Linguistic Variation in Animal-Sound Word Development:

The Cross-Linguistic Examination of Common Animal-Sound Words

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ABSTRACT

The goal of this study is to investigate the cross-linguistic differences in the development of animal-sound word production in children between the ages of 12-30 months across 17 languages. Specifically, I examined whether children's ability to produce animal-sound words are impacted by factors such as age, gender, language, and syllable length. Previous studies have displayed that animal-sound words (e.g., *woof woof)* were among the early words of monolingual English-speaking children. However, there is little known about how the development of animal-sound words may differ in other languages. Due to linguistic exposure to animals, familial influences, and other variables impacting the child, it is likely that there are cross-linguistic differences in the production of animal-sound words. Using MacArthur-Bates Communicative Development Inventories (MB-CDIs) data from Stanford's Word Bank, I examined children's animal-sound word production across 17 languages: *English, Cantonese, Croatian, Danish, French, Greek, Hebrew, Italian, Kiswahili, Korean, Norwegian, Mandarin, Russian, Slovack, Spanish (Mexican), Swedish, and Turkish*. For the English language, we included data from children speaking American English, Australian English, British English. For French, we included data from children speaking French as well as French (Quebecois). A total of 17,409 participants (8,199 girls, 8,091 boys, and 135 not reported), ranging between 12-30 months, were included in this dataset. Specifically, this study included the analysis of seven animal-sound words: *cockadoodledoo* (rooster), *baa baa* (sheep), *meow* (cat), *moo* (cow), *quack quack* (duck), *grr* (bear), *and woof woof* (dog). Results show that children's age, gender, language, and syllable length are all significant predictors of the development of animal-sound words. The findings suggest that there are differences across the languages and through the patterns of animal-sound word production cross-linguistically. Clinical implications are discussed.

Keywords: animal-sound words, linguistic variation, expressive vocabulary production, cross-linguistic analysis

INTRODUCTION

This study aims to examine the cross-linguistic differences in the development of animal-sound words for typically developing children. Animal-sound words are a type of onomatopoeia that reflects a sound that an animal would typically make. For example, in English, "*woof woof*" is for a dog's barking sound and "*meow*" is for cat sounds. Animal-sound words are interesting because many studies have found that these are some of the first words children learn (Motamedi et al., 2020). The understanding of children's development of animal-sound words can provide information about early vocabulary development. Specifically, the present study examines the developmental patterns of animal-sound word productions by children between the ages of 12-30 months across languages.

In this study, I examined a total of 11 animal-sound words including *cockadoodledoo* (rooster), *meow* (cat), *moo (*cow*), quack quack (*duck*), woof woof (*dog*), baa baa (*sheep*), gobble gobble (*turkey*), grr (*bear*), neigh (*horse*), oink (*pig*), peep (*chicken*),* using data from Stanford's Wordbank (Frank et al., 2017). After recoding the data and comparing the animal-sound words cross-linguistically, I decided to not analyze the sounds for turkey (English equivalent: *gobble gobble*), horse (English equivalent: *neigh*), pig (English equivalent: *oink*), and chicken (English equivalent: *peep*) since these animal-sound words were only included in a couple of the languages and would not provide as much cross-linguistic comparison. Stanford's Wordbank is an online database that includes receptive and expressive vocabulary development data from MacArthur-Bates Communicative Development Inventories (MB-CDI) across languages. This study intends to explore whether animal-sound words are learned differently across languages. The research examines multiple factors, including age, language, and syllable length, that may impact the development of animal-sound words. Overall, the present study focuses on typical early language vocabulary and production of animal-sound words for 17 languages. Together with three dialects for English and two dialects for French, the languages in the dataset include *American English, Australian English, British English, Cantonese, Croatian, Danish, French, French (Quebecois), Greek, Hebrew, Italian, Kiswahili, Korean, Mandarin, Norwegian, Russian, Slovack, Spanish (Mexican), Swedish, Turkish*. Furthermore, this study contributes to the understanding of animal-sound word development by analyzing the different factors that could impact the production of those words.

LITERATURE REVIEW

Onomatopoeia in Early Language Development

An onomatopoeia is a word that looks like the sound it makes such as the word "Boom" (Motamedi et al., 2020). As stated previously, animal-sound words are a type of onomatopoeia, so each word reflects the sound the animal makes. The phonological structures of animal-sound words tend to be reduplicated sounds (e.g., *woof woof*) and the open CV syllable (e.g., *moo, baa*; Laing, 2019). Within each language, there are phonological differences across animal-sound words. For example, in English, *woof woof* is the word representing the sound of a dog while *cockadoodledoo* is the word representing the sound of a rooster. The representation of animal-sound words are related to the phonological system of the language. For example, the phoneme /f/ in the animal-sound word *woof* is in the final position of the word— a pattern that is common in the English language. However, the phoneme /f/ does not occur in the final position of the word in Cantonese or Mandarin and a final consonant is not expected in any animal-sound words in either language. In addition, some words are longer, and some are shorter. For example, in Croatian, there are one-syllable animal-sound words (e.g., *moo* for cow in American English) and 4-syllable words (e.g., *kukuriku* for rooster in Croatian). This demonstrates the linguistic variations along with the differences in syllable length for each of the animal-sound words.

Furthermore, across language, I observe that there are differences in individual animal-sound words. Presumably, animal-sound words are the imitation of animal sounds, which is determined by the phonological system of the language. In English, for example, "*cockadoodledoo*" is the sound that a rooster makes but in Croatian, the sound is "*kukuriku*." The cross-linguistic variation of animal-sound words reflects the differences of the phonological systems across languages (Abbott et al., 2001). In addition, cultural variation could be related to the differences of the animal-sound words. For example, Abbott and others (2001) created a table that demonstrates the linguistic variation in different animal-sound words. Specifically, the table shows that some languages such as Danish have different animals-sound words for “bird” depending on the size or number of birds being talked about. All these factors could contribute to the variation of the development of animal-sound words production in young children.

Onomatopoeia is important in early language development because it allows children to start creating associations in their brain between the sounds they say and the meanings behind them (Motamedi et al., 2020). Additionally, onomatopoeia improves their expressive language skills where they can advance their communication with their peers (Motamedi et al., 2020). In addition to this, onomatopoeia also allows children to gather data from their sensory environment and use it when talking about more unfamiliar referents (Motamedi et al., 2020). A recent study examined how children learn the associations between their words and the meanings in their early language development using onomatopoeia (Motamedi et al., 2020). This study included a total of 64 participants, and data was taken at 18 months, 26 months, and 34 months to observe the child’s vocabulary growth. The researchers explored the relationship between the child’s age and the use of onomatopoeic words. Specifically, this study found that learning onomatopoeic words can help improve a child’s expressive language vocabulary and use these words to engage with their sensory environment. Motamedi et al. (2020) did note that caregivers tend to produce a higher rate of onomatopoeic words when they interact with younger children, and these words are seen more in older children than in younger children.

