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Cognate Facilitation in Child Third Language Learners in a Multilingual Setting

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Abstract: Research has established cognate facilitation effects as a robust finding in bilingual adults and children. Recent studies suggest that cognate facilitation also occurs in highly proficient trilingual adults and can even accumulate across languages. The evidence for multilingual children is scarce and inconclusive. This study examines whether and in which direction cognate effects arise in 35 ten-year-old unbalanced trilingual children, who, in addition to their L1 Italian, acquired L2 German and L3 English in a three-way immersion class in the multilingual region of South Tyrol in Italy. We manipulated cognate status, comparing naming accuracy and latencies in both the L1 and the L3 across double, triple, and non-cognates. The results reveal cognate facilitation effects in naming accuracy, but not in naming speed, for all cognate conditions relative to non-cognates. Furthermore, cognate facilitation was restricted to the L3, replicating previously attested asymmetric effects in unbalanced speakers. In sum, the results indicate that cognate facilitation may boost lexical learning in unbalanced trilingual children who acquire the L2 and the L3 in mainly instructed settings. We discuss these findings in relation to the potential role of language proximity, the L2 status factor, and implications for lexical learning in diverse multilingual environments.

Keywords: cognate facilitation; child trilingualism; L3 learning; multilingual immersion; language production; multilingual lexicon

Citation: Engemann, Helen, and Stefanie Radetzky. 2024. Cognate Facilitation in Child Third Language Learners in a Multilingual Setting. *Languages* 9: 310. https://doi.org/10.3390/languages9100310

Academic Editors: Margreet Vogelzang and Jeanine Treffers-Daller

Received: 27 July 2023
Revised: 4 July 2024
Accepted: 5 September 2024
Published: 27 September 2024

1. Introduction

Psycholinguistic research on bilingualism has consistently demonstrated that cross-linguistic interactions are pervasive across all levels of linguistic processing, ranging from phonology (e.g., von Holzen and Mani 2012) to syntax (e.g., Hartsuiker et al. 2004). Thus, it is widely acknowledged that bilingual speakers co-activate both of their languages in parallel, even in situations which only call for one of them (e.g., Blumenfeld and Marian 2007; Dijkstra and Van Heuven 2002; Thierry and Wu 2007). Such parallel co-activation can be driven or enhanced by cross-linguistic form similarity or overlap, as evidenced, for instance, by studies on the role of word order overlap in cross-linguistic syntactic priming (e.g., Bernolet et al. 2007; Hopp and Jackson 2023). At the lexical level, a wealth of studies using cognates (i.e., translation equivalents that share a phonological form, such as German *Haus* and English 'house') demonstrates that such lexical cross-linguistic similarity can facilitate bilinguals' linguistic performances across a range of different tasks, in both the receptive and the productive modality. Thus, when processing or producing cognate words, bilinguals exhibit faster and more accurate performance relative to control words that do not show form overlap. This robust phenomenon has been termed the *cognate facilitation effect* (van Hell and Dijkstra 2002) or *cognate advantage effect*. Cognate facilitation effects (henceforth, CFEs) have been reported in studies using lexical decision tasks (Dijkstra et al. 1999; Lemhöfer and Dijkstra 2004), picture naming (Costa et al. 2000; Hoshino and Kroll 2008; Strijkers et al. 2010), translation (de Groot and Poot 1997; Schelletter 2002), written production (Muylle et al. 2022; Woumans et al. 2021), sentence comprehension (Van Assche et al. 2011), and sentence reading tasks (Bosma and Nota 2020; Bultena et al. 2014).

CFEs have been interpreted as strong evidence for non-selective access and an integrated bilingual mental lexicon on the grounds that such differential effects of cognates relative to non-cognates would not be expected if bilinguals accessed representations of each language separately. Studying CFEs can thus provide insight into the organization of the bilingual mental lexicon and the nature of lexical processing in bilingual speakers.

Most studies on CFEs have been conducted with bilingual adults, although cognate facilitation is also attested in bilingual children (Bosma and Nota 2020; Brenders et al. 2011; Gastmann and Poarch 2022; Poarch and van Hell 2012; Quirk and Cohen 2022; Sheng et al. 2016). While some studies report less robust and more inconsistent CFEs in children than in adults (Kelley and Kohnert 2012; Potapova et al. 2016), the general consensus is that very similar patterns of cognate facilitation occur in bilingual children as in adults, although cognate sensitivity may develop with increasing age, given that effects are found to be stronger in older than in younger children (Bosma et al. 2019; Kelley and Kohnert 2012; Malabonga et al. 2008; Quirk and Cohen 2022). By contrast, it is still largely unknown whether and to what extent cognate facilitation also applies to multilingual children who are in the process of learning to negotiate more than two languages successively and who have neither balanced proficiency nor extensive naturalistic exposure to all three languages.

1.1. The Multilingual Lexicon

When acquiring lexical representations in a second (L2) or third (L3) language, children must map existing conceptual representations from their L1 onto new L2 and L3 forms. When forms are shared cross-linguistically as in cognates, this mapping process is facilitated and results in faster learning and more stable retention. This is evidenced by a range of studies demonstrating that cognate words are acquired earlier in contexts of naturalistic early bilingual acquisition (Bosch and Ramon-Casas 2014; Gampe et al. 2021; Mitchell et al. 2024) but are also easier to learn in instructed L2 contexts, in both children (Tonzar et al. 2009; Valente et al. 2018) and adults (Otwinowska and Szewczyk 2019; Rogers et al. 2015). The question remains as to whether the cognate advantage observed for bilingual lexical acquisition also extends to young multilingual learners, especially at early stages of the learning process.

Apart from age-related developmental factors (Kelley and Kohnert 2012; Malabonga et al. 2008), one reason as to why CFEs may not necessarily apply to emergent multilingual learners, i.e., at relatively early stages of the learning process, is the factor of proficiency, which has been shown to drastically modulate CFEs (Christoffels et al. 2006; Kroll et al. 2005; Otwinowska 2015). It has been claimed that a certain proficiency threshold may be required for co-activation to reach sufficient levels to affect processing in the other language (e.g., Poarch and van Hell 2012; van Hell and Dijkstra 2002) or at least for any subtle effects to be detectable (Szubko-Sitarek 2015; van Hell and Dijkstra 2002). In line with this argument, imbalances in proficiency and associated differences in activation levels have been taken as an explanation for frequently attested asymmetries in CFEs, which are usually either restricted to the weaker language or larger than in the dominant language (Costa et al. 2000; Rosselli et al. 2014; Stadthagen-González et al. 2013). In turn, CFEs have been reported to emerge in the dominant language only in speakers displaying relatively high proficiency in the non-dominant language or in balanced bilinguals with early childhood exposure to both languages (e.g., Costa et al. 2000; Hoshino and Kroll 2008; Poarch and van Hell 2012; Sheng et al. 2016).

The asymmetry of CFEs has been explained from an activation-based perspective by the fact that a dominant language is typically associated with higher overall activation levels. When processing or producing cognate words in a non-dominant language, the word candidate from the dominant language will therefore receive strong parallel co-activation. Consequently, in production tasks performed in the non-dominant language, this strong co-activation of the non-target competitor spreads to the phonological level, resulting in facilitated retrieval due to cross-linguistic phonological overlap. In turn, when performing the same task in the dominant language, parallel co-activation of the word candidate in the

weaker language will also occur up to the level of phonology, but it may not be sufficiently strong to have an observable facilitatory effect on lexical retrieval. According to this account, asymmetries in CFEs thus reflect asymmetries in speakers' relative language proficiency (e.g., Costa et al. 2000; Poarch and van Hell 2012) by virtue of 'a strong language spreading more activation to the weaker language than vice versa' (Poarch and van Hell 2014, p. 694).

An alternative explanation of cognate facilitation is the learning-based account (Costa et al. 2017), according to which the cognate advantage is an artifact of the process of learning cognates. Due to cross-linguistic form similarities between the L2 words and their L1 translation equivalents, they are learned faster and give rise to more robust lexical representations that are more conducive to lexical access, thus generating observable CFEs. The cognate advantage thus originally arises in the process of learning due to links learners establish between the L1 and the L2 based on cross-linguistic overlap, but once the cognate word has been learned, the advantage is crucially no longer dependent on co-activation of the L1 translation equivalent. In other words, CFEs under this account are not considered a result of on-line parallel co-activation but a remnant of learning, which results in qualitatively different lexical representations for cognates than for non-cognates. It is unclear whether the learning-based account would also hold for L3 lexical development, as mappings in the L3 learning process may not necessarily be established with the L1 but could also instead privilege the L2 as a basis (see more on the L2 status factor below). Given that L2 lexical representations tend to be weaker, the question arises as to whether L2–L3 mappings could lead to similarly robust lexical representations and associated facilitatory effects as L1–L2 mappings.

