tested children. For accuracy analysis, data was excluded for children who responded in fewer than 50% of trials ($n=7$). For RT analysis, we first excluded responses that were faster than 1300 ms or slower than 2800 ms (25.5% of correct cognate and matched noncognate trials). The rate of exclusions may be higher than what is typically considered normal, in part due to the testing circumstances. We chose relatively strict limits based on visual inspection of the data, to counteract the noisiness of the raw data: Stimuli were presented online, with timing differences depending on participants' computer and internet connection, and the RTs were deduced from audio recordings made on different devices and under different circumstances. As such, responses that were visibly faster or slower than the majority were deemed more likely to reflect measurement errors. Next, participants with (lenient) accuracy below 70% of their given responses on cognates and matched noncognates were excluded from analysis ($n=2$), as well as items with mean (lenient) accuracy below 50% of given responses ($n=3$). Item exclusion did not affect the matching between cognates and noncognates ($ps>.05$). Next, all remaining trials that were incorrect under the strict scoring scheme were excluded. Finally, we calculated mean RTs per participant per testing session based on their remaining trials, and excluded responses above or below 2.5 SD of this participant mean (1.5%). Based on these data exclusion measures, data from 48 and 53 children was included in the picture naming accuracy and RT analyses, respectively.

3.1.2 *Lexical decision*

Lexical decision data were available for all 63 children. First, responses with RTs below 700 ms or above 2200 ms were excluded from both accuracy and RT analysis, again based on visual inspection of the data. This resulted in exclusion of 7.3% of all responses to cognates and matched noncognates and 6.4% of correct responses. Next, participants with accuracy scores below 80% on pseudowords were excluded ($n=2$), as this indicated that they had a bias for 'yes'-responses. All remaining participants had accuracy scores above 80% on cognates and matched noncognates. For RT analysis only, we excluded items with mean accuracy below 80% ($n=8$, four cognates), as well as all remaining incorrect trials. Item exclusion did not affect the matching between cognates and noncognates ($ps>.05$). Finally, for both accuracy analysis and RT analysis, we calculated mean RTs per participant per testing session based on their remaining trials, and excluded responses above or below 2.5 SD of this participant mean (1.4% for accuracy analysis; 1.4% for RT analysis). Based on these data exclusion measures, data from 61 children was included in both lexical decision analyses.

The results of the preliminary analyses, which revealed no significant interactions between *Cognate Status* and *Target Language*, can be found in the Appendix (https://osf.io/9agup).

3.2 Picture naming results

Descriptive picture naming results per condition per session, for children with higher and lower percentages of other-language exposure (based on a median split, for illustrative purposes), are presented in Table 4.

Table 4. Mean picture naming accuracy and reaction times (standard deviations between parentheses) per condition per session, for children with higher and lower percentages of other-language exposure

	Single-language session	Dual-language session	Single-language session	Dual-language session
	Accuracy		**Reaction times**	
Cognates	0.94 (0.24)	0.96 (0.19)	1859 (337)	1880 (325)
- Higher Other-Language Exposure	0.93 (0.26)	0.97 (0.18)	1897 (326)	1921 (315)
- Lower Other-Language Exposure	0.95 (0.22)	0.96 (0.21)	1822 (344)	1836 (329)
Noncognates	0.76 (0.43)	0.88 (0.33)	1916 (371)	1940 (347)
- Higher Other-Language Exposure	0.73 (0.44)	0.85 (0.35)	2004 (356)	1956 (322)
- Lower Other-Language Exposure	0.78 (0.42)	0.89 (0.31)	1847 (368)	1925 (368)

The best-fitting models are presented in Table 5. The accuracy analysis revealed a main effect of *Cognate Status*, with more accurate responses to cognates than to noncognates, and a main effect of *Language Context*, with more accurate responses in the dual-language context than in the single-language context. The RT analysis revealed main effects of *Cognate Status* and *Other-Language Exposure*, as well as interactions between *Other-Language Exposure*, *Cognate Status*, and *Language Context*. Children responded more quickly to cognates than to noncognates, and overall faster when they were more dominant in the target language. In the single-language session, the cognate facilitation effect increased with *Other-Language Exposure*; see Figure 3 (left). For example, among the children performing the task in Dutch, the more German-dominant children showed a larger cognate facilitation effect. In the dual-language session, this pattern was more or less reversed: The cognate facilitation effect decreased with *Other-Language Exposure*, that is, the cognate facilitation effect was stronger for more target-language-dominant children; see Figure 3 (right).