In the second study in Motamedi et al. (2020), they also revealed that children were more likely to learn onomatopoeic labels over controlled labels. Although they found significant data for their hypothesis, it would be interesting to know if this pertains specifically to English or if this could be done in other countries with different languages to see if onomatopoeia is a universal technique of children learning the associations between words and meanings. Since animal-sound words are a type of onomatopoeic words, these data sets will be extremely useful in my research to see how being able to produce those sounds can impact children's early language development.

Early Word Learning

In general, children start to develop their linguistic abilities as young as six months of age and they follow a similar language progression. Within this developmental stage, onomatopoeic words are among the first words children start to learn (Motamedi et al., 2020). Even as infants, children begin in the pre-linguistic phase where they begin to process comprehension and meaning of the world. During this phase, there are beginnings of intentionality and children begin to use perlocutionary acts such as gazing, crying, laughing, smiling, and some vocalizations, which act as a precursor for the expression of pragmatics. Children then start to advance their linguistic capabilities by moving to more canonical syllables and then to more advanced forms between 9-18 months. This is where they would start to produce or imitate different animal-sound words. Animal-sound words have a large significance in early expressive language and play a key role in transitioning to more conventional words (Nylund et al., 2021). They also help children learn the association between words in their environment and meaning behind those words or sounds (Motamedi et al., 2021). The study of animal-sound words development could be a vital part of understanding expressive language development and the importance of children being able to produce or imitate those sounds in their environment. Furthermore, this helps to explain how children transition from animal-sound words to even more advanced linguistic forms. Linguistic variation can differ in many ways. By utilizing the

MacArthur CDIs from the Word bank (Frank et al., 2017), we can match lexical items more closely. The results could potentially provide important information about early language acquisition.

To discover the impacts on vocabulary growth from a variety of factors such as a child's age, sex, or other family characteristics, a study was performed by three researchers where they utilized vocabulary sets from the Finnish version of the MacArthur Communicative Developmental Inventory (Nylund et al., 2021). After implementing inclusion criteria, there were a total of 719 participants in this experiment. The main lexical categories that were focused on were sound effects and animal-sound words, common nouns, people, games and routines, action words, descriptive words, time words, pronouns, questions, prepositions, amount, and particles. The researchers found that between 13-24 months, there was a large variation in the total vocabulary size for the participants. They also noted that girls seemed to have a larger vocabulary size at 13 months in sound effects and animal-sound words, common nouns, people, and games and routines. This continued even up until 24 months when the girls had significantly larger vocabulary sizes in all lexical categories observed. This study by Nylund et al. (2021) could benefit from more research on the sound effects category to see if there are specific items where boys and girls do have more variation. I think it would be interesting to see the factors presented in the study for animal-sound words over sound effect noises and see if there is a significant difference between boys and girls. In general, this study is important when thinking about the different factors that play into animal-sound production for children within a similar age group to the participants I am observing.

While the previous study mainly focused on the factors behind language development, others focus on the production of common lexical items. A recent study focused specifically on the production of color words across 11 languages (British English, German, Danish, Norwegian, Swedish, French, Italian, Spanish, Mandarin, and Cantonese) for children between the ages of 8 - 30 months of age (Forbes & Plunkett, 2020). In the first study, there was a total of 3,413 CDIs were completed using the four color terms: red, blue, green, and yellow. The researchers used previously collected data from the Oxford CDI, which measured comprehension and production in 416 terms. Study 2 then consisted of 22,642 participants from the Word Bank database. This study could benefit from more research on the cultural exposure to these languages and why there may be variability across each language. The key findings from this study aid in suggesting that infants use their linguistic exposure and experience to advance their understanding of color words. This study also uses a similar data collection method to the present study of animal sound production with the use of MB-CDIs and how they can impact vocabulary development.

Similar to the study by Forbes and Plunkett (2020), previous research has shown cross-linguistic differences in early language development. For instance, in a study by Devescovi et al (2005), researchers aimed to answer the questions on if vocabulary would account for more developmental variance than age would, and what the differences are in structural complexity between the English vs Italian language. This study was performed on 466 children, equally divided based on their native language of English or Italian and relied on data from parents or other caregivers. The English data was based on the CDI and a total of a 680-word vocabulary production checklist whereas the Italian used data from the MacArthur-Bates CDI with a 670-word vocabulary production checklist. This study found a positive correlation between mean length of utterance (MLU) and content words on the MB-CDI and spontaneous speech samples. Furthermore, they examined the relationship between MLU and vocabulary size to be nonlinear in English, but linear in Italian. This proposes the idea that vocabulary size can provide a basis for cross-linguistic comparisons in grammatical development (Devescovi et al., 2005) Primarily, they concluded that the Italian children had higher scores in structural complexity which the researchers hypothesized was due to a higher proportion of social words. As mentioned by the researchers, this study is based on a very limited number of participants and the data can be subjective since they are using parental reports instead of free-speech recordings. Based on this research, I expect cross-linguistic differences to be present in my study.

Animal-Sound Words Across Languages

Animal-sound words can greatly vary across languages phonologically. Presumably, the production of these can be dependent on cultural exposure to that animal, and how others imitate those sounds to make it become a part of their lexicon. Continuing with the idea of linguistic variation, there is a great difference in phonemes and phonological rules across languages and the average age at which these phonemes are produced can also vary depending on the complexity of the phonology in their language (Devescovi et al., 2005). There are a lot of data into English animal-sound words and imitating those (Motamedi et al., 2020), but this is not as widely researched in other languages. Different languages may also categorize animal-sound words uniquely (Abbott et al., 2001). For instance, in English, many may assume “chirp” or “peep” to both be birds of any kind whereas in a language like Danish, they create distinct sounds depending on the size of that bird (Abbott et al., 2001).

As both an SLP and an audiologist, it is important to understand the cross-linguistic differences as each language may have significant differences in pragmatics, semantics, or syntax. The present study focuses mainly on phonology of animal-sound words, which can provide a lot of information as to how the child both speaks and hears and can be extremely beneficial when evaluating the child for services. Even more so, this can help a clinician to determine the child's expressive language skills. As described by Motamedi and others (2020), onomatopoeic words are some of the most common sounds that children learn first. These researchers (Motamedi et al., 2020) continue to say that by learning the association between words used and the meaning behind them, such as in onomatopoeic words, children will start to advance their linguistic capabilities.