How are (cognate) words acquired in L3 contexts? The exact mechanisms of lexical L3 learning remain to be explained. In particular, it is, as of yet, unclear how the previously acquired L1 and L2 may interact in and guide this process (Puig-Mayenco et al. 2020) and what the role of cross-linguistic similarity (i.e., cognate status) between the three languages is. In this respect, three similarity-based models have been proposed to account for L3 word learning (for a recent review, see Otwinowska 2023). According to the *Parasitic Model* (Ecke 2015), newly acquired L3 cognate words are initially stored by establishing a 'parasitic' connection ('anchoring') between the new L3 word and a pre-existing 'host' (L1 or L2) lexical representation. This anchoring can be based on any type of cross-linguistic similarity between parasite and host (e.g., phonological, orthographic, semantic). Crucially, this mechanism would explain why cognates are acquired with greater ease because they benefit from co-activating already established L1/L2 host representations every time the L3 word is processed and are hence more likely to be stored in the mental lexicon. By extension, cognateness across all three languages should result in cumulative benefits, as triple cognates can be anchored to pre-existing lexical entries of multiple languages. Two further models were put forth by Bartolotti and Marian (2017). Their *Scaffolding Account* assumes that formal cross-linguistic similarity with already established lexical representations, whether in the L1 or the L2, is sufficient to establish a link with the new L3 word and results in facilitated learning. However, similarity shared by three languages does not necessarily lead to a greater learning advantage since cross-linguistic influence is assumed to occur on a single-sourced one-to-one basis. By contrast, under the *Accumulation Account* proposed by the same authors (Bartolotti and Marian 2017), cross-linguistic influence is predicted to affect the new L3 word operating from multiple previously acquired sources (both the L1 and the L2). Consequently, L3 learning benefits more from triple than from double cognate words because the former generate co-activation of similar forms across multiple representations (L1, L2, and L3) in the mental lexicon. Thus, cumulative benefits of cognateness shared between three (rather than two) languages would be expected according to both the Accumulation Account and the Parasitic Model, but not under a Scaffolding Account, according to which anchoring of the L3 word to just one existing lexical entry in any language will be sufficient to boost learning. This means that investigations comparing L3 children's processing of double vs. triple cognates

can be informative about models of L3 vocabulary learning and the facilitative role of cross-linguistic similarity.

In multilingual learning, there are a number of additional factors at play that may favor cross-linguistic interactions between the L2 and L3, especially if they have been acquired in similar settings (for instance, instructed classroom-based learning), a phenomenon which has been termed the *L2 status factor* (Bardel and Falk 2007; Williams and Hammarberg 1998) or the foreign language effect (Meisel 1983). Moreover, psycho-typological proximity (Kellerman 1983; Rothman 2011), that is, the degree of perceived cross-linguistic similarity is another factor that may encourage co-activation between languages (e.g., Cenoz 2001; Puig-Mayenco et al. 2020). There is some indication that the impact of language proximity may be more prominent in low-proficiency speakers (Bardel and Lindqvist 2007). This factor may therefore constitute a particularly relevant force at play in beginning learners. In addition, there is some emerging evidence that lexicon-external factors, such as the global language context (single-language vs. dual-language) characterizing the experimental setting (such as the language of communication used with the experimenter), also influence cognate processing in bilingual children (Koutamanis et al. 2023) and adults (Elston-Güttler et al. 2005) and that language context can interact with proficiency/dominance in their impact on CFEs. This was evidenced by the fact that in unbalanced bilingual children, CFEs in picture naming were found to be stronger in a dual- than in a single-language context, while for balanced bilingual children, the language context played less of a role (Koutamanis et al. 2023).

Multilingual learning allows us to address a number of hitherto unresolved questions in the realm of cognate processing. Specifically, can form and meaning overlap between the L2 and L3 also lead to facilitatory effects in children, or would facilitation require overlap with the dominant language? In this study, we aim to address this question by investigating CFEs in word production, using a picture-naming task in developing trilingual children (L1 Italian, L2 German, L3 English) who were growing up in the multilingual context of South Tyrol in Northern Italy and attended a three-way immersion program. We manipulate cognate status across the three languages to shed light on the conditions necessary for cognate facilitation to occur in this population. In what follows, we summarize the available research on CFEs in trilingual adults and children before providing an overview of the rationale and hypotheses pursued in this study.

1.2. Cognate Facilitation in Trilingual Adults

The few available studies investigating cognate facilitation in multilingual speakers (for a recent comprehensive review, see Otwinowska 2023) mainly focus on visual word recognition in trilingual adults. In one of the first studies on cognate effects in trilinguals (van Hell and Dijkstra 2002), Dutch–English–French trilingual adults with high proficiency in L2 English and variable L3 French proficiency levels performed a lexical decision and word association task, both exclusively in their L1 Dutch. To tease out effects of L2/L3 proficiency, the study compared two types of double cognates (Dutch–English vs. Dutch–French). Dutch–French cognates only yielded facilitation effects in those speakers with relatively high proficiency in their L3 French, while CFEs were obtained in the Dutch–English condition independently of French proficiency. These findings suggest that CFEs in trilingual speakers rely on a relatively high degree of L2/L3 proficiency to exert any effect on speakers' L1 processing.

To further explore the scope of cognate facilitation in (adult) trilingual processing, several subsequent studies compared the effects of double cognates (overlap spanning two of the languages) vs. triple cognates (overlapping in all three languages). In this vein, Lemhöfer et al. (2004) found that CFEs observed in a lexical decision task (carried out in the L3) accumulated across highly proficient Dutch–English–German trilinguals' languages, such that the effects generated were stronger for triple than for double cognates, regarding both the speed and accuracy of judgements. This indicates that parallel co-activation and non-selective access also apply to three languages in trilingual speakers. Moreover, the

results on double vs. triple cognate effects interestingly also suggest that interactions between two non-native languages can affect lexical processing, at least in the L3. Similarly, Szubko-Sitarek (2011) examined both double and triple cognates in a word recognition study testing Polish–English–German trilinguals. In contrast to Lemhöfer et al. (2004), their lexical decision task was administered in both the L3 and the L1. In the L3, both double and triple cognate conditions generated significant CFEs in reaction times and error rates, with triple cognates exerting significantly stronger effects than double cognates. When performing the task in the L1, however, only triple cognates resulted in enhanced speed and accuracy of recognition. These findings thus lend additional support to a cumulative benefit of triple cognates, in line with Lemhöfer et al. (2004), but also suggest that lexical processing in the L1 may either not be susceptible to parallel co-activation to the same extent as processing in a weaker language or may at least depend on sufficiently high proficiency in the L3, in line with the results reported by van Hell and Dijkstra (2002).

Cumulative CFEs were also observed for language production in a picture-naming task performed by three groups of trilingual adults (Poarch and van Hell 2014) with different proficiency and immersion profiles. The speed and accuracy of naming were compared across triple, double, and non-cognates in both the L2 and the L3. The results revealed that CFEs accumulated across all three languages, thus replicating results by Lemhöfer et al. (2004) and Szubko-Sitarek (2011) and extending the evidence for parallel co-activation to speech production. However, the additive cognate effect was not consistent across experiments but depended on whether picture naming was performed in speakers' L2 or L3 and their associated degree of proficiency and immersion. Of note, only the immersed trilingual group who had experienced sustained and regular exposure to both non-native languages (L2 English and L3 German) evinced cumulative CFEs in both L2 and L3 naming. Non-immersed trilinguals with an unbalanced L2/L3 proficiency profile, on the other hand, experienced CFEs in both of their non-dominant languages but showed no evidence of cumulative facilitation. Lastly, L3-immersed trilinguals with relatively weaker proficiency in the L2 demonstrated additive effects only when naming in the L2 (benefiting from the highly activated L3) but not in the L3. These findings are interpreted by the authors as support for activation-based accounts of CFEs, according to which only sufficiently strong activation levels in a language, associated with high proficiency/immersion, can yield measurable facilitatory effects when performing a task in another language. Further evidence for the important role of proficiency also comes from recent studies using translation paradigms in trilingual speakers of Polish, German, and English of advanced (Lijewska and Chmiel 2015) and advanced vs. intermediate (Lijewska and Błaszkowska 2021) proficiency. While advanced learners in both studies demonstrated CFEs in their translation latencies (RTs), but not in translation accuracy (likely due to ceiling effects), effects were only observed for translation accuracy but not for latencies in the intermediate learners (Lijewska and Błaszkowska 2021). This absence of detected latency effects is argued by the authors to be likely due to a high number of omissions and errors, decreasing statistical power.

Notwithstanding these earlier studies, there is some recent evidence suggesting that even modest levels of L3 proficiency can exert a detectable influence on a stronger L2 and result in CFEs, at least in the receptive modality. In a lexical decision task carried out by Zhu and Mok (2020) L1 Cantonese high-proficiency speakers of L2 English (acquired in childhood) who were beginning-to-intermediate level learners of L3 German (acquired in adulthood) showed faster and more accurate performance for German–English cognates in both their L2 and their L3 compared to non-cognate controls. The occurrence of cognate facilitation despite limited exposure to and proficiency in the L3 points to the possibility that trilingual lexical access may in some respects be reliant on different factors than bilingual processing mechanisms. Crucially, the L2 status factor and the perceived typological proximity may encourage co-activation of languages, even if their overall activation level based on proficiency should be low (see Zhu and Mok 2020, pp. 461–62). Importantly, cross-linguistic form-meaning overlap may interact with language status (native vs. non-native),

which may in turn give rise to different processing outcomes of cognates depending on which types of languages show overlap. This means that we cannot necessarily assume that the same language processing mechanisms established for bilinguals automatically also apply to trilingual processing (see, also, Lijewska 2022 for this argument). This possibility is underscored by several recent studies which have indicated qualitatively different patterns in bilingual vs. trilingual cognate processing (Lijewska 2022; Lijewska and Chmiel 2015; Szubko-Sitarek 2015; Zhu and Mok 2020).

1.3. Cognate Facilitation in Trilingual Children

In sum, while there is an emerging body of evidence for CFEs in adult trilinguals, cognate processing has so far not received much attention in contexts of child multilingualism. To the best of our knowledge, there are only two available studies to date investigating the cognate advantage in trilingual children. Poarch and van Hell (2012) conducted a picture-naming task with three groups of children aged between 5 and 8 years, including simultaneous bilinguals (English–German), early L2 learners and trilingual children. Children were tested in both German and English. In the child L2 learners, cognate facilitation was restricted to naming in the L2, whereas for both the simultaneous English–German bilinguals and trilinguals (simultaneous bilinguals who acquired either English or German as an L3 together with an additional unspecified L1/L2), CFEs also extended to their dominant L1. This goes to show, as the authors argue, that CFEs in children may be subject to the same requirement of balanced proficiency as previously demonstrated for adults. In the absence of sufficiently developed proficiency, CFEs will thus remain unidirectional with the stronger L1 affecting the non-dominant language but not vice versa. Nonetheless, since the second home language in the trilingual group was not controlled for and was not taken into account in the design of experimental items, the likelihood that the CFEs in the trilingual group were, to some extent, also influenced by co-activation patterns of the second home language cannot be excluded. The conclusions that can be drawn on this basis about cognate processing in trilingual child development therefore remain limited.