Table 5. Parameter estimates and significance tests of accuracy and reaction times in the picture naming task

	Accuracy				**Reaction times**				
					Parameter estimates		**Significance tests**		
Predictor	*B*	*SE*	*z*	*p*	*B*	*SE*	*F*	*df*	*p*
(Intercept)	2.858	0.194	14.701	<.001	7.512	0.018			
Cognate Status	1.713	0.294	5.829	<.001	−0.047	0.011	18.739	1,125.7	<.001
Other-Language Exposure	−1.187	0.719	−1.651	.099	0.195	0.081	5.503	1,52.5	.023
Language Context	0.653	0.276	2.365	.018	0.017	0.010	3.748	1,234.0	.054
Other-Language Exposure × Cognate Status	1.537	0.817	1.881	.060	−0.021	0.039	0.224	1,1864.0	.636
Cognate Status × Language Context	−0.583	0.552	−1.055	.291	0.012	0.020	0.373	1,186.7	.542
Other-Language Exposure × Language Context	0.386	0.812	0.476	.634	−0.119	0.040	6.957	1,1893.5	.008
Other-Language Exposure × Cognate Status × Language Context	2.395	1.624	1.475	.140	0.153	0.077	3.905	1,1854.9	.048
Trial Number					0.0004	0.0002	3.829	1,394.3	.051

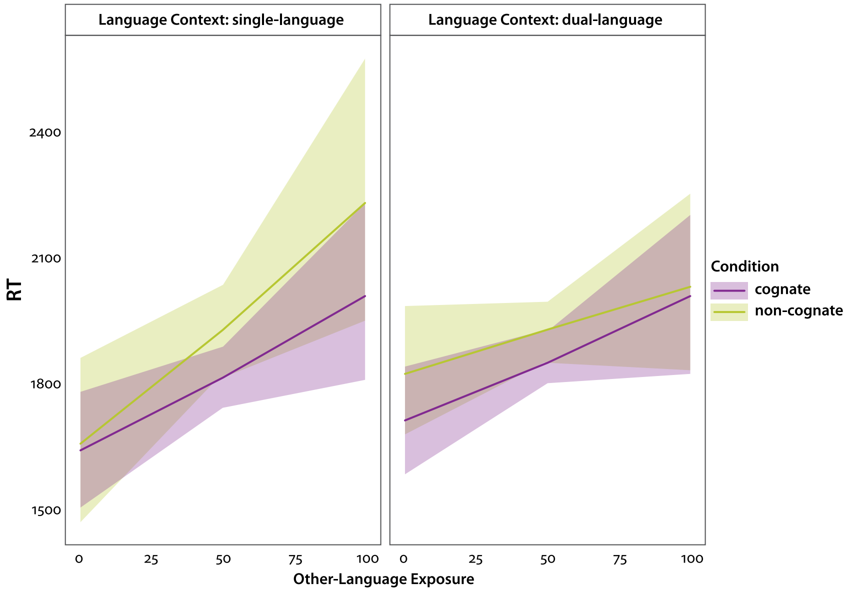

Figure 3. Interaction between Other-Language Exposure, Language Context, and Cognate Status

3.3 Lexical decision results

Descriptive lexical decision results per condition per session, for children with higher and lower percentages of other-language exposure (based on a median split, for illustrative purposes), are presented in Table 6.

The best-fitting models are presented in Table 7. The accuracy analysis revealed a main effect of *Other-Language Exposure*, where more target-language-dominant children responded correctly more often. The RT analysis revealed significant effects of *Cognate Status* and *Language Context*, and a significant interaction between *Other-Language Exposure* and *Language Context*. Children responded more quickly to cognates than to noncognates, and more quickly in the dual-language context than in the single-language context. As illustrated in Figure 4, *Other-Language Exposure* did not affect RTs in the single-language context, but in the dual-language context, children with more other-language exposure (i.e., less target-language-dominant children) responded more slowly than children with less other-language exposure (i.e., more target-language-dominant children).