Many studies have been done utilizing the importance of animal-sound words and their impact on young children. One study to note is if young medics can use animal-sound words as an effective tool of verbal communication engagement with their pediatric patients (Cornwall & Roy, 2016). In this study, the researchers used a sample of convenience of six native-English medical students where each participant was required to listen to and repeat selected pre-recorded sounds in the languages of Dutch, Arabic, and Danish. The main animal-sound words that were emphasized included those for a duck, cow, dog, frog, pig, and sheep. These participants were then rated on how accurately they could imitate the sounds in each of the recordings using a 1-5 scale with 1 being barely recognizable and 5 being an excellent imitation. The researchers found that Danish imitations had the lowest mean rating of 3.1 in comparison to Dutch (mean = 3.6) and Arabic (mean = 3.8). On average, the participants showed greater imitation for sheep sounds (mean = 4.7) than for pig sounds (mean = 2.2) (Cornwall & Roy, 2016). Because the data was a convenience sample which involved possible bias and students under the influence, the results can be viewed as informal and subjective. The results from a larger sample could help to explain how medical professionals working with pediatric patients can better engage their clients with animal-sound words. Regardless, this study displayed that by utilizing their linguistic competence in animal-sound words, one can improve their engagement with clients from multiple ethnic backgrounds. The research used in Cornwall & Roy's 2016 study can be utilized to support that learning animal-sound words can be useful cross-linguistically to display information about how a child learns to produce these, and likewise, use them in their expressive language.

Animal-sound words are not solely useful in studies involving children and their vocabulary development. In another study, animal-sound words are used to further investigate the influence of familiar environmental sounds on sound processing outside of the focus of attention for adults between the ages of 18-33 years old (Kirmse et al., 2009). These researchers compared event-related brain protocols (ERPs) of a familiar animal sound to an unfamiliar complex sound that was matched acoustically for a sample of 24 young adults. This study concluded findings that a familiar sound does elicit a certain response in the brain before 300 ms, which supports that animal-sound words are able to be processed even when they are outside of the focus. This further helps to display that animal sound production can be a useful tool in expanding more complex expressive language, even as an adult. A limitation of this study is that they only applied their findings to one language, so it could have been interesting to see it applied to a more diverse scale to truly help understand vocabulary development in children.

The Word Bank and Parent Reports

In this study, I examined the cross-linguistic differences in young children's production of animal-sound words using the Word Bank (Frank et al., 2017). The Word Bank (Frank et al., 2017) was created to provide a structured database that can be utilized to research early language acquisition and development. While Mac-Arthur Bates Communicative Development Inventories are an inexpensive way of obtaining data to be used in studies, they are not easily accessible. The Word Bank, however, is publicly shared and includes data from various types of languages. This data even includes more in-depth analyses that can be used to determine associations between common children's factors such as mother's educational level, age, gender, and language production and/or comprehension. MB-CDIs also rely heavily on parent reports, which can be more subjective and biased towards their own children (Frank et al., 2017). To help combat this, the Word Bank allows researchers to see certain item trajectories and vocabulary norms, which can be used to compare the data in each language.

Continuing with the Word Bank, there are multiple lexical categories including animal-sound words and other sound effects. These data can even be separated into whether the child produces the word or comprehends it, which provides another set of analysis that can be utilized. For my study, this allowed for more in-depth observations behind the factors that could be associated with early development of animal-sound words cross-linguistically. Specifically, I collected data on the 11 animal-sound words found in the Word Bank (Table 1). The MB-CDI form in some languages does not include the equivalent words of *gobble gobble* (turkey), *neigh* (horse), *oink* (pig), and *peep peep* (chicken). In this study, I focus on the analysis of the following seven words: *Cockadoodledoo* (rooster), *meow* (cat), *moo* (cow), *quack quack* (duck), *woof woof* (dog), *baa baa* (sheep), *and grr* (bear).

Because MB-CDIs rely heavily on parent reports, studies have been done to observe the validity of how accurately parents can detail their child's language abilities. For many of these studies, the worry is that parents may overestimate their children's capacity and make it seem like it is more advanced than it is. In a study, Feldman et al. (2005) utilized a randomized clinical trial for delayed tympanostomy tube placement with a total of 113 participants and data taken from MB-CDIs. This study could benefit from more research on speech sound disorders as this was mentioned a few times in the paper, but it would be interesting to see the differences in parent reports of those with neurotypical development and those with speech sound disorders. This study also uses a small sample size of only 113 participants, so it would be beneficial to increase this to a larger and more representative population. Lastly, using Brown's developmental scale for mean utterance length could be a better collection assessment for the data. This study found mainly that parents are reasonably good informants about their child's expressive language development for the age range of 18-30 months. This study also shows a lot about the other factors that may affect the validity of parent reports such as the age of the mother, the mother's education background, the socioeconomic status, etc. These all help reveal how much of a role these can play in expressive language reports, which will be beneficial for my study of animal-sound words.

Table 1

Animal-sound Words Found in Stanford's Word Bank

Language	Terms										
English (American)	cockadoodledoo	meow	moo	quack quack	woof woof	baa baa	gobble gobble	neigh	oink	peep peep	grr
English (British)	cockadoodledoo	meow	moo	quack	woof	baa baa	--	--	--	--	grr
English (Australian)	cockadoodledoo	meow	moo	quack quack	woof woof	baa baa	--	--	--	--	grr
Croatian	kukurikuuu	mijau	muu	kva-kva	vau-vau	Ga-ga	--	--	--	--	grr
Danish	kykliky	mjav	muh	rap	vov	mæh	--	--	--	--	grr
French (French)	cocorico	miaou	meuh	coin coin	--	--	--	--	--	--	grrrr
French (Quebecois)	cocorico	miaou	meuh	coin coin	wouf wouf	bêêêê bêêêê	--	--	--	--	grrrr
Greek	κικιρίκου	μιάου	μουουου	εκεκέξ κουάξ κοι	γαβ γαβ	μπεεε	--	--	--	--	--
Hebrew	קוקוריקו	מיאו	מו	געגע	הב הב	מה מה	--	--	--	ציף ציף	--
Italian	coccodè	miao	muh	qua qua	bau bau	beh beh	--	--	--	--	grr
Kiswahili	Kukuriukuu	miau miau	mooh mooh	--	--	Baa baa, mmee mmee	--	Jirani	--	--	--
Korean	꼬끼오	야옹	음매	꽥꽥	멍멍	--	--	--	꿀꿀	--	--
Norwegian	kykeliky	mjau	møø	gakk gakk	voff voff	bææ	--	--	--	--	grr
Russian	кукареку	мяу	му	кря	ав	бе, ме	бл-бл	о/цока-юоши	хрр/хрю	--	ррр
Slovack	kikiriki (kohút)	mňau (mačka)	mú (krava)	--	hav (pes)	--	--	--	--	--	--
Spanish (Mexican)	quiquiriquí	miau	muu	cuacuá	guaguá	bee/mee	--	--	--	--	--
Swedish	kuckeliku	mjau	mu	kvack kvack	vov vov	bä bä	--	--	--	--	grrr
Cantonese	--	喵 (貓叫聲)	--	呷呷 (鴨叫聲)	Wou Wou (狗吠聲)	咩咩 (羊叫聲)	--	--	--	--	--
Mandarin	--	喵（猫叫）	--	嘎嘎（鸭子叫）	汪汪（狗叫）	咩咩（羊叫声）	--	--	--	--	--
Turkish	--	Pisi-pisi	Möö	--	Havhav	Mee	--	--	--	--	--