The only other available study on cognate facilitation in trilingual children, Muñoz (2020), used the English Peabody Picture Vocabulary Test (Dunn and Dunn 2007), a standardized receptive measure of vocabulary, to compare picture identification performance in early Catalan–Spanish bilingual children aged 7 and 9 years who learned English as a foreign L3 at school. The accuracy of identification (correct matching of auditory and visual stimulus) was compared across triple cognate items and non-cognate items in the test. The findings indicated that cognate items achieved a higher proportion of correct identifications than non-cognate test items, irrespective of age. Furthermore, this CFE was more pronounced in the older than in the younger age group, which the author attributed to age-related developments in children's metalinguistic abilities (Muñoz 2020, p. 159). Given that the results were based on a standardized lexical assessment test, cognates and non-cognates were not matched in difficulty level nor in terms of other stimuli characteristics that could impact recognition performance, such as word frequency and length, which could provide alternative explanations for the obtained effects. In sum, the available evidence on trilingual children suggests that cognate facilitation may indeed extend to children who acquire three languages, in both instructed and naturalistic settings. However, given that triple vs. double cognate effects have so far not been systematically examined in this population, it remains to be investigated whether cumulative effects also emerge in trilingual children.

1.4. This Study

This study aims to examine cognate facilitation in child trilingual learners in a classroom-based immersion setting using a picture-naming paradigm. The goal is to inform cognate processing in young multilingual speakers. While there is some evidence on proficient trilingual adults, much less is known about whether and to what degree CFEs also extend to unbalanced trilingual children exposed to a second and a third language in a

predominantly instructed setting. To investigate this question, we manipulated cognate status across different combinations of children's three languages (Italian L1, German L2, English L3), yielding four conditions: (i) triple cognates (words overlapping in form and meaning in Italian, German, and English), (ii) double L2–L3 cognates, (iii) double L1–L3 cognates, and (iv) a matched baseline non-cognate condition. This manipulation allowed us to test both for cumulative CFEs by comparing naming performance in triple vs. double cognates and, for the role of language status, by comparing the effects of the two double cognate conditions (ii) and (iii), one of which involved the two non-native languages, while the other one combined the children's L1 and L3. Furthermore, to broaden the evidence base for the widely attested asymmetry of CFEs in unbalanced speakers, this current study also tested the directionality of CFEs by administering the naming task with each child in two separate sessions, once in their dominant language (L1 Italian) and once in their weaker language (L3 English).

We entertained several hypotheses regarding the directionality of CFEs and the influence of cognate status. Regarding directionality, in line with previous research on unbalanced bilinguals, we expected that CFEs should be obtained mainly in the weaker language (English session) but not necessarily when naming in the L1 (Italian session), where only attenuated (if any) effects were expected. Based on previous research reporting additive facilitation generated by triple overlap, we also predicted that any CFEs occurring in the L1 would be limited to the triple cognate condition, on the grounds that this condition could potentially leverage higher activation levels arising from three languages. Regarding the impact of cognate status, our predictions were as follows. First, cognate words should result in facilitation, such that they are named with higher accuracy and shorter latencies when compared to non-cognate controls. Second, based on previous research on trilingual adults, we expected that CFEs would also accumulate across the three languages, hence resulting in stronger facilitation in naming triple vs. double cognates. Third, the two double cognate conditions should yield different outcomes in terms of the relative strength of effects, depending on theoretical assumptions. According to an activation-based account, we would expect double Italian–English cognates to give rise to stronger CFEs compared to German–English cognates because of the involvement of the stronger L1. This outcome would also yield evidence for both the Parasitic and the Accumulation Account since both would predict cumulative CFEs. Alternatively, if the L2 status factor and/or typological proximity play a role, it is possible that the German–English double cognate condition results in enhanced cross-linguistic activation, which in turn could boost CFEs and hence potentially give rise to similar or even superior effects relative to Italian–English cognates.

2. Materials and Methods

2.1. Participants

Fifty-seven fifth graders between the ages of nine and eleven were recruited from an elementary school in Bolzano, located in the trilingual (German, Italian, Ladin) province of South Tyrol in Northern Italy. Despite the official status of both German and Italian in this region, it must be noted that individual levels of language contact and bilingualism (understood here as the regular use of two languages) tend to be low (Vettori et al. 2021) and vary starkly between the urban areas of Bolzano and Merano, where the majority (73%) of L1-Italian speakers reside, and rural municipalities, mainly populated by L1-German speakers (ASTAT 2012). For historical and socio-political reasons, the province's social and educational policies have promoted a division of society into distinct language groups. This division of language communities remains a prominent aspect of everyday life in South Tyrol, such that 'socialisation and daily life take place mainly within one language group' (Vettori et al. 2021, p. 237). For Italian speakers, this divide is exacerbated by the fact that the South Tyrolean variety spoken by the local community differs distinctively from standard German taught at school. The division is further reflected in the local school system, which is strictly segregated according to the language of instruction, with L1-German-speaking pupils attending different schools than L1-Italian-speaking pupils, thus affording few op-

portunities for social contact and naturalistic language practice. Within the Italian schools, there have been initiatives for bilingual and multilingual educational programs, which have, however, not been widely implemented due to the regional authorities' opposition to and deep-rooted skepticism towards institutionalized multilingual education (Hofer 2015). The sample in this study originates from an Italian school which runs a multilingual CLIL (Content and Language Integrated Learning) immersion class, in which pupils receive increased tuition delivered in both German and English. Thus, the children in the present sample were raised mainly with L1 Italian at home and are, in addition, regularly exposed to Italian, German, and English at school. Due to the status and presence of German in the province, children can be expected to also receive some degree of exposure to German in everyday life, although this will vary considerably according to individual levels of personal contact with the German-speaking community.

From our initial sample (N = 57), 12 children were excluded because their first language did not match the language profile under investigation (L1 Italian, L2 German, L3 English). Ten further participants were excluded from the analysis due to technical problems (n = 2), missing linguistic background information (n = 5), or because of reported atypical language development or learning difficulties (n = 3). The remaining 35 children (17 girls and 18 boys, M_{age} = 10;5.3, SD = 0.3) had received formal instruction in German as well as English since their first grade (i.e., for approximately four years at the time of the study). At the time of the experiment, all participants attended six hours of German language classes each week in addition to four hours of mathematics, science, and geography classes taught in German, amounting to a total weekly exposure to German of ten hours. Regarding English, the participants received one hour of English language instruction per week, in addition to four hours of lessons in various subjects taught in English, totaling five hours of weekly exposure.

Parents or guardians of all participating children provided written informed consent. To assess children's language background, the Italian version of the Language Experience and Proficiency Questionnaire (LEAP-Q: Marian et al. 2007) was administered, including exposure to and proficiency in the three languages investigated. Table 1 shows that parents rated their children's reading, understanding, and speaking abilities in their L1 Italian (based on a 11-point Likert scale) on average as 'very good' to 'excellent'. Parental estimates of children's respective L2 and L3 exposure and language use indicated that participants spoke more German than English both at home and at school (see Table 2). Language exposure at school was also reported to be higher for German compared to English, in line with the information provided by teachers. Furthermore, participants seemed to be more frequently exposed to German outside of school, as would be expected given the regional status of German. For both languages, use and exposure were on average never higher than 19% of the total time (see Table 2). To obtain a standardized measure of participants' proficiency in their L2 German and L3 English, the Test for Reception of Grammar (TROG) was administered in their standardized versions for English (TROG-2: Bishop 2003) and German (TROG-D: Fox-Boyer 2020). Participants' proficiency scores in German and English (reported in Table 1) were near-equivalent and did not significantly differ from one another, as indicated by a paired-samples t-test ($t(34) = 0.00$, $p = 1.0$).

Table 1. Participant characteristics: age, gender and language proficiency.

Characteristic	N	Mean (SD)	Range	Maximum Possible Score
Male/female	18/17	-	-	-
Age in years; months	35	10;5.30 (0.30)	9;11–11;0	-
Self-rated proficiency				
L1				
Speaking	35	8.43 (1.25)	5.00–10.00	10.00
Understanding	35	8.80 (1.10)	7.00–10.00	10.00
Reading	35	8.20 (1.13)	6.00–10.00	10.00
TROG-2 (EN)				
Total blocks passed	35	6.20 (2.86)	3.00–15.00	20
Standard score	35	58.89 (8.69)	55.00–92.00	116
TROG-D (GER)				
Total blocks passed	35	6.63 (2.83)	1.00–14.00	20
Standard score	35	58.89 (8.69)	55.00–88.00	116

Note. German T-values[1] were transformed to the range/scale of English Standard Scores following Poarch and van Hell (2012, p. 423) using the following formula: Standard Score = {[(T-value − T-value$_{mean}$)/T-value$_{SD}$] * Standard Score$_{SD}$} + Standard Score$_{mean}$.

Table 2. Parental estimates of participants' language exposure and use in L2 (German)/L3 (English).

Characteristic	N	Mean (SD)	Range	Maximum Possible Score
Speaking				
German	35	0.11 (0.06)	0.02–0.40	1
English	35	0.07 (0.04)	0.01–0.20	1
Hearing				
German	35	0.13 (0.09)	0.00–0.40	1
English	35	0.11 (0.06)	0.01–0.80	1
School Speaking				
German	35	0.16 (0.11)	0.01–0.40	1
English	35	0.10 (0.05)	0.02–0.20	1
School Hearing				
German	35	0.19 (0.09)	0.02–0.40	1
English	35	0.11 (0.05)	0.03–0.20	1

Note. Estimates for means, range, and maximum possible score represent percentages of language exposure/use. A score of 1 indicates that the language is used 100% of the time.