Table 6. Mean lexical decision accuracy and reaction times (standard deviations between parentheses) per condition per session, for children with higher and lower percentages of other-language exposure

	Single-language session	Dual-language session	Single-language session	Dual-language session
	Accuracy		Reaction times	
Cognates	0.95 (0.22)	0.94 (0.24)	1254 (282)	1236 (299)
- Higher Other-Language Exposure	0.94 (0.24)	0.92 (0.27)	1254 (282)	1269 (303)
- Lower Other-Language Exposure	0.96 (0.20)	0.96 (0.20)	1253 (282)	1204 (291)
Noncognates	0.95 (0.22)	0.93 (0.26)	1299 (286)	1267 (291)
- Higher Other-Language Exposure	0.94 (0.24)	0.91 (0.29)	1285 (277)	1288 (286)
- Lower Other-Language Exposure	0.96 (0.19)	0.95 (0.22)	1314 (295)	1246 (295)

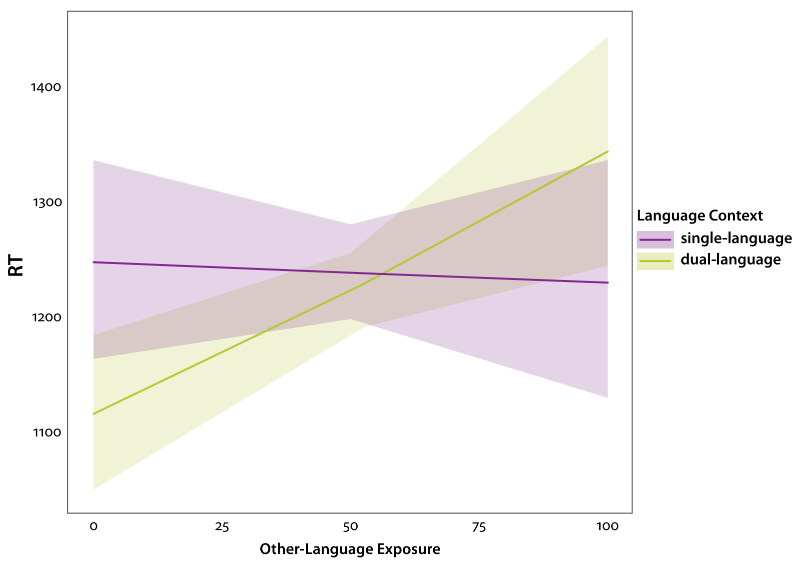

Figure 4. Interaction between Other-Language Exposure and Language Context

Table 7. Parameter estimates and significance tests of accuracy and reaction times in the lexical decision task

	Accuracy				Reaction times				
					Parameter estimates		Significance tests		
Predictor	*B*	*SE*	*z*	*p*	*B*	*SE*	*F*	*df*	*p*
(Intercept)	3.098	0.283	10.937	<.001	7.006	0.048			
Cognate Status	0.086	0.275	0.314	.754	−0.028	0.012	5.043	1,113.8	.027
Other-Language Exposure	−1.666	0.518	−3.218	.001	0.059	0.063	0.956	1,60.0	.332
Language Context	−0.354	0.226	−1.569	.117	−0.028	0.010	8.431	1,501.2	.004
Other-Language Exposure × Cognate Status	−0.215	0.688	−0.313	.754	0.052	0.032	2.719	1,3525.9	.099
Cognate Status × Language Context	0.126	0.449	0.280	.780	0.003	0.020	0.023	1,208.6	.880
Other-Language Exposure × Language Context	−0.571	0.705	−0.810	.418	0.175	0.032	29.317	1,3524.7	<.001
Other-Language Exposure × Cognate Status × Language Context	−0.109	1.408	−0.077	.938	0.052	0.064	0.657	1,3524.6	.418
Previous Trial logRT					0.020	0.006	10.670	1,3508.7	.001
Previous Trial Accuracy	0.490	0.237	2.068	.039	−0.028	0.013	4.506	1,3496.4	.034

4. Discussion

The aim of this study was to establish to what extent lexical cross-linguistic influence occurs in simultaneous bilingual children and is modulated by lexicon-internal and lexicon-external variation. Specifically, we investigated the effect of global language context, which is considered a lexicon-external effect, on cognate processing, in interaction with individual children's language dominance, which is assumed to lead to lexicon-internal variation in activation. Dutch-German simultaneous bilingual children, ranging from more Dutch-dominant to more German-dominant, performed cognate production (picture naming) and comprehension (auditory lexical decision) tasks in single-language and dual-language contexts. In the single-language context, all language use matched the target language of the cognate processing tasks, which was Dutch for half of the children and German for the other half. In the dual-language context, the other, non-target language was used in instructional videos, in communication between participant and experimenter, and in proficiency tests run in between blocks of the main tasks, so participants switched between their languages frequently between blocks and activities.

4.1 Cognate facilitation

Compared to noncognate control words, cognates were generally processed more accurately and more quickly in both production and comprehension, as predicted, which indicates that children were tapping into knowledge of both languages while performing the tasks. There was one exception: In the lexical decision task, accuracy did not differ significantly between cognates and noncognates. As scores were high (around 95%) for both cognates and noncognates, this suggests a ceiling effect (similar to findings by Schröter and Schroeder, 2016), where performance could not be further improved by any increased activation in the lexicon.