The Current Study

The current study aims to examine the cross-linguistic differences in the production of animal-sound words for children between the ages of 12-30 months. Specifically, the study focuses on whether animal-sound words are universally produced for children in the early linguistic phases. Animal-sound words include any imitation of a sound that an animal would typically make. This study examines 7 animal-sound words including *Cockadoodledoo, meow, moo, quack quack, woof woof, baa baa, and grr*. Using data from Stanford's Wordbank and the MB-CDI list, this study explores cross-linguistic animal-sound patterns of production. This data was collected from a total of 17,409 participants across 17 languages. The research will include different factors that may impact the patterns of animal-sound production including the association between onomatopoeic words and their meaning, early word learning, linguistic variation of animal-sound words, and the Word Bank, along with the validity of parent reports.

Generally speaking, the study focuses on typical early production of animal-sound words for languages across the world. *The s*pecific research questions are:

1. What are the developmental patterns of animal-sound word production by children from 12 to 30 months across languages? With this, are there any linguistic variations?
2. Does syllable length influence children's production of animal-sound words?
3. Do the factors of age, sex, and language contribute to a higher proportion of animal-sound word production?

METHODS

Participants

The dataset downloaded from the *WordBank* includes a total of 17,409 monolingual participants between the ages of 12 months to 30 months among 17 languages. Shown in Table 2 below, there are a differing number of participants in the samples across languages with the smallest sample size being in Greek (n=176) and the highest sample size being in Australian English (n=1,493). On average, the age range is between 12-30 months with a couple of exceptions. For Hebrew, the data begins at 25 months and goes to 36 months of age. Then for Italian, Korean, Russian, and Slovack, the age ranges from 12-36 months. There are also different numbers of each gender observed for each language, but there are more female participants. Specifically, there are 8,747 females included and 8,662 males included in this data. All data was collected and analyzed through Stanford's Word Bank and MacArthur CDIs. After first collecting all data from the 17 languages, the data was cleaned to only include participants between the ages of 12-30 months. Table 2 shows the month categories 12-18, 19-24, 25-30 for all languages. Italian, Korean, Russian, and Slovack also include an age range of 31-36 months. The analysis of this study focused on children from 12 to 30 months so any participants between the ages of 31-36 months were not included. From here, the data was re-coded in order to compare the same lexicon cross-linguistically.

Table 2

Gender and Age-Range Across Languages

Language	n	Age group	Female	Male	Unknown
American English	1255	12 - 18 months	97	114	0
		19 - 24 months	271	259	0
		25 - 30 months	266	248	0
Australian English	1493	12 - 18 months	284	304	0
		19 - 24 months	253	233	4
		25 - 30 months	208	211	0
British English	1206	12 - 18 months	285	331	0
		19 - 24 months	251	303	0
		25 - 30 months	21	15	0
Cantonese	987	12 - 18 months	86	86	0
		19 - 24 months	207	209	0
		25 - 30 months	192	207	0
Croatian	377	12 - 18 months	27	33	0
		19 - 24 months	82	74	0
		25 - 30 months	70	91	0
Danish	1223	12 - 18 months	123	76	0
		19 - 24 months	304	255	0
		25 - 30 months	248	217	0
French	522	12 - 18 months	24	24	46
		19 - 24 months	153	127	69
		25 - 30 months	100	94	4
French (Quebecois)	824	12 - 18 months	81	71	1
		19 - 24 months	169	172	1
		25 - 30 months	164	167	1
Greek	176	12 - 18 months	24	21	0
		19 - 24 months	31	37	0
		25 - 30 months	28	35	0
Hebrew	357	12 - 18 months	0	0	0
		19 - 24 months	0	0	0
		25 - 30 months	181	176	0
Italian	639	12 - 18 months	18	13	0
		19 - 24 months	172	165	0
		25 - 30 months	132	139	0
Kiswahili	87	12 - 18 months	2	0	0
		19 - 24 months	19	7	0
		25 - 30 months	28	31	0

Table 2 (Cont.)

Gender and Age-Range Across Languages

language	n	age group	Female	Male	NA
Korean	938	12 - 18 months	37	28	0
		19 - 24 months	200	215	0
		25 - 30 months	223	235	1
Mandarin	1056	12 - 18 months	105	108	0
		19 - 24 months	210	212	0
		25 - 30 months	211	210	0
Norwegian	1119	12 - 18 months	273	251	0
		19 - 24 months	175	210	0
		25 - 30 months	100	110	0
Russian	712	12 - 18 months	25	18	0
		19 - 24 months	156	141	0
		25 - 30 months	202	170	1
Slovack	924	12 - 18 months	69	66	0
		19 - 24 months	186	184	0
		25 - 30 months	214	205	0
Spanish (Mexican)	1146	12 - 18 months	98	90	0
		19 - 24 months	251	252	0
		25 - 30 months	223	232	0
Swedish	893	12 - 18 months	90	66	3
		19 - 24 months	247	208	4
		25 - 30 months	136	146	0
Turkish	1475	12 - 18 months	175	169	0
		19 - 24 months	361	366	0
		25 - 30 months	179	225	0

As for the mother's education level, the same participants from Table 2 are used. Table 3 shows the number of participants' mothers within each category including college, graduate, NA (not known/announced), none, primary, secondary, some college, some graduate, and some secondary. For many of them (12,518 people), the mother's education level is not known or included in the data. The smallest category was for no education, which was only for 30 of the participants. Out of all the languages, Spanish (Mexican) had the most mothers with a college degree with 1,713 individuals in total. Norwegian included the most mothers with a graduate degree education (273 members total).

