Outline

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# Introduction

Most people around the world are familiar with more than one language. A substantial portion of this population have learnt the two languages from birth. The literature on bilingual language acquisition suggests that monolinguals and bilinguals achieve most of their developmental milestones at similar ages, in spite of receiving different linguistic input, both in quantity and quality, but seem to do it following different paths (Sebastian-Galles & Santolin, 2020). Both groups can discriminate languages from different rhythmic families at birth (Byers-Heinlein, Burns, & Werker, 2010; Ramus, Nespor, & Mehler, 1999), and languages from the same rhythmic class at six months of age (Bosch & Sebastián-Gallés, 1997, 2001), as long as they are familiar with one of them. Monolingual and bilingual infants also seem to acquired the native phoneme repertoire at around their first birthday (Albareda-Castellot, Pons, & Sebastián-Gallés, 2011; Burns, Yoshida, Hill, & Werker, 2007; Sundara & Scutellaro, 2011). Word learning seems to start at aroud similar ages in monolinguals and bilinguals. [Insert here some BS I can’t come up with now].

Before the end of their first year of life, infants have already encoded some sound patterns (Jusczyk & Aslin, 1995; Tincoff & Jusczyk, 1999), and are able to associate them with their referents (Bergelson & Swingley, 2012). During the second year infants encode such representations with more phonological detail (e.g. Werker, Fennell, Corcoran, & Stager, 2002) and from 18 to 24 months of age, they acquire new words at an increasingly faster rate (Bloom, 2002; Fenson et al., 1994). There is large variability in both the number of words children know at these ages, and in what words they know. For example, not all words are equally likely to enter this early lexicon: the acquisition a new word results from the complex interplay between (1) the properties of the word and (2) the properties of the child and their linguistic background. Although the trajectories of acquisition of individual words have been relatively well studied, it remains unclear how simultaneous bilingualism (i.e., exposure to a two languages from early ages) impacts word acquisition, and what interacts with the properties of the . In this study, we investigate how bilingual children acquire new words

In this study we investigate the particular case of children learning two languages, to whom we will refer as *bilingual children*. We will first summarise the extant literature on the determinants of vocabulary size during the first years of life, then we will focus on the bilingual case, elaborating on how dual language exposure interacts with the trajectories of acquisition of the words children learn at early ages, conditional to the

## Lexical predictors of word acquisition

### Grammatical class

The grammatical class of a word impacts its age of acquisition. A considerable portion of the literature on vocabulary acquisition suggests that children acquire nouns, verbs, adjectives an function words at different ages. Although it was initially claimed that this bias universally favoured nouns over the other categories (Bates et al., 1994; C. Caselli, Casadio, & Bates, 1999; M. C. Caselli et al., 1995; Gentner, 1982; Gentner & Boroditsky, 2001), later studies pointed to important cross-linguistic differences, especially regarding whether nouns are acquired earlier than verbs. For example, children learning Korean (Choi & Gopnik, 1995) or Mandarin (Tardiff, Gelman, & Xu, 1999) exhibit a verb bias instead, pointing to important differences in how these word-class biases operate, conditional to the qualities of the input (Waxman, Senghas, & Benveniste, 1997).

### Lexical frequency

Lexical frequency also plays a role in the acquisition of new words. Words that occur more frequently in the input the child receives are acquired earlier on average (Goodman, Dale, & Li, 2008; Swingley & Humphrey, 2018). Importantly, this effect seems to be quite stable across languages and grammatical classes: using vocabulary reports from a large sample of children learning a wide variety of languages, Braginsky, Yurovsky, Marchman, & Frank (2019) examined the effect of many word-level predictors on the age of acquisition of an extensive list of words, and found a similar effect of lexical frequency, both across languages and across grammatical categories, with nouns showing a slightly larger effect of frequency over verbs and function words. In the same study, the authors also report a similar cross-linguistic similarity in mean length in words of utterances (MLU-w): words that, on average, occur in short sentences are acquired earlier than words that commonly occur in long utterances, providing evidence in line with previous experimental studies reporting that words the occur in isolation are more easily acquired than words that occur surrounded by other words (Brent & Siskind, 2001; Swingley & Humphrey, 2018).

### Phonological form

The phonological properties of the word also impact its age of acquisition. Overall, children seem to acquire simpler word forms earlier than more complex word forms. For example, Braginsky, Yurovsky, Marchman, & Frank (2019) found that shorter word-forms (with fewer phonemes) were on average acquired earlier across languages than words with more phonemes. Using a similar approach, Jones & Brandt (2019) also reported this association in a sample of toddlers learning British English. This effect seems to affect the age of production, but no the age of comprehension, suggesting that children’s age of production is more dependent on the specific properties of the phonological form of the word, while these same properties play a lesser role in comprehension. Perhaps more interestingly is the fact that Jones & Brandt (2019) found that children in their sample acquired words from denser phonological neighbourhoods earlier than words from sparser phonological neighbourhoods. This suggests that the word forms a toddler has already encoded in their lexicon impact the probability of acquisition of new word forms, especially of those with which they share phonological similarity.