2.2. Materials

Previous research has established picture naming as a valid paradigm to investigate CFEs in children (Poarch and van Hell 2012; Sheng et al. 2016). Different criteria can be used to determine cognate status (for an overview, see Potapova et al. 2016). For the purpose of this study, words from different languages were considered cognates if, in addition to semantic overlap, they shared (i) at least three phonemes (following Pérez et al. 2010; Muñoz 2020) or (ii) two phonemes, one of which was word-initial, in line with research suggesting that word-initial phonemes are more salient for similarity perception (Walley et al. 1986; Schramm et al. 2020). The latter category consisted mainly of short words of two or fewer syllables (e.g., *Buch*/'book').

Given the focus of this current study on trilingual learning and the role of language status, we established cognate categories across different combinations of the three languages: triple cognates (Italian–German–English), German–English double cognates, Italian–English double cognates, and non-cognates. Triple cognates shared similar phonological and semantic representations across all three languages (e.g., *Karotte*/'carrot'/*carota*). Double cognates overlapped semantically and phonologically across either German and English (e.g., *Haus*/'house') or Italian and English (e.g., *penna*/'pen'). Additionally, non-cognates, showing neither phonological nor semantic overlap, served as a baseline control category. A total of 64 target words were determined, comprising 16 items for each of the 4 cognate categories. Corresponding pictures representing the target words were selected

from the International Picture Naming Project (IPNP) database (Szekely et al. 2004), consisting of black-on-white line drawings representing everyday objects. Target words were matched on word frequency, word length (operationalized as number of syllables) and name agreement, based on values reported in the IPNP database. Word lemma frequencies from the IPNP were taken from the CELEX Lexical Database (Baayen et al. 1995) and were transformed into natural log-values. The corpus contained a mixture of written texts (such as newspapers, fiction, and non-fiction books) and transcribed speech (e.g., video subtitles). Table 3 shows that there was no significant difference ($p \geq 0.1$) in frequency, word length, and name agreement between items of each experimental category within each of the three languages, except for German. However, since word frequencies for German triples were lower than for double cognates, which in turn were lower than for non-cognates, these differences run counter to expected effects. Similarly, word length in German items was highest in triple cognates, which once again, run counter to the expected effects. Similarly, although visual complexity (for reported values, refer to Szekely et al. 2004) was found to be significantly higher in triple cognates ($p \leq 0.1$) relative to other conditions, this difference was not considered problematic as it runs counter to expected effects (i.e., higher visual complexity should lead to slower processing, whereas triples were expected to lead to facilitated processing). To further take into account and control for unintended differences between conditions, we also ran additional follow-up analyses on our statistical models (see Section 3). In these models, we included each of the above factors as control variables, in addition to length-corrected Levenshtein distance to control for any differences in between-language orthographic overlap.

Table 3. Analysis of variance comparing the means of stimuli between experimental conditions regarding word frequency, word length, name agreement, and visual complexity.

Variables	English				German				Italian			
	Triple	Double Ger-Eng	Double Ita-Eng	Non-Cognates	Triple	Double Ger-Eng	Double Ita-Eng	Non-Cognates	Triple	Double Ger-Eng	Double Ita-Eng	Non-Cognates
Frequency	2.65	3.64	3.30	3.42	2.00	3.00	2.46	3.07	1.12	2.19	2.01	2.07
		$F(3, 60) = 1.51$, $p = 0.222$				$F(3, 60) = 2.24$, $p = 0.092$				$F(3, 60) = 1.60$, $p = 0.199$		
Word length (syllables)	1.88	1.50	1.81	1.50	2.06	1.56	1.88	1.56	2.63	2.44	2.88	2.69
		$F(3, 60) = 1.59$, $p = 0.201$				$H(3) = 7.60$, $p = 0.055$ [b]				$F(3, 60) = 1.16$, $p = 0.331$		
Name agreement [a]	0.26	0.34	0.37	0.50	0.61	0.40	0.84	0.40	0.78	0.48	0.57	0.48
		$H(3) = 2.15$, $p = 0.542$ [b]				$H(3) = 4.66$, $p = 0.198$ [b]				$F(3, 60) = 1.01$, $p = 0.393$		
Visual complexity	26,836.38	14,073.00	13,846.63	13,458.94	26,836.38	14,073.00	13,846.63	13,458.94	26,836.38	14,073.00	13,846.63	13,458.94
		$H(3) = 8.34$, $p = 0.039$ *,[b]				$H(3) = 8.34$, $p = 0.039$ *,[b]				$H(3) = 8.34$, $p = 0.039$ *,[b]		

Note. See Bates et al. (2003) for additional information on the calculation of visual complexity. [a] Lower scores indicate higher levels of name agreement. [b] The data were not normally distributed, and a Kruskal–Wallis Test was performed. * $p < 0.05$.

A one-way ANOVA confirmed that the number of shared phonemes was significantly higher in the three cognate categories compared to the non-cognates ($F(3, 60) = 11.38$, $p < 0.001$). The final set of stimuli seen by each participant (within-subjects design) comprised 100 items (see Table A1 in Appendix A for a list of all experimental items)—64 target items, in addition to 32 non-cognate fillers, and 4 practice items, resulting in equal numbers (=48) of cognate vs. non-cognate items (fillers + baseline items). The experiment was divided into four experimental 24-trial blocks, each consisting of 16 targets and 8 fillers.

2.3. Procedure

Naming task: The experiment was programmed using E-Prime 3.0 (Psychology Software Tools 2016) and was presented on a Lenovo Think Pad laptop with a 15-inch display. Children were tested individually by a trained research assistant in a quiet room at their school during school hours. Each participant completed the experiment in two separate sessions with an interval of one to two weeks between sessions to minimize practice effects. Each session included the picture-naming task in either English or Italian,

followed by one version (German or English) of the TROG test. Half of the children performed the first session in Italian and the other half in English. The order of sessions was counterbalanced across participants to avoid order and priming effects. Each child was instructed to name the objects in the pictures displayed on the screen as fast and as accurately as possible. A microphone was connected to a Chronos response box (Psychology Software Tools 2016), which recorded reaction times and responses.

Each trial was initiated by a fixation cross displayed for 1000 ms at the center of a blank screen, followed by a stimulus picture and an auditory cue. Participants were expected to name the target item within 5000 ms after its appearance. As soon as either the time elapsed or Chronos registered a response, E-Prime automatically moved on to the next trial. Each session was preceded by a block of four practice items to familiarize participants with the task, after which the children had the opportunity to ask questions and receive additional instructions if necessary. Subsequently, participants performed the four experimental 24-trial blocks (96 items in total) in randomized order. The trials within each block were pseudorandomized, such that each block started with two filler items, and no more than two items of the same cognate condition appeared in a row. Between blocks, there was a short break of up to two minutes.

TROG tests: Participants subsequently proceeded with the TROG tests in English and German, one after each session, following the standardized procedure laid out in the respective manuals (Bishop 2003; Fox-Boyer 2020). The tests were used to obtain an independent measure of the children's receptive proficiency in their L2 and L3. Raw scores were calculated and transformed into standard scores (TROG-2) and T-values (TROG-D). German T-values were subsequently transferred to the scale of English standard scores to facilitate the comparison of German and English language proficiency (see Table 1). Each full session (including naming task and proficiency test) lasted approximately 30 min. The children received a small gift after completion of both sessions to thank them for their participation.

2.4. Coding

To assess accuracy, responses were assigned to one of three categories: (1) accurate, (2) omission, (3) inaccurate/other. A response was labeled 'accurate' if it matched the target word form for the respective item. Responses that were accompanied by a determiner (e.g., articles) or contained modifying elements (e.g., compound nouns such as 'shopping bag' instead of 'bag') were considered 'accurate' if they contained the target word and hence maintained the relevant cognate status. If no response was given for an item within the allotted time frame (5000 ms), it was scored as 'omission'. All other cases were categorized as 'inaccurate/other'. This included responses that matched the image displayed but did not correspond to the expected target word and therefore altered the item's cognate status. This category comprised hypernyms (e.g., 'flower' instead of 'rose'), different terms in American and British English (e.g., 'pants' instead of 'trousers'), brand names (e.g., 'Oreo' instead of 'biscuit'), and synonyms (e.g., 'light' instead of 'lamp'). Furthermore, it also included switches into a non-target language.

3. Results

3.1. Accuracy

To address the question of whether cognate status predicted the likelihood of accurate responses (note that only responses matching the target word were considered accurate, see Section 2.4), we ran ANOVA tests on two generalized linear mixed-effects regression models using the ANOVA and glmer function of the lme4 package (Bates et al. 2015) in R version 4.0.0 (R Core Team 2022). For the dependent variable, the categories 'omission' and 'inaccurate/other' were combined in order to obtain a binomial dependent variable ('accurate' = 1 and 'not accurate' = 0). A separate model was run for each language session with cognate status as the fixed effect predictor (four levels: triple cognates, double English–German cognates, double Italian–English cognates, and baseline non-cognates). Random

effects were included for items (i.e., the target picture named) and participants. No random slopes were specified due to convergence failure. For the mixed-model ANOVA tables, *p*-values were calculated with Wald Chi-square tests. In the case of significant effects ($p < 0.05$), pairwise post hoc comparisons were subsequently conducted with Tukey's method of adjusting *p*-values for multiple comparisons using the emmeans function of the emmeans package.

The overall accuracy rate in the Italian session was 94.6% (2091 responses), while in the English session, it amounted to only 56.2% (1128 responses). Moreover, there was a high rate of omissions (non-responses, as defined above) in English (27.8%, 608 occurrences) compared to Italian (0.4%, 9 occurrences). Figure 1 shows that accuracy rates in the Italian session were close to the ceiling across all cognate conditions, including matched non-cognates. By contrast, in the English session, there were marked differences across conditions. The highest rate of accurate responses was achieved for triple cognates, followed by double German–English cognates and double Italian–English cognates, with the lowest rate obtained for non-cognates.