Table 3

Mother Education Levels

language	None	Primary	Some Secondary	Secondary	Some College	College	Some Graduate	Graduate	NA
American English	0	6	101	318	311	316	63	139	1
Australian English	0	0	0	0	0	0	0	0	1497
British English	0	0	0	0	0	0	0	0	1206
Cantonese	0	0	0	0	0	0	0	0	987
Croatian	0	0	0	0	0	0	0	0	377
Danish	23	73	4	53	559	332	1	178	0
French	0	0	0	46	101	11	43	21	419
French (Quebecois)	0	0	0	0	0	0	0	0	827
Greek	0	0	0	0	0	0	0	0	176
Hebrew	0	0	0	0	0	0	0	0	357
Italian	0	0	0	0	0	0	0	0	639
Kiswahili	0	0	0	0	0	0	0	0	87
Korean	0	0	0	5	8	57	0	23	846
Mandarin	0	0	0	0	0	0	0	0	1056
Norwegian	0	15	0	253	0	575	0	273	3
Russian	0	0	0	0	0	0	0	0	713
Slovack	0	0	0	0	0	0	0	0	924
Spanish (Mexican)	7	81	256	345	7	422	0	0	28
Swedish	0	0	0	0	0	0	0	0	900
Turkish	0	0	0	0	0	0	0	0	1475

In addition to the production of animal-sound words of individual children, the dataset provides information about the proportion of the children who were able to produce each animal sound by language. The initial dataset includes 2,608 data points. Each data point is an age group from 8 to 36 months. In the analysis, I focused on children from 12 to 30 months and the production of seven animal-sound words for rooster (*Cockadoodledoo* in English), cat (*meow* in English), Cow (*moo* in English), duck *(quack quack* in English), dog (*woof woof in English),* sheep (*baa baa* in English), and bear (*grr* in English) (See all target animal-sound words across the 17 languages in Table 1)

Table 4

Dictionaries used as references when writing out the orthographic IPA and syllable lengths

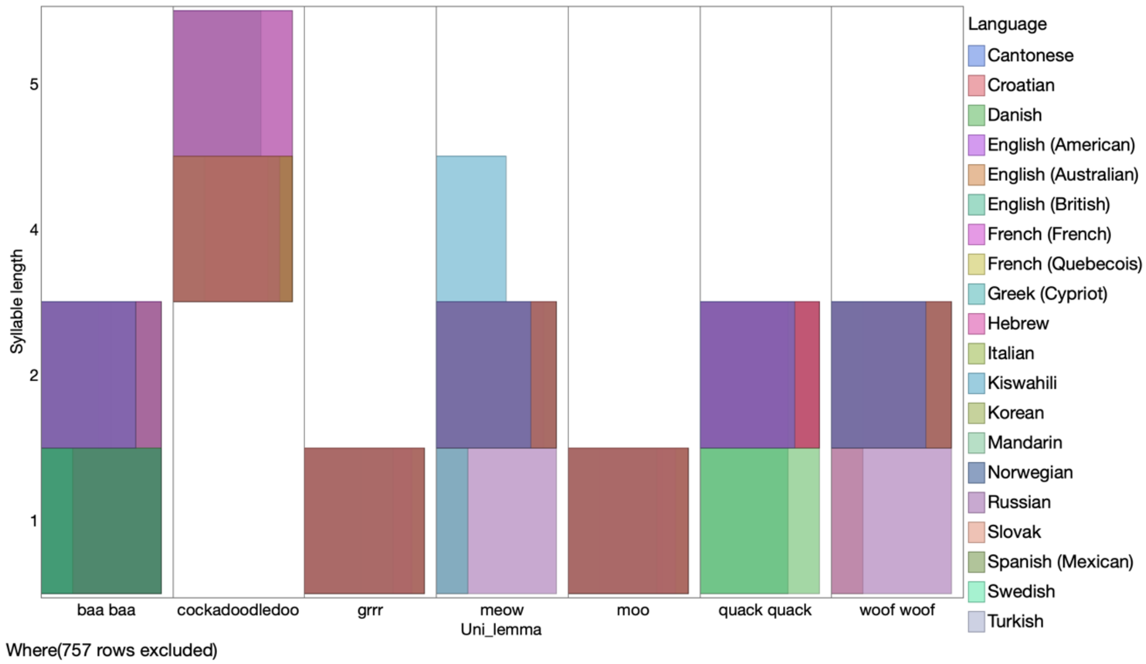
Language	Dictionary
American English	(Merriam-Webster, 2003)
Cantonese	(Bauer, 2021)
Croatian	(Susnjar, 2000)
Danish	(Garde, 2006)
French	(Merriam-Webster, 2005)
Greek	(Diggle et al., 2021)
Hebrew	(Sivan et al., 2009)
Italian	(Martini, 2016)
Kiswahili	(Rigdon, 2016)
Korean	(Lee & Yi, 2010)
Mandarin	(Collins, 2018)
Norwegian	(Haugen, 1974)
Russian	(Katzner, 2006)
Slovack	(Trnka, 1992)
Spanish	(Jarman et al., 2008)
Swedish	(Prisma, 1998)
Turkish	(Kornrumpf & Akdikmen, 2009)

To further analyze the effect of syllable length, I identified the number of syllables of each animal sound word in each language (see Figure 1). Figure 1 shows overlap among the languages within each of the columns. To analyze the syllable length, I used language-specific dictionaries (see Table 4) to orthographically write out the IPA for each one of the animal-word sounds. A full IPA table is included in the appendix. From here, I was able to calculate the number of syllables in each one of the words for each language by breaking up the phonemes and saying or listening to the words out loud. *Cockadoodledoo* (rooster) ranged from 3-5 syllables cross-linguistically. *Meow* (cat) consisted mainly of 1 to 2 syllables across the languages with the exception of Kiswahili. *Moo* (cow) had 1 syllable throughout every language depending on if the word used was repeated such as in Kiswahili (*mooh mooh*). Similarly, *baa*

baa (sheep) had 1-2 syllables based on if the animal-sound word was repeated. *Grr* (bear) had 1 syllable in each language analyzed in this study. *Quack quack* (duck) ranged from 2-5 syllables cross-linguistically. *Woof woof* (dog) had the most variation in the number of syllables across each language with a range of 1-4 syllables. All in all, most of the animal-sound words ranged between 1-2 syllables, except for *cockadoodledoo* in all languages and *miau miau* in Kiswahili. A syllable is defined as a unit with at least one vowel forming a part of the word. For this study, examples include *meow* (cat) which has two syllables or *woof woof* (dog) which has also has two syllables. For *meow* (cat), there is the consonant and vowel structure for the first syllable ("*me*") and the diphthong ("*ow*"). For *woof woof* (dog), there are multiple vowels but there is still one syllable in the "woof" so there are two syllables. Using the International Phonetic Alphabet (IPA) (see Appendix B) and language-specific dictionaries, syllable amounts were calculated for each animal-sound word within each language. The syllable length was determined to analyze the patterns for animal-sound words cross-linguistically.