The cognate facilitation effects in all other outcomes are in line with many studies on bilingual adults (see e.g., Dijkstra & van Heuven, 2018, for a review) and with models such as BIA+ (Dijkstra & van Heuven, 2002) and Multilink (Dijkstra et al., 2019), which assume that cognates have shared semantic and sub-lexical representations and that activation resonates between representations. Importantly, our findings add to a growing body of evidence that, like adults, bilingual children have an integrated lexicon with language-nonselective access, in which words from both languages can become co-activated and influence each other's processing (Bosma et al., 2019; Bosma & Nota, 2020; Duñabeitia et al., 2016; Floccia et al., 2020; Jardak & Byers-Heinlein, 2019; Koutamanis et al., 2023a, 2023b; Poarch & van Hell, 2012; Schröter & Schroeder, 2016; Singh, 2014; Von Holzen & Mani, 2012). Moreover, as our study was conducted online, using a testing platform designed for linguistic experiments and using instructional videos embedded in an overarching story, our results show that cognate facilitation effects in bilingual children are robust and that they can be replicated under different circumstances. At the same time, cognate processing was influenced by language dominance and language context, which we discuss below.

4.2 Language dominance

Main effects of language dominance were found in both tasks. Specifically, the more exposure children had to the target language (and thus the less exposure to the other language), the more accurately (in lexical decision) or quickly (in picture naming) they responded. According to BIA+ (Dijkstra & van Heuven, 2002) and Multilink (Dijkstra et al., 2019), increased exposure leads to higher resting-level activation. As such, words from the more dominant language would be activated more quickly, leading to faster responses and fewer errors. In addition to increased activation, the dominance effects may also be (partly) explained through better representation. Exposure and lexical proficiency were moderately to strongly correlated in our sample (see Table 3), so children with more exposure were also more likely to have the target words well-represented in their lexicon, similarly leading to faster and more accurate responses.

In the picture naming task, dominance modulated the cognate facilitation effect in RTs in interaction with language context. In this section, we focus on the findings in the single-language context – the dual-language context is discussed in the next section. In the single-language context, a clear dominance effect emerged, in line with our predictions: The more dominant children were in the other language, the stronger the cognate facilitation effect in the target language. Similar patterns have been found in bilingual adults (e.g., Muntendam et al., 2022; van Hell & Dijkstra, 2002; van Hell & Tanner, 2012) as well as children (Bosma et al., 2019; Bosma & Nota, 2020; Poarch & van Hell, 2012; Singh, 2014): Cognate effects often emerge in participants' non-dominant language but not (or to a much lesser extent) in their dominant language. During non-dominant-language processing, dominant-language words are relatively easily co-activated and therefore have a strong influence. During dominant-language processing, however, the low resting-level activation of non-dominant language words leads to less co-activation and less influence, including weaker cognate facilitation effects.

Our results build on existing evidence that dominance affects lexical cross-linguistic influence in simultaneous bilingual children in similar ways as in bilingual adults. These findings are in line with predictions from models such as BIA+ (Dijkstra & van Heuven, 2002) and Multilink (Dijkstra et al., 2019). In addition to these lexicon-internal effects, our study also tested for lexicon-external effects of language context. We discuss our findings in the next section.

4.3 Language context

As predicted, language context and dominance interacted in their influence on the cognate facilitation effect, namely in the three-way interaction in picture naming RTs. The results in the dual-language context were different from Elston-Güttler et al. (2005): If children would not be 'zoomed in' on either language, both languages could influence each other and the resulting cognate facilitation effect would be unaffected by dominance. The results, however, revealed weaker cognate effects for children with more other-language exposure – the opposite pattern of the dominance effects discussed above. This effect may be explained as decision-level inhibition, in line with Dijkstra and van Heuven (2002) and Green and Abutalebi (2013), as well as literature on language switching (see e.g., Bobb & Wodniecka, 2013; Misra et al., 2012). Specifically, if these children had just performed a background task in their more dominant language, performing the picture naming task in their non-dominant language required inhibition of the dominant language in the Task/Decision subsystem. Previous studies have found that inhibition of a dominant language is particularly effortful and therefore often strong (e.g., Misra et al., 2012). Indeed, it appears that the more dominant the other language was for a child, the more strongly it was inhibited, resulting in a weaker influence and small or null cognate effects.