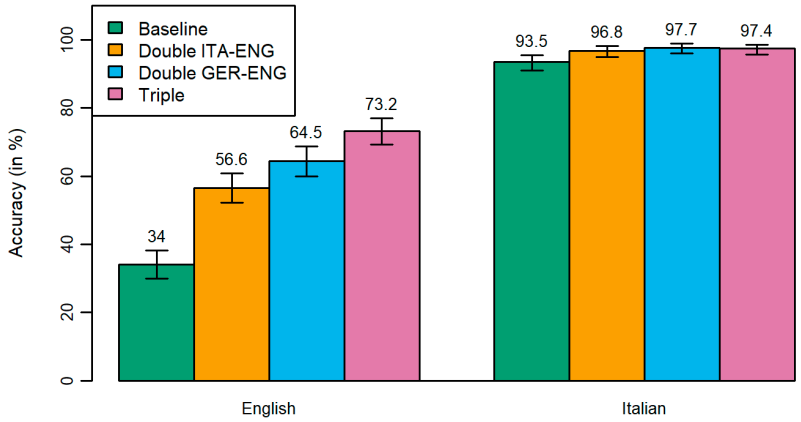

Figure 1. Accuracy rates (in %) per language session as a function of cognate status.

The generalized mixed-effects model described above was run on a total of 2174[2] responses within the Italian session and revealed that cognate status did not significantly affect accuracy rates ($\chi^2(3, N = 2174) = 4.51$, $p = 0.21$) when children performed the task in the L1. By contrast, in the L3, the model analysis (conducted on 2149 responses) yielded a main effect of cognate status ($\chi^2(3, N = 2149) = 21.44$, $p < 0.001$). Post hoc comparisons (reported in Table 4) showed that significantly more accurate responses were produced in all three cognate conditions relative to non-cognates.[3] Although effect sizes (see estimates in Table 4) were largest for the contrast baseline vs. triples, followed by the contrasts involving the two double cognate conditions, these did not translate into significant differences in the comparisons between any of the individual cognate conditions. Thus, neither the contrast between the two double conditions (Italian–English vs. German–English) nor between the triple cognates and each of the respective double cognate conditions turned out to be significant. In other words, although there is a numerical trend supporting additive effects going in the expected direction, the facilitation effects obtained for triples cannot be claimed to be significantly stronger than for double cognates.[4]

It is noteworthy that the double English–German cognate condition involving the children's two non-native languages gave rise to a similar magnitude of cognate facilitation (as gauged by the effect sizes) as the other two cognate conditions which involved their native Italian, including the triple condition. This would not be expected under an activation-based account, which explains CFEs in unbalanced speakers as a result of stronger activation spreading from the dominant L1. We will return to this point and explore potential explanations for the obtained effects in this condition in the discussion.

Given the difficulties of matching items across conditions in all three languages (see Section 2.2), we additionally ran follow-up analyses on the data of the English session.

These analyses included the control variables frequency, word length, name agreement and visual complexity, as well as length-corrected Levenshtein distance, which were individually included in the above generalized mixed-effects model to rule out the possibility that differences along these critical dimensions explained our results. None of the control variables was found to significantly affect children's accuracy rates (frequency: $\chi^2(1, N = 2174) = 3.34$, $p = 0.068$; word length: $\chi^2(1, N = 2174) = 0.76$, $p = 0.383$; name agreement: $\chi^2(1, N = 2174) = 1.88$, $p = 0.17$; visual complexity: $\chi^2(1, N = 2174) = 1.8$, $p = 0.18$; Levenshtein distance: $\chi^2(1, N = 2174) = 0.06$, $p = 0.805$), whereas the effect of cognate status remained highly significant in all models ($p < 0.001$) as in the original model without the control variables.

Table 4. Pairwise comparisons between cognate conditions for accuracy, English session.

Contrast	Estimate	SE	Z	*p*-Value
Baseline—Double ITA-ENG	−1.43	0.555	−2.577	0.049 *
Baseline—Double GER-ENG	−1.984	0.559	−3.549	0.002 **
Baseline—Triple	−2.441	0.56	−4.358	<0.001 ***
Double ITA-ENG—Double GER-ENG	−0.554	0.553	−1.002	0.748
Double ITA-ENG—Triple	−1.011	0.553	−1.827	0.261
Double GER-ENG—Triple	−0.456	0.557	−0.82	0.845

Note. Results are given on the log odds ratio (not the response) scale. Results are obtained using the emmeans function with Tukey *p*-value adjustment. *** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$.

3.2. Reaction Times

The dependent variable of naming latency/reaction time was measured as the time (in ms) between the appearance of a target image on the screen and the point at which the voice key of the Chronos response box was triggered when children named the corresponding object. Technical voice-key failures and children's omissions were excluded from the analysis along with all inaccurate responses. Only accurate responses were considered for the reaction time analysis because only responses matching the target cognate words can be expected to result in cross-linguistic co-activation. From the remaining accurate responses, we further removed all responses registered below 200 ms or which were above 3 *SD*s from the participant's mean as outliers, resulting in a removal of an additional 84 observations (2.8% of all data). The analyses reported below were conducted on a remaining total of 1998 accurate responses in the Italian session and 968 accurate responses in the English session.[5]

Overall, reaction times averaged across all conditions were shorter and showed less variability in Italian (Mdn_{RT} = 1069 ms, *IQR* = 382) than in English (Mdn_{RT} = 1458 ms, *IQR* = 769). The boxplot in Figure 2 illustrates the distribution of reaction time scores across experimental conditions for both sessions. Visual inspection suggests that naming latencies were very similar across all conditions, in Italian as well as in English, with the exception of double German–English cognates, which yielded slightly shorter reaction times in the English session. However, this difference did not turn out to be statistically significant, as the subsequent model analyses indicated. Two linear mixed-effects regression models (as the outcome variable was continuous), using the lmer function of the lme4 package (Bates et al. 2015) were fitted, one for each language session, with the same fixed and random effects structure as for the accuracy model (see above) and with log-transformed reaction times (to improve normality of the distribution) as the outcome variable. Neither model yielded any significant effect of cognate status on RTs, neither in English ($\chi^2(3, N = 968) = 7.51$, $p = 0.06$) nor in Italian ($\chi^2(3, N = 1998) = 5.54$, $p = 0.14$). Thus, we could not detect an effect of cognate status on the children's speed of picture naming in our models, neither when producing words in their L3 English nor in their native Italian.

Automatic voice onset measurements have been demonstrated to lack reliability, particularly with child participants and for onsets such as fricatives (Rastle and Davis 2002), which can generate noise in the data, as pointed out by an anonymous reviewer. We therefore ran a post hoc analysis in which the factor of 'Onset Type' (plosives vs. fricatives vs. all other onsets) was included as a control variable in our above models, in addition

to cognate status. The results of this analysis did not reveal any significant effect of Onset Type on children's naming latencies, neither in the English ($\chi^2(2, N = 968) = 3.33$, $p = 0.189$) nor in the Italian session ($\chi^2(3, N = 1998) = 2.82$, $p = 0.244$), and this indicated that the pattern of results remained the same. Thus, cognate status remained non-significant after the inclusion of Onset Type ($p > 0.05$), indicating that this latter factor likely did not affect the results (but see Section 4.5).

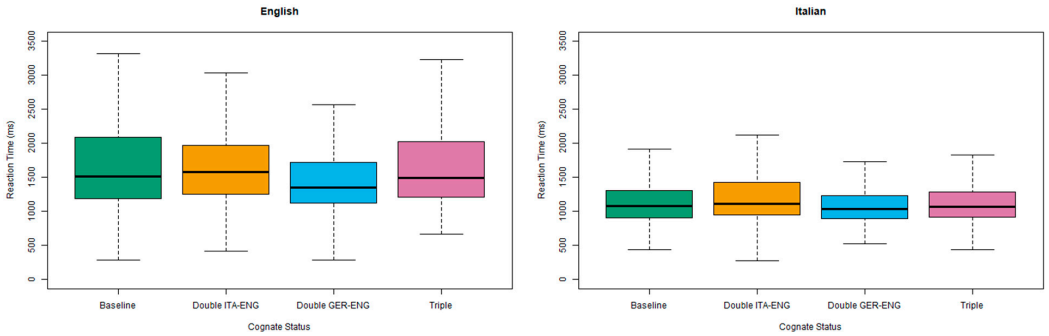

Figure 2. Distribution of (untransformed) reaction time data (in ms) across cognate conditions in English L3 and Italian L1 (showing medians and interquartile ranges).

3.3. Omission Rates and Word Type

Omission rates: To better understand the unexpected finding that CFEs emerged for naming accuracy, whilst no evidence for a significant effect could be detected for reaction times, a follow-up analysis was considered necessary. To provide more robust evidence for the presence of cognate facilitation, we ran another mixed-effects model (glmer) for the English session, with the same structure as reported above for accuracy, but this time with the binomial outcome variable of 'omission' (0 vs. 1). The rationale of this follow-up analysis was that omissions may signal failures in lexical retrieval. Thus, if cognates indeed aid children's lexical retrieval process when naming in their L3, the cognate conditions should not only give rise to more accurate responses but also to a lower rate of response omissions as compared to matched controls, even in the absence of a boost in retrieval speed. Descriptively, omission rates mirrored the pattern of accuracy rates obtained for English. Out of the total of 608 omissions, the majority (45.1%) occurred in response to non-cognates (=248 occurrences), 27.8% to double Italian–English cognates (=151 occurrences), 25% to double German–English cognates (=136 occurrences), while only 13.3% occurred in response to triple cognates (=73 occurrences).