Figure 1

Syllable length of the language sounds (uni-lemma) by language


Syllable length
5
4
2
1
baa baa
cockadoodledoo
grrr
meow
moo
quack quack
woof woof
Uni_lemma
Where(757 rows excluded)
Language
Cantonese
Croatian
Danish
English (American)
English (Australian)
English (British)
French (French)
French (Quebecois)
Greek (Cypriot)
Hebrew
Italian
Kiswahili
Korean
Mandarin
Norwegian
Russian
Slovak
Spanish (Mexican)
Swedish
Turkish

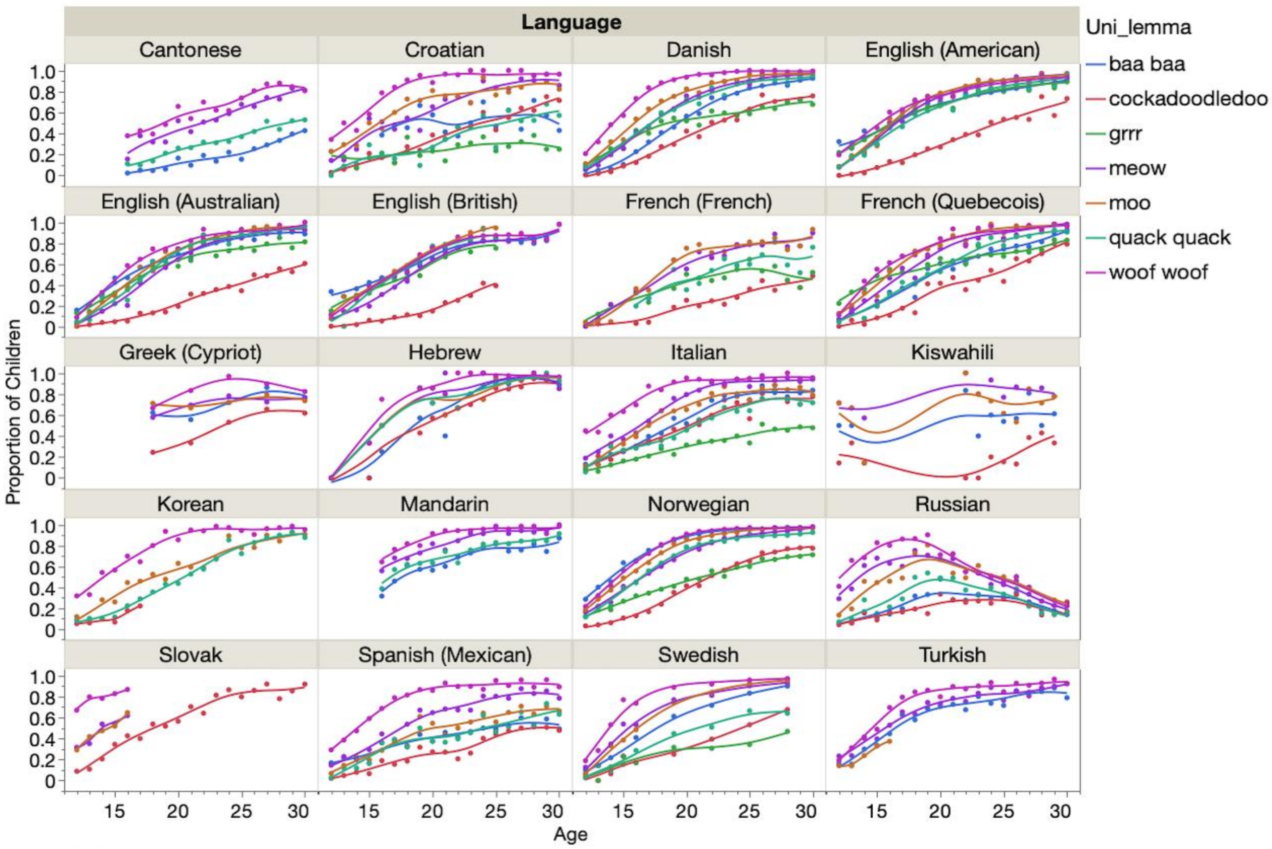
RESULTS

1. Descriptive Statistics

The developmental patterns of animal-sound production are displayed in Figure 2. Figure 2 shows the developmental trajectory of animal sound production between the age of 12 to 30 months across language groups. On the x-axis is the animal-sound word among each language and the y-axis displays the proportion (as a percentage) of the participants able to produce the word. Across the languages, there is a similar pattern of trajectory for each of the animal-sound words. With that being said, Russian has higher associations at the early age ranges and then slopes downward as the participants get older. Kiswahili also shows deviance in the results as animal-sound words such as *meow* (cat), which is flat across the age ranges. *Cockadoodledoo* (rooster) also presents a notch in the production of animal-sound words in the middle of the age ranges. Overall, *meow* displays the highest proportion across the languages throughout the age-ranges whereas *cockadoodledoo* (rooster) shows the lowest proportion cross-linguistically. The general pattern is that as children across all languages grow older, there is a greater proportion of the population able to produce animal-sound words.

Figure 2

The developmental trajectory of animal sound production by language



Analysis was run to determine how many participants in each language were able to produce the animal-sound word, and this was organized based on the age-range group. Any data collected from children below 12 months of age or above 30 months of age was not included in this analysis. An example of the tables created for each can be found below in Figure 3 for *baa baa* (sheep). The rest of the Figures can be found in Appendix A.