Previous studies have suggested that the phonological and semantic properties of a child’s lexicon constrain the acquisition of new words. There is evidence that, during the second year of life, infants not only acquire new words rapidly, but they also start forming the underpinning of what later will become mature lexical-semantic networks. As more words enter their lexicon, children start co-activating them during language use: phonologically or conceptually related words activate or inhibit each other during word comprehension and production (Chow, Aimola Davies, Fuentes, & Plunkett, 2016, 2019; Mani & Plunkett, 2010; Wojcik & Saffran, 2013). Critically, the connectivity of this early lexicon constrains how new words are acquired: words with higher connectivity are more likely to be acquired next, compared to words with lower connectivity (Fourtassi, Bian, & Frank, 2020; Hills, Maouene, Maouene, Sheya, & Smith, 2009). In summary, children’s trajectories of vocabulary acquisition show important similarities across languages, but are to some degree dependent on the language background of the infant. next, we review some of the factors related to children’s demographic and linguistic characteristics that have been reported to impact vocabulary acquisition.

## Demographic and linguistic predictors of word acquisition

### Age

It is obvious that age impacts the vocabulary size of children. Older children know more words than younger children. However, the relationship between age and vocabulary size is non-linear: from their first birthday, infants’ comprehension grows more rapidly, a phenomenon labelled as the *vocabulary spurt*. Two sources of evidence support the existence of this non-linear trend: one the one hand, parental reports of vocabulary point to toddler’s productive vocabulary growing non-linearly between 18 and 24 months of age (Fenson et al., 1994; Goldfield & Reznick, 1990; Hamilton, Plunkett, & Schafer, 2000; Rescorla, Mirak, & Singh, 2000; but see Mervis & Bertrand, 1995). It is less clear whether receptive vocabulary follows the same trend, with linear models performing virtually as well as non-linear models (see Bergelson, 2020 for review). On the other hand, experimental studies using the *looking while listening* paradigms top test toddler’s word comprehension provide data supporting a non-linear trend [e.g., garrison2020familiarity; Bergelson & Swingley (2015); Fernald, Perfors, & Marchman (2006)]. The exact definition and specific shape of the non-linear function underlying vocabulary growth, both receptive and productive, is still a matter of debate, with several plausible models providing similar fit (Ganger & Brent, 2004). Altogether, there is robust evidence that vocabulary acquisition follows a non-linear trend, both in comprehension and production. Interesting as it is, the mechanisms underlying this non-linear trajectory of vocabulary acquisition remain elusive. There are multiple, sometime exclusive accounts for the developmental underpinnings of the vocabulary spurt, but those favouring a qualitative change in the mechanisms involved in lexical learning around the age around which the vocabulary spurt takes place seem to be more compatible with the available evidence, as opposed to those favouring a change in the input received by infants it that same age (Bergelson, 2020; Nazzi & Bertoncini, 2003).

### Socio-economic status

The age trajectory of vocabulary growth is mediated by the cultural and social context in which children acquire their first language. For instance, the socio-economic status (SES) is a robust predictor of vocabulary outputs during toddlerhood and childhood. Fernald, Marchman, & Weisleder (2013) collected longitudinal data of 48 English-learning toddlers raised in the US at 18 and 24 months of age from high and low SES, and found that higher vocabulary sizes in the higher SES group than in the lower SES group at both ages. Moreover, these differences were also evident in a word recognition experimental task, in which participants from higher SES showed a stronger preference toward a named picture (relative to an unnamed picture displayed next to it) than participants from lower SES. These findings suggest that SES impacts language acquisition at early ages, and that this effect shapes the trajectory of vocabulary growth of children, as well as their language processing skill. Other studies have found convergent evidence in similar (Rowe, Raudenbush, & Goldin-Meadow, 2012) and different population groups, such as children raised in countries other than the US [e.g., Coddington, Mistry, & Bailey (2014); though evidence from non-WEIRD[[1]](#footnote-1) countries is still sparse], bilingual children (Meir & Armon-Lotem, 2017), and children at later ages (Lee & Burkam, 2002; Nelson, Welsh, Trup, & Greenberg, 2011; e.g., Tabors, Snow, & Dickinson, 2001). It has been suggested that the quantity and quality of the input the child receives from their caregivers underlies this effect of SES (Hoff, 2003).