The model analysis revealed a significant effect of cognate status ($\chi^2(3, N = 2185) = 29.24$, $p < 0.001$) on the probability of omissions. Post hoc analyses, reported in Table 5, yielded a similar pattern as the one obtained for accuracy. Thus, all cognate conditions resulted in significantly fewer omissions compared to non-cognates. Moreover, similarly as for accuracy, there were no significant differences between the individual cognate conditions. Thus, while the presence of any cognate type resulted in significantly lower omission rates, triple cognates did not show a significant advantage over double cognates, nor did the two double cognate conditions differ from each other with respect to omission rates. This indicates that cognate items gave rise not only to more accurate responses but also to more responses generally than non-cognates when naming in the L3. This similar pattern of results for both variables thus supports the evidence that cognates indeed exerted a facilitative effect on word naming, at least as far as the off-line measures of response accuracy and omission rate are concerned.

Word Type: A second follow-up analysis was conducted to rule out potential effects of (near-)identical cognates in our item list. Recent research on the effects of stimuli list composition suggests that CFEs can increase as a function of the degree of cross-linguistic form overlap (e.g., Vanlangendonck et al. 2020). In particular, identical cognates (words that share a complete orthographic overlap) have been found to drive CFEs in word recognition

experiments. Some lexical decision studies report that CFEs are drastically reduced or even disappear once identical cognates are removed from or reduced in the stimuli list (e.g., Arana et al. 2022; Comesaña et al. 2015; Dijkstra et al. 2010). To assess whether word type similarly predicted children's response accuracy in the current naming task, we created the additional categorical predictor variable 'Word Type'. Since this current study was based on a production task and not lexical decision, coding was based on phonological overlap, in line with the cognate identification procedure followed in this study. All cognate items that were either identical phonological cognates (e.g., German *Fisch* and English 'fish') or that differed in no more than one phoneme (e.g., German *Nase* and Italian *naso*, 'nose') were scored as '(near-)identical cognates', all other cognate items were scored as 'non-identical cognates'. For triple cognates, overlaps as specified above over at least two of the three languages were considered necessary to count as (near-)identical. We ran a mixed-effects regression model (glmer) with both Word Type (3 levels) and cognate status as fixed factors and fitted the same random effects structure as for the preceding analyses for the outcome variable of accuracy. The analysis was restricted to the English session, as no cognate effects had been detected in Italian. If the observed CFEs in naming accuracy are indeed restricted to (near-)identical cognate targets, we should expect the effect of cognate status to disappear in a model containing both predictors. However, the results of the mixed-effects model analysis revealed that the facilitation effects on accuracy were not substantially driven by Word Type ($\chi^2(3, N = 2149) = 2.84$, $p = 0.09$). Cognate status, on the other hand, remained a significant predictor ($\chi^2(3, N = 2149) = 8.71$, $p = 0.03$). Accordingly, the facilitation effects obtained for accuracy in L3 naming cannot be explained as a result of the presence of (near-)identical cognates in our stimuli. This is in line with some recent research on CFEs in trilinguals using translation tasks (Lijewska and Błaszkowska 2021).

Table 5. Pairwise comparisons between cognate conditions for omission rates, English session.

Contrast	Estimate	SE	Z	*p*-Value
Baseline—Double ITA-ENG	1.138	0.401	2.841	0.023 *
Baseline—Double GER-ENG	1.288	0.401	3.211	0.007 **
Baseline—Triple	2.198	0.41	5.359	<0.001 ***
Double ITA-ENG—Double GER-ENG	0.149	0.405	0.369	0.983
Double ITA-ENG—Triple	1.06	0.413	2.567	0.05
Double GER-ENG—Triple	0.91	0.413	2.204	0.122

Note. Results are given on the log odds ratio (not the response) scale. Results are obtained using the emmeans function with Tukey *p*-value adjustment. *** $p < 0.001$ ** $p < 0.01$ * $p < 0.05$.

4. Discussion

The aim of this study was to investigate lexical production processes via cognate facilitation effects in a hitherto understudied population of unbalanced emergent trilingual primary school children, who acquire their L2 and L3 mainly in a classroom-based setting. Children were asked to name pictures of objects corresponding to triple, double, and non-cognate words. This allowed us to explore the possibility of cumulative CFEs, which we investigated by comparing children's naming performance across the respective conditions in their L1 and L3. Based on previous studies on trilingual adults (Lemhöfer et al. 2004; Szubko-Sitarek 2011) and children (Brenders et al. 2011; Poarch and van Hell 2012), it was hypothesized that developing trilingual children would similarly benefit from CFEs but that these would mainly or exclusively arise in their non-dominant language (L3 English). A further prediction was that CFEs would accumulate over children's languages, as was shown previously for trilingual adults (Lemhöfer et al. 2004; Szubko-Sitarek 2011).

Our findings partially confirmed the above predictions. The results revealed that when naming pictures in their L3, children were significantly more accurate in their responses to all types of cognate items (triples as well as doubles) compared to non-cognate controls. However, facilitatory effects could not be detected for reaction times, nor did they extend to naming in the dominant language (L1). Thus, our findings replicated the frequently attested

asymmetry of cross-linguistic facilitation. The evidence for cumulative CFEs was limited in our study and could not be substantiated by our analyses. When children produced words in their L3 English, triple cognates indeed gave rise to the highest overall number of accurate responses, followed by double cognates. Despite this tentative numerical trend, differences between triple and double CFEs were, however, not statistically significant. Interestingly, double cognates combining children's non-native languages (L2 German and L3 English) gave rise to cognate effects of a similar size to those obtained for triple cognates and double cognates involving the L1 (Italian–English condition). This indicates that even two non-native languages acquired primarily by instruction can result in significant facilitation effects in children's L3 production accuracy, and even at relatively early stages of the acquisition process. We address and discuss these findings below.

4.1. Cognates Effects on L3 Word Learning

There are several possible explanations for the effects observed in this study. First, although care was taken to match lexical target items across conditions on several critical dimensions and although a follow-up analysis showed that the observed facilitation effects were not driven by (near-)identical cognates in the stimulus list, we cannot completely rule out the possibility that the observed effects resulted to some extent from other unintended differences between stimuli across the experimental conditions (see Section 4.5). Nonetheless, an additional follow-up analysis on response omissions mirrored the pattern of the results obtained for accuracy, indicating that cognates (of any type) resulted not only in more accurate responses but also in fewer omissions than non-cognates. This could be interpreted as strengthening the interpretation that cognates aided lexical retrieval in children's L3 production, at least in terms of accuracy. However, note that this conclusion cannot be drawn in the absence of a prior vocabulary test, i.e., without having established whether the relevant words had in fact already been acquired by children and were hence available for retrieval. Moreover, it is important to note that the absence of RT effects and the lack of statistical power for the RT analyses do not allow us to interpret the present data as evidence for *co-activation*. Although the effects of cognate status on accuracy in picture naming were robust, they do not by themselves support the presence of co-activation. In fact, the absence of RT effects, coupled with the observation of large omission rates rather point to an alternative explanation of the present findings in terms of facilitated lexical learning of cognates vs. non-cognates rather than co-activation during the production process. That is, the present findings may reflect the frequently demonstrated phenomenon that cognates are simply easier to learn than non-cognates (e.g., de Vos et al. 2019; Tonzar et al. 2009; Valente et al. 2018) and that this effect may also potentially accumulate across multiple languages.

4.2. Asymmetrical Cognate Effects

Our findings are consistent with previous studies on bilingual children and child L2 learners which have reported CFEs to disappear or substantially diminish when performing a task in the dominant language (e.g., Bosma and Nota 2020 for reading; Brenders et al. 2011 for word recognition; Poarch and van Hell 2012 for word naming). In previous studies that report CFEs for RTs, these effects have often been interpreted as evidence for an activation-based account (see Costa et al. 2000). Accordingly, such asymmetry in CFEs is argued to arise because speakers' proficiency in their weaker language(s) may not be sufficiently robust to impact lexical processing in their L1. In other words, the relatively weaker activation levels associated with an L2 may not be sufficient to boost processing in the L1 (Brenders et al. 2011; van Hell and Dijkstra 2002), whereas the L1 will conversely exert a stronger influence on the processing of the weaker L2/L3. In the context of a naming task, the spreading of strong co-activation of the L1 cognate to the phonological level would facilitate lexical retrieval in the L3, while the much lower activation levels of the non-native language(s) would not result in any or the same degree of facilitation when retrieving L1 phonological segments (cf. Poarch and van Hell 2012). On this basis, one should expect

CFEs to be limited to situations that can benefit from recruiting the dominant language. While the activation-based account is consistent with research findings of asymmetric CFEs on RTs, it is not easily applicable to the pattern of results observed in this study. First, no CFEs could be detected for RTs but only for accuracy. Second, an activation-based account would be at odds with our finding that L2–L3 double cognates elicited equally robust effects as the other cognate conditions that involved the stronger L1, even though the former condition could not benefit from recruiting the dominant (and hence strongly activated) language. The asymmetry of CFEs observed for accuracy rates is very likely a result of a ceiling effect, i.e., the extremely high rates of accurate responses when children named pictures in their L1 compared to their L3 (similar to findings by Koutamanis et al. 2023 and Schröter and Schroeder 2016). The same asymmetry was also reflected in omission rates, which were dramatically lower in the L1 than in the L3.