Figure 3

Distribution of the production of baa baa across languages

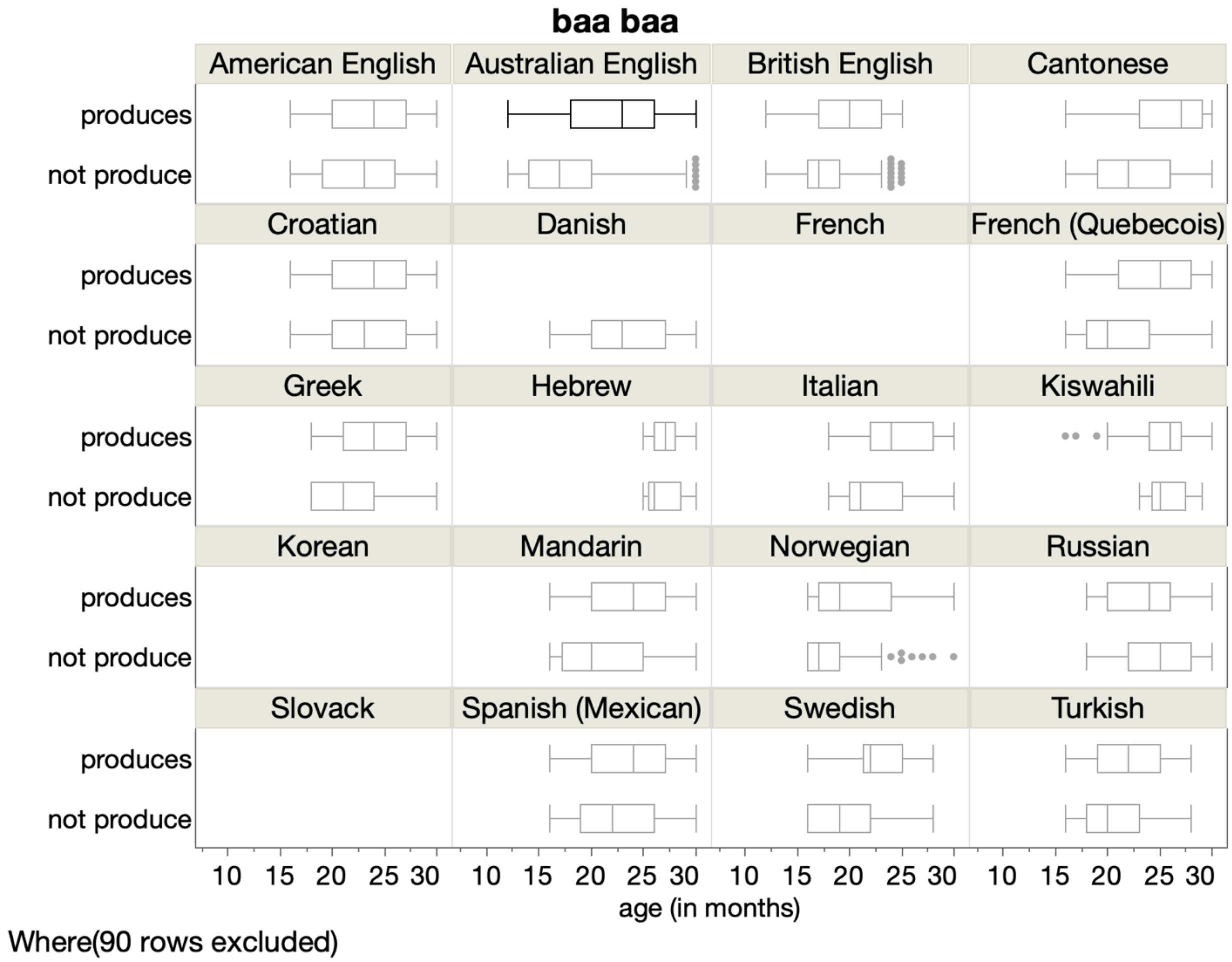
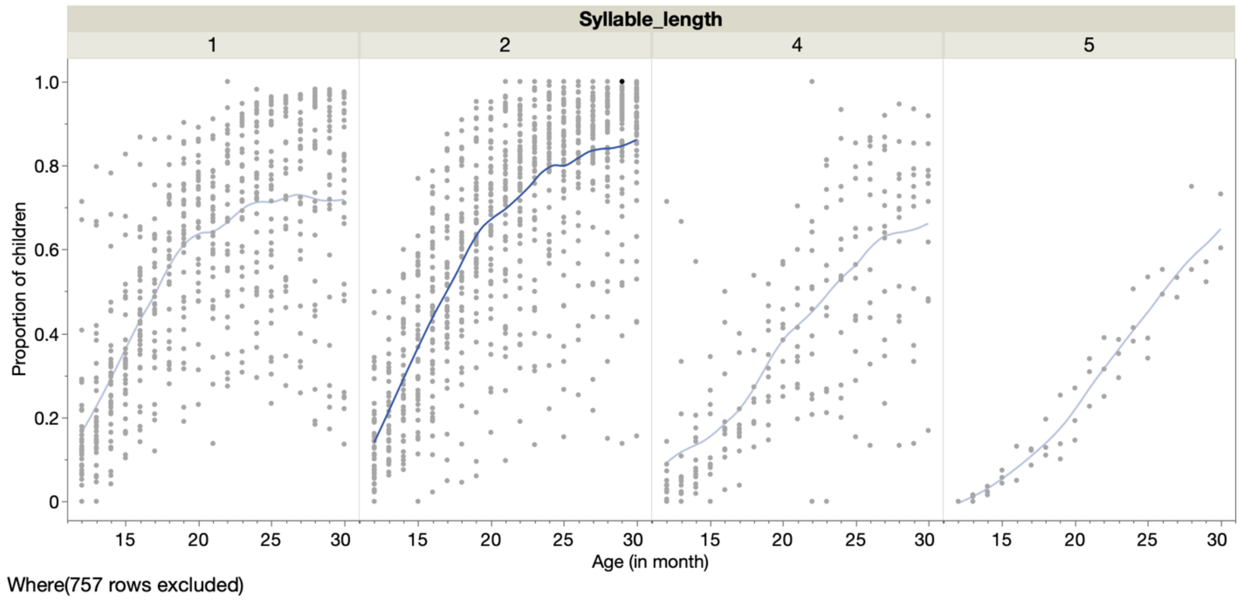


Figure 4 shows the trajectory of animal-sound words production by syllable length across all languages. Out of the seven animal-sound words, the majority fall within 1-2 syllables. There are some variations in *meow* (cat), *cockadoodledoo* (rooster), *and grr* (bear). There are also some interesting trajectories that occur for syllable length as the age increases where the length decreases. This can be seen for *moo* (cow) in one syllable, suggesting that as age increases, children become more proficient in producing animal-sound words.