Interestingly, cognate effects were not necessarily stronger in the dual-language context. This is different from what we predicted based on e.g., Elston-Güttler et al. (2005) and Gross and Kaushanskaya (2020). Differences between studies may be partly explained by several methodological differences, such as stimulus type and manipulation of language context. For example, Paulmann et al. (2006) conducted a highly similar experiment to Elston-Güttler et al. (2005), but with words presented in isolation rather than in sentences, and found no language context effects. In addition, our findings highlight the importance of taking dominance into account. For children who were dominant in the target language, results resembled Elston-Güttler et al. (2005): Cognate effects were stronger in picture naming in the dual-language context than in the single-language context. For more balanced bilinguals, on the other hand, language context had less of an effect, more similar to Paulmann et al. (2006). Together, these findings suggest that bilingual word processing is indeed influenced by language context, but the extent to which cognate facilitation or other types of cross-linguistic influence are affected is modulated by both participant characteristics and task-related differences.

We also found effects of language context that did not involve cognate status. There were main effects where children responded more accurately (in picture naming) or quickly (in lexical decision) in the dual-language context. Dual-language contexts are typically more cognitively demanding (Green & Abutalebi, 2013), so this pattern was unexpected. A limitation of the present study was that we did not counterbalance the two types of language context: To avoid influence from the dual-language context on the single-language context, the first session was always the single-language session. In the dual-language session, then, children may have been more used to the specific tasks and types of materials than in the first session. In other words, the main effect of language context may have been an unintended learning effect.

In addition, there was an interaction effect between context and dominance in lexical decision RTs. Language exposure did not affect children's lexical decision RTs in the single-language context, but it did in the dual-language context: The more dominant children were in the other language, the more slowly they responded. This pattern provides further support for our explanation of the picture naming results in terms of decision-level inhibition, as it suggests that the dominant language was inhibited in order to perform the task in the non-dominant target language. Unlike in picture naming, this decision-level inhibition did not modulate the cognate effect, which may be the result of differences in task demands (see e.g., Koutamanis et al., 2023b).

A limitation of the present study was that a straightforward comparison of both tasks is complicated, because they differ on multiple dimensions. Future studies may further explore the effects of task demands on decision-level language inhibition in simultaneous bilingual children by directly comparing language processing in dual-language contexts in multiple production and comprehension tasks. Other potential limitations of the present study include the high SES backgrounds of the participants and the high degree of similarity with many cognates between the languages they spoke. We also did not look into children's cognitive control and/or (non-linguistic) switching abilities, for instance in relation to the type of language context they are exposed to at home. Future studies may aim to include children with more varied backgrounds, both on the level of SES and on the level of language distance, and look further into children's home environment and/or cognitive control.

4.4 Conclusion

This study revealed cognate effects in simultaneous bilingual children across a range of language dominance, in two tasks, with two outcome measures, in two contexts, in an online experiment. This underscores the robustness of cognate facilitation in bilingual children, similar to bilingual adults, and indicates that bilinguals have an integrated lexicon with language-nonselective access, which can lead to cross-linguistic influence, in principle under all circumstances.

This study is one of the first to include both language dominance and language context in a cognate processing study with simultaneous bilingual children. Our findings for dominance fit in with models like BIA+ (Dijkstra & van Heuven, 2002) and Multilink (Dijkstra et al., 2019): The more dominant a language, the more active it is in the lexicon, resulting in a greater influence, for example in cognate processing. Our manipulation of language context was largely based on Elston-Güttler et al. (2005; see also Paulmann et al., 2006), forming a bridge between more ecologically valid studies on language context in naturalistic interactions (Green & Abutalebi, 2013; Gross & Kaushanskaya, 2020) and more experimental, lab-based studies on stimulus list effects (Brenders et al., 2011; Poort & Rodd, 2017). Our results suggest that similar mechanisms may be at play in both global and local language context effects, including decision-level inhibition or cognitive control. Future studies may systematically compare single- and dual-language contexts on global and local levels to further examine the relationship between these different ways of operationalizing language context. Importantly, we found that effects of language context on cognate processing depend on children's language dominance and possibly on task demands, highlighting the complex interplay between lexicon-internal and lexicon-external factors on the extent to which cross-linguistic influence can be found in an integrated bilingual lexicon.

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Data availability statement

The full data sets and analysis scripts used can be found on this project's entry on the Open Science Framework (link: https://osf.io/9agup) under a CC-By Attribution 4.0 International license.

Competing interests declaration

Competing interests: The author(s) declare none.

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