Regarding the strength of the L2–L3 cognate condition, one possibility is that the combination of the two non-native languages exerted an added boost on word learning. This may be explained as a manifestation of a foreign language effect (Meisel 1983) or the L2 status factor (Bardel and Falk 2007; Williams and Hammarberg 1998), according to which, in L3 acquisition, cross-linguistic interactions occur more prominently between the L2 and L3 (rather than between the L1 and L3), based on their similar cognitive status in learners' minds. Although children in this study did indeed acquire both German and English predominantly as foreign languages in a classroom setting, it must be noted that the learning context for L2 vs. L3 cannot be considered equivalent, as they received some additional naturalistic exposure from German as one of the widely spoken regional languages, whereas English was largely restricted to the classroom. Alternatively, what may be at play is perceived language proximity (Kellerman 1983; Rothman 2011) between German and English, which has been argued to be a prime factor in determining lexical cross-linguistic interference patterns in L3 acquisition (e.g., Cenoz 2001; Ringbom 2001), privileging cross-linguistic interactions between languages perceived as similar (e.g., Persici et al. 2019; Puig-Mayenco et al. 2020). Thus, it is possible that perceived language similarity even between two foreign languages also positively impacts children's word learning in instructed learning contexts. It should be noted, however, that our design does not allow us to conclusively disentangle language proximity from potential L2 status factor effects. Future studies should systematically manipulate both factors specifically in contexts of child multilingualism to gauge their impact on the cognate advantage in this population.

4.3. Absence of Additive Cognate Effects

Contrary to the study on trilingual adults by Lemhöfer et al. (2004), we could not substantiate the hypothesis of additive cognate effects in our sample, despite a numerical trend pointing in this direction. Apart from a lack of statistical power (16 items per condition and relatively small sample size), there may be other reasons why this study could not replicate previous research on adults. Importantly, in Lemhöfer et al.'s (2004) study, the three languages considered were all closely related (Dutch, English, and German), which may have helped to boost interactions, thus generating the cumulative effects observed. In the present case, however, the L2 and L3 are closely related, whereas the children's L1 is not. Along the lines argued above, language status, in particular perceived language proximity, may have thus been more influential in determining the pattern of CFEs than the mere quantity of languages involved, particularly because the children's proficiency was low relative to their L1, which in turn may have further reinforced the impact of language proximity (see Bardel and Lindqvist 2007). By contrast, the trilingual adults tested by Lemhöfer et al. (2004) were highly proficient in all three languages and had on average accumulated more than 11 years of direct experience in both their L2 and L3. Moreover, task- and modality-specific factors could have also contributed to the present findings. Like most research on CFEs in adults, Lemhöfer et al. (2004) used lexical decision and, hence, a receptive task. In this study, participants were required to overtly produce words, hence recruiting different, crucially also top–down processes (going from the conceptual to

the phonological level) that could have modulated CFEs. This would align with recently emerging evidence that cognate CFEs are indeed sensitive to the specific language modality recruited in the task employed in an experiment (Cornut et al. 2022; Frances et al. 2021; Salomé et al. 2022). The fact that spoken forms are more ephemeral may pose additional challenges for CFEs to emerge in tasks that are based on the phonological rather than the orthographic form (see Salomé et al. 2022 for a similar argument), particularly in contexts of classroom-based learning where input is often biased towards written rather than spoken language. Given that our sample and task differed on several dimensions from those of Lemhöfer et al. (2004), we cannot conclude with certainty which factor(s) brought about the differences in findings. To shed further light on this, future studies could investigate highly proficient trilingual children with language combinations featuring different degrees of language proximity.

4.4. Absence of RT Effects

Unlike for the accuracy of naming, no significant effect of cognate status could be detected on children's response latencies, which contrasts both with our predictions and with previous research using picture-naming tasks (e.g., Costa et al. 2000; Muylle et al. 2022; Poarch and van Hell 2012). In addition to the lack of statistical power discussed earlier, this finding may be related to children's much lower proficiency in the L2 and L3 relative to their dominant L1, as evidenced by the large number of response omissions and inaccurate responses in the English session. As only accurate responses (i.e., target responses matching the expected cognate word form) were considered for RT analyses, the remaining observations for the English session were only less than half of the data points available for the Italian. Similar observations regarding the lack of RT effects as a result of power deficiency have been reported for adult trilinguals of intermediate proficiency (Lijewska and Błaszkowska 2021). These low response numbers are further underscored by the impression that children noticeably struggled performing the task in their L3 and by the observation that many children evidently did not feel confident producing words in a foreign language under time pressure. These shortcomings suggest that for unbalanced multilingual children who learn an L2/L3 in an instructed classroom setting, tasks that require an overt response such as picture naming may not be ideally suited to capture the cognate advantage in terms of reaction times. We acknowledge this limitation and recommend that future studies on populations of child L2/L3 learners should rather employ receptive measures, such as auditory lexical decision tasks (e.g., Persici et al. 2019), or eye-tracking (e.g., Gastmann and Poarch 2022), which do not require children to actively produce words in the foreign language. Alternatively, for word production studies, future studies should place greater emphasis on using a more playful task, for instance by integrating gamification elements to create a setting in which children feel more at ease to produce in a foreign language.

4.5. Limitations and Future Directions

There are several methodological shortcomings of this study which require careful consideration of the conclusions that can be drawn based on the present data. First, given the difficulty of matching the four cognate conditions across all relevant dimensions, testing a control group of monolingual children would have strengthened an interpretation of the results in terms of cognate facilitation. If indeed the effects are a result of cognate status rather than of other confounded differences between conditions, then both the triple and the double cognate conditions should pattern together with the non-cognates in monolinguals. Nonetheless, recruiting a monolingual or even bilingual control group in South Tyrol is difficult, given that all three languages are compulsory subjects in the region. Second, it is important to note that the frequency measures used for matching in this study were drawn from the CELEX corpus, which may, however, not accurately represent the type of input typically directed at children, given its datedness and the amount of formal (written) language it contains. As pointed out by an anonymous reviewer, future studies should take

care to select frequency measures from more recent corpora, which should ideally reflect the target population and the associated text type of participants' input situation. Related to this point, future studies should take into account and control for frequency measures of words in all languages involved, including the L1 and L2, which have also been shown to affect activation levels when producing and processing words in the L3. Third, although our post hoc analysis on Onset Type did not detect an effect of the unequal presence of fricative and plosive onsets across conditions, future studies should carefully match words in different conditions for initial onset from the outset, as each onset phoneme constitutes a different challenge in terms of measurement (Rastle and Davis 2002). Notwithstanding our post hoc analysis, we cannot rule out the possibility that other differences in initial phonemes in our stimuli generated noise in the data, which may have made it harder for any effects to be detected in the RT data.

4.6. Implications

This study has several theoretical and educational implications. Theoretically, our findings provide further evidence for an integrated lexicon in multilingual individuals, which we can conclude not only applies to highly proficient adults but also to trilingual children, even at relatively early stages of primarily instructed L2/L3 learning. The findings demonstrate that cross-linguistic overlap (cognateness) even between two non-native languages can exert facilitatory effects on naming accuracy of a similar magnitude as when children's native language is involved. Thus, naming accuracy in the L3 was boosted not just by cognate words that involved children's L1, but to a similar extent by cognates in children's later acquired L2 German and L3 English. This strongly suggests that factors beyond proficiency alone need to be factored in to account for the facilitation afforded by cognate words in multilinguals. In the present case, we have argued that language status, in particular the perceived language proximity between children's L2 German and L3 English, may have played an important role in facilitating lexical learning, despite the unbalanced proficiency profile, although further research will be necessary to tease apart the factors of typological proximity and L2 status. The finding of cognate facilitation in the absence of L1 involvement is incompatible with a learning-based account (Costa et al. 2017), which explains cognate effects as arising from qualitatively different lexical representations for cognates resulting from the initial mapping to L1 representations during the learning process. An account in terms of co-activation is similarly inconsistent with the present set of findings given that no effects on reaction times were detected. While our data pattern does not allow us to draw conclusions about co-activation, these results provide compelling evidence that emerging trilingual children are sensitive to cross-linguistic similarity, not just between their L1 and the L2/L3 but also between the two instructed foreign L2 and L3. Furthermore, the cognate effects on naming accuracy suggest that child L3 learners can leverage this sensitivity to boost lexical learning in their L3. With respect to models of L3 word learning, our finding of cognate effects for all cognate words (irrespective of double vs. triple status) in the absence of any significant cumulative benefits can be accommodated within a Scaffolding Account (Bartolotti and Marian 2017) predicting one-to-one cross-linguistic influence. However, more research is necessary using more sensitive measures with this population and based on larger sample sizes to ascertain the possibility of cumulative effects.

Regarding educational implications, the fact that emerging learners in this study were able to benefit from cognateness not only between their L1 and the L2/L3 but also between the two later acquired languages suggests that facilitatory effects between foreign languages could be capitalized on for language learning by explicitly drawing children's attention to cognates status in the classroom (for a recent review of the effectiveness of such educational strategies, see Bosma et al. 2023). Multilingual immersion programs could strive to actively promote awareness of lexical similarities between different languages by implementing learning activities that encourage children to make connections between languages. This idea has been actively pursued by advocates of translanguaging practices

in the classroom (e.g., Günther-van der Meij et al. 2020; see also review by Bosma et al. 2023). The rationale in the context of cognate facilitation is that enhanced cognate awareness could lead to increased cross-linguistic interaction and facilitated lexical transfer from the L1 to the L2/L3, which in turn is expected to boost L2/L3 vocabulary learning. There is some empirical evidence that cognate awareness training by explicit instruction may indeed promote heightened levels of cognate awareness (Dressler et al. 2011; Otwinowska et al. 2020), as evidenced by increased cognate identification rates. Nonetheless, research to date has not conclusively established whether such enhanced cognate awareness can indeed boost lexical learning (see review by Bosma et al. 2023). The empirical evidence on the link between awareness and learning benefits is mixed. Although some previous intervention studies suggest that raising awareness of lexical similarities can indeed enhance learning (e.g., Helms-Park and Perhan 2016; Molnár 2010; Otwinowska-Kasztelanic 2009), a more recent study reports null effects of cognate awareness on learning (Otwinowska et al. 2020). It thus remains to be further investigated if and how cognate processing and awareness could be leveraged in instructed settings to foster L2/L3 learning across both adult and child populations.