### Bilingualism

Although early studies on vocabulary growth reported smaller vocabulary sizes for bilinguals in each language (Ben-Zeev, 1977; E. Bialystok, Feng, Durgunoglu, & Goldenberg, 2011; Ellen Bialystok, Luk, Peets, & Yang, 2010, 2010; Marchman, Fernald, & Hurtado, 2010; Thordardottir, Rothenberg, Rivard, & Naves, 2006; Vagh, Pan, & Mancilla-Martinez, 2009), it was later brought into focus the fact that when assessing bilinguals’ vocabulary in both languages–e.g. calculating the total number of words they know in both languages and not just in one of them–bilinguals and bilinguals knew a similar number of words (De Houwer, Bornstein, & Putnick, 2014; Gonzalez-Barrero, Schott, & Byers-Heinlein, 2020; Junker & Stockman, 2002; Oller & Eilers, 2002; J. L. Patterson, 2004; J. Patterson, Pearson, & Goldstein, 2004; Barbara Zurer Pearson & Fernández, 1994; Barbara Zurer Pearson, Fernández, & Oller, 1993; Petitto et al., 2001; Smithson, Paradis, & Nicoladis, 2014). Apart from the influence of the factors involved in monolingual vocabulary acquisition described above, bilingual children’s vocabulary sizes result from the interplay between additional factors, one the most important being the quantity of input in each language the child receives in each language. The more a child is exposed to a given language, the more words they are likely to know in that language (Cattani et al., 2014; David & Wei, 2008; e.g., Gathercole, 2002; Hemsley, Holm, & Dodd, 2010; Barbara Z. Pearson, Fernández, Lewedeg, & Oller, 1997; Thordardottir, Rothenberg, Rivard, & Naves, 2006). In their study with English-Spanish bilingual toddlers, Hoff et al. (2012) reported a graded effect of dual language exposure on vocabulary size. Although monolinguals showed larger English vocabulary sizes, English-dominant bilinguals (whose exposure to English was substantially higher than their exposure to Spanish, up to 90% of exposure to English), knew almost as many English words as English monolinguals. The difference between monolinguals and balanced bilinguals (with a roughly similar degree of exposure to English and Spanish), and between monolinguals and Spanish-dominant bilinguals was much larger.

A second factor that impacts bilinguals’ vocabulary size is the linguistic distance between the languages the child is learning. Most of the literature on vocabulary acquisition involve children learning English and Spanish in the US, followed by children learning English and French in Canada. This is hardly representative of the profile of most bilingual children in the world, and this should taken into consideration when generalising the above mentioned findings to other populations. Floccia et al. (2018) found that the particular pair of languages children learn impacts their vocabulary size at 24 months of age. They collected vocabulary data from 372 toddlers in the UK being raised in English and and additional language, with this language being on of a diverse sample of 13 languages. Overall, their findings point to linguistically close language pairs being more easily acquired, at least when considering participant’s vocabulary sizes. Of particular interest for the present study is the fact that the average phonological similarity between translation equivalents of the language pairs–measured as an adaptation of the Levenshtein distance between the word forms of each translation pair–was associated with larger vocabulary sizes. For example, toddlers learning English and Dutch (22.14% phonological overlap) knew a larger amount of words than children learning English and Mandarin (1.97%). The authors interpret this finding in the context of the language non-selective account of lexical access, which states that during speech comprehension and production bilinguals activate both languages in parallel (e.g., Costa, Caramazza, & Sebastian-Galles, 2000; Hoshino & Kroll, 2008; Thierry & Wu, 2007). The authors suggest that the exposure to one of the word forms of the translation equivalent may activate to some degree the representation of the other, boosting its acquisition, and therefore accounting for the increase vocabulary size associated with a higher phonological similarity between the language pairs participants in their study were learning. This hypothesis is consistent with the findings of Bilson, Yoshida, Tran, Woods, & Hills (2015), who reported that translation equivalents represent a surprisingly large proportion of the word known by toddlers, therefore pointing to translation equivalents playing a substantial role during early bilingual vocabulary acquisition.

It is unclear, however, how words that have still not been acquired can be activated by their translation equivalent. One possibility is that when a bilingual child is exposed to an unfamiliar label for which they already know a label in the other language, they activate the already acquired label *only* when both word forms are phonological similarity. This way, children might start building a new phonological representation associated to the same concept as the already acquired one, which could explain why phonologically similar translation equivalents are acquired earlier. Worth noting, Floccia et al. (2018) do not report any translation equivalent-level analysis, and therefore it cannot be concluded from their study that phonologically similar translation equivalents (hereafter cognates) are acquired earlier than non-cognates.

## The present study

We capitalised on the role of cognateness in the acquisition of translation equivalents. We collected receptive and productive vocabulary data from a sample of 450 Catalan-Spanish participants aged 12 to 36 months using an extensive online vocabulary inventory developed for the purposes of this study. We modelled the proportion of participants reported to *understand* or *understand and produce* each translation equivalent across different ages, and estimated the effect of cognateness on the trajectory of aquisition adjusting for other variables of interest.

### Hypotheses

We hypothesised that, if cognateness facilitates the acquisition of translation equivalents, the proportion of infants that understand or produce cognate translation equivalents would be higher than the proportion of infants that understand or produce non-cognate translation equivalents.

We also hypothesised that, in order for cognateness to play an role in the acquisition of a cognate pair, one of the word forms must have already been acquired. If the acquisition of a word is facilitated by its phonological similarity with its translation equivalent, the later must already be present in the lexicon, so it can be activated upong the presentation of the former. Accordingly, we predicted that the effect of cognateness would be larger when a participant’s exposure to the language it belongs is low. Since todders are more likely to acquire first words in the language of highest exposure (relative to words in the language of lowest exposure), this means that the acquistion of words in the languuage of high exposure will be aided by the presence of its translation equivalent less often than the acquisition of words in the language of low exposure, which shoiuld on average occur later.

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1. Western, Educated, Industrial, Rich, and Democratic [↑](#footnote-ref-1)