The added potential of growing up in a linguistically rich and diverse multilingual environment such as the present case of South Tyrol should not be underestimated in this respect (see Bice and Kroll 2019). That is, multilingual communities where children receive some degree of naturalistic exposure from more than one language can afford a wealth of opportunities for fostering such awareness training based on everyday activities. Rather than viewing additionally acquired languages as competitors for learning resources, their great potential in acting as facilitators for learning should be emphasized to teachers. Promoting children's awareness of cross-linguistic similarities could thus help them to tap into their multilingual resources to bootstrap lexical learning. The extent to which language context, both the local (school) context and the global regional context in which children experience exposure to their various acquired languages, plays a role for cognate awareness, processing, and learning remains a topic to be explored by future research.

Author Contributions: Conceptualization, H.E. and S.R.; Methodology, H.E.; Validation, H.E. and S.R.; Formal analysis, H.E.; Data curation, H.E. and S.R.; writing—original draft preparation, H.E. and S.R.; writing—review and editing, H.E.; visualization, H.E.; supervision, H.E.; project administration, H.E.; funding acquisition, H.E. All authors have read and agreed to the published version of the manuscript.

Funding: This research was funded by a start-up grant that the first author received from the University of Mannheim (Forschungsfonds Universität Mannheim). The APC was funded by the University of Mannheim.

Institutional Review Board Statement: This study was conducted in accordance with the Declaration of Helsinki and approved by the Ethics Committee of the University of Mannheim (EK Mannheim 28/2021, 25 May 2021).

Informed Consent Statement: Informed written consent was obtained from the parents or guardians of all pupils participating in this study.

Data Availability Statement: The data presented in this study are openly available on the OSF platform at https://osf.io/qa58z/?view_only=ba1475a73f8145a1a5f02f3406d3834c.

Acknowledgments: We are very grateful to the Alessandro Manzoni School in Bolzano and all teachers involved for their valuable support, as well as the pupils and their parents for participating in this study. We also wish to thank Helen Forsyth for coordinating and conducting data collection and Anna Toews and Anna Dürbeck for their assistance with transcription and coding.

Conflicts of Interest: The authors declare no conflicts of interest. The funders had no role in the design of the study; in the collection, analyses, or interpretation of data; in the writing of the manuscript; or in the decision to publish the results.

Appendix A

Table A1. English, German, and Italian Items and corresponding IPA transcriptions used in the experiment.

English		German		Italian	
Target Item	**IPA**	**Target Item**	**IPA**	**Target Item**	**IPA**
		Triple Cognates			
dolphin	/dɒlfɪn/	Delfin	/dɛlfiːn/	delfino	/delfino/
rose	/rəʊz/	Rose	/roːzə/	rosa	/rɔza/
lamp	/læmp/	Lampe	/lampə/	lampada	/lampada/
tractor	/træktər/	Traktor	/trakto:ɐ̯/	trattore	/tratːore/
nose	/nəʊz/	Nase	/naːzə/	naso	/naso/
pizza	/piːtsə/	Pizza	/pɪtsa/	pizza	/pitːsa/
baby	/beɪbi/	Baby	/beːbi/	bambino	/bambino/
tiger	/taɪgər/	Tiger	/tiːgɐ/	tigre	/tigre/
cactus	/kæktəs/	Kaktus	/kaktʊs/	cactus	/kaktus/
banana	/bənɑːnə/	Banane	/banaːnə/	banana	/banana/
lion	/laɪən/	Löwe	/løːvə/	leone	/leone/
bus	/bʌs/	Bus	/bʊs/	autobus	/autobus/
carrot	/kærət/	Karotte	/karɔtə/	carota	/karɔta/
zebra	/zebrə/	Zebra	/tseːbra/	zebra	/dzɛbra/
pirate	/paɪrət/	Pirat	/piraːt/	pirata	/pirata/
volcano	/vɒlkeɪnəʊ/	Vulkan	/vʊlkaːn/	vulcano	/vulkano/
		Double German–English Cognates			
bear	/beər/	Bär	/bɛːɐ̯/	orso	/orso/
helmet	/helmɪt/	Helm	/helm/	casco	/kasko/
ice-cream	/aɪs kriːm/	Eis	/eːɪs/	gelato	/dʒelato/
bee	/biː/	Biene	/biːnə/	ape	/ape/
house	/haʊs/	Haus	/haus/	casa	/kasa/
fish	/fɪʃ/	Fisch	/fɪʃ/	pesce	/peʃe/
tomato	/təmɑːtəʊ/	Tomate	/tomaːtə/	pomodoro	/pomodɔro/
book	/bʊk/	Buch	/buːx/	libro	/libro/
frog	/frɒg/	Frosch	/frɔʃ/	rana	/rana/
shoe	/ʃuː/	Schuh	/ʃuː/	scarpa	/skarpa/
rainbow	/reɪnbəʊ/	Regenbogen	/reːgn̩ˌboːgn̩/	arcobaleno	/arkobaleno/
apple	/æpl/	Apfel	/apfl̩/	mela	/mela/
mouse	/maʊs/	Maus	/maus/	topo	/tɔpo/
glass	/glɑːs/	Glas	/glaːs/	bicchiere	/bikːjɛre/
finger	/fɪŋgə(r)/	Finger	/fɪŋɐ̯/	dito	/dito/
ladder	/lædər/	Leiter	/laitɐ̯/	scala	/skala/
		Double Italian–English Cognates			
lemon	/lemən/	Zitrone	/tsitroːnə/	limone	/limone/
umbrella	/ʌmbrelə/	Regenschirm	/reːgnʃɪrm/	ombrello	/ombrɛlːo/
bottle	/bɒtl/	Flasche	/flaʃə/	bottiglia	/botːiʎa/
mountain	/maʊntən/	Berg	/bɛrk/	montagna	/montaɲa/
pen	/pen/	Kugelschreiber	/kuːgl̩ʃraɪ̯bɐ̯/	penna	/penːa/
pear	/peər/	Birne	/bɪrnə/	pera	/pera/
train	/treɪn/	Zug	/tsuːk/	treno	/trɛno/
fork	/fɔːk/	Gabel	/gaːbl̩/	forchetta	/forketːa/
candle	/kændl/	Kerze	/kɛrtsə/	candela	/kandela/
letter	/letər/	Brief	/briːf/	lettera	/letːera/
potato	/pəteɪtəʊ/	Kartoffel	/kartɔfl̩/	patata	/patata/
castle	/kɑːsl/	Burg	/bʊrk/	castello	/kastɛlːo/
tent	/tent/	Zelt	/tsɛlt/	tenda	/tɛnda/
button	/bʌtn/	Knopf	/knɔpf/	bottone	/botːone/
biscuit	/bɪskɪt/	Keks	/keːks/	biscotto	/biskɔtːo/
hippopotamus	/hɪpəpɒtəməs/	Nilpferd	/niːlpfeːɐ̯t/	ippopotamo	/ipːopɔtamo/

Table A1. *Cont.*

English		German		Italian	
Target Item	**IPA**	**Target Item**	**IPA**	**Target Item**	**IPA**
		Noncognates			
skirt	/skɜːt/	Rock	/rɔk/	gonna	/gonːa/
eye	/aɪ/	Auge	/augə/	occhio	/ɔkːjo/
chair	/tʃeər/	Stuhl	/ʃtuːl/	sedia	/sɛdja/
chicken	/tʃɪkɪn/	Huhn	/huːn/	gallina	/galːina/
tree	/triː/	Baum	/baum/	albero	/albero/
horse	/hɔːs/	Pferd	/pfeːɐ̯t/	cavallo	/kavalːo/
suitcase	/suːtkeɪs/	Koffer	/kɔfɐ/	valigia	/validʒa/
scissors	/sɪzəz/	Schere	/ʃeːrə/	forbici	/fɔr.biˑtʃi/
leg	/leg/	Bein	/bain/	gamba	/gamba/
bird	/bɜːd/	Vogel	/foːgl̩/	uccello	/utːʃɛlːo/
knife	/naɪf/	Messer	/mɛsɐ/	coltello	/koltɛlːo/
strawberry	/strɔːbəri/	Erdbeere	/eːɐ̯tbeːrə/	fragola	/fragola/
present	/preznt/	Geschenk	/gəʃɛŋk/	regalo	/regalo/
mushroom	/mʌʃrʊm/	Pilz	/pɪlts/	fungo	/fungo/
closet	/klɒzɪt/	Schrank	/ʃraŋk/	armadio	/armadjo/
spoon	/spuːn/	Löffel	/lœfl̩/	cucchiaio	/kukːjajo/

Notes

[1] T-values are standardized scores used in psychometric tests that indicate how far an individual's test performance deviates from the average performance. They are based on conversions of raw scores to a scale with a mean of 50 (SD = 10).

[2] There was some data loss (66 data points in the Italian and 91 in the English session) due to technical failure, caused mainly by cases of the Chronos response box failing to record and, in some rare cases, due to picture items failing to appear on the screen.

[3] We would like to thank an anonymous reviewer for pointing out the potential inhibition effect of three false cognates present in our stimuli (Ital. *ape*, 'bee' = Engl. 'monkey'; Ital. *casa*, 'house', similar to Engl. 'case'; German *Rock*, 'skirt' and Engl. rock). All models reported in this paper were additionally run after removing the false cognate items and yielded the same results. We therefore kept these items in the analyses.

[4] A post hoc power analysis was conducted in which the power of the tests for pairwise comparisons was calculated for different odds ratios. These calculations show that the present sample size (n = 35) is sufficient to achieve satisfactory power (82%) in the English session to detect significant differences if the odds ratio of double cognates is 2.5 times higher and the odds ratio of triple cognates is five times higher than the odds ratio of non-cognates. However, the sample size is insufficient (47.6%) to detect statistically significant differences in the Italian session, which can be explained by the very high proportion of accurate responses.

[5] A post-hoc power analysis revealed that power was sufficient (80%) in our sample to detect differences of at least 15%, corresponding to a difference of 220 ms in the English session and 160 ms in the Italian session.

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