Figure 4

The production of animal-sound words by syllable length

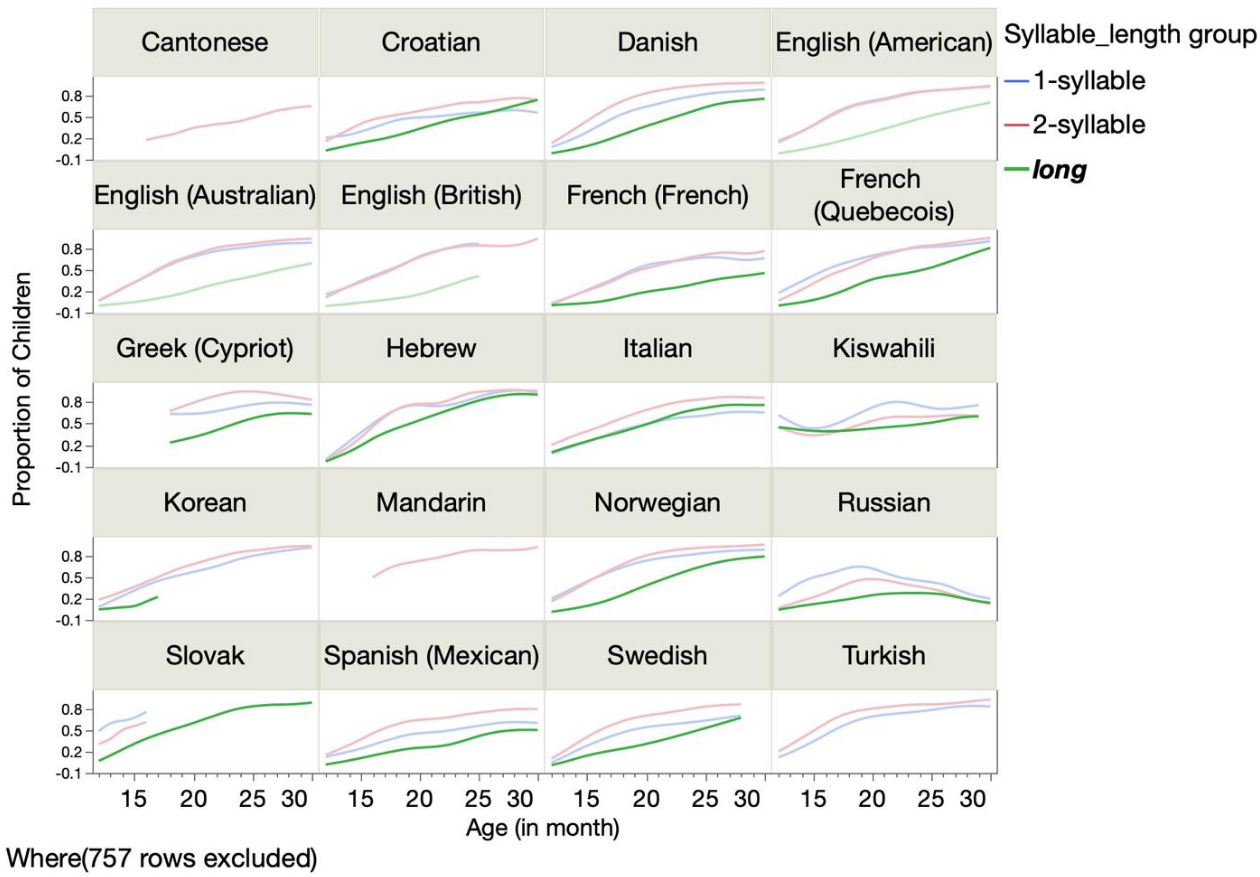


2. The effect of syllable length on the production of animal-sound words

A linear regression model was used to examine the effect of syllable length on children's production of animal-sound words. The dataset was the proportion of children who were able to produce specific animal-sound words. The dependent variable was the proportion of children. The independent variables were syllable length (1, 2, long) with covariates age and language as covariates. Since very few words are 5-syllable-words, the analysis group the 4 and 5 syllable words as "long" words. The analysis shows that syllable length was a significant predictor of the proportion of children who were able to produce the animal-sound words, F (5,1850) = 99.97, $p < 0.001$, η^2=9.2. The results also demonstrate that a lower proportion of children were able to produce longer animal-sound words compared to 1 and 2-syllable animal-sound words (see Figure 3), suggesting syllable length plays a role in children's production. In general, there are more children able to produce 1-2 syllable words and as the syllable length increases, there are fewer people who can produce those words. This same pattern is seen cross-linguistically as the green lines (for 4 & 5 syllables) in Figure 3 is almost always at a lower proportion in every single language where 4 & 5 syllables are included.

Figure 5

Syllable length effect on the proportion of children producing animal-sound words



2. Production of animal-sound words: The effect of age, gender, and language

Logistic regression analyses were done to examine the factors, including age, sex, and language that are associated with children's production of animal-sound words. The dataset from individual children was used for these analyses. The dependent variable was whether children were able to produce each animal-sound word based on the parent reports (1 = being able to produce and 0 not being able to produce), and the independent variables included age (in months), gender, and language.

Table 5 summarizes the results of the analyses. Language was the significant predictors for the production of all animal-sound words, including sheep (English equivalent: *baa baa*), rooster (English equivalent: *cockadoodledoo*), bear (English equivalent: *grr*), cat (English equivalent: *meow*), duck (English equivalent: *quack quack*), cow (English equivalent: *moo*), dog (English equivalent: *woof woof*). The significant language effect suggests that there are differences across languages in producing the animal sounds. Age was the significant predictor for the production of the sounds by bear (English equivalent: *grr*), but not the other animal-sound words. However, age and language interactions were significant for all animal-sound words, suggesting the age effects depend on language. For example, for the animal sound words for sheep (English equivalent: *baa baa*), more older children who learn Swedish were able to produce the word (*bä, bä*) than younger children, but a similar number of older and younger children were to produce the word (*baa baa*) in American English. Sex was not a significant predictor for the production of animal-sound words. However, the results also showed there were significant sex x language interactions across some animal-sound words for sheep (*baa baa*), bear (*grr*), cat (*meow*), cow *(moo),* duck *(quack quack),* and dog *(woof woof).* The results suggest that the sex difference (boys vs. girls) in words for those words depends on the language children are exposed to. For example, for the animal sound for duck, girls and boys had similar performance across most languages, but for children who learn Danish as a home language, girls were more likely to produce the word *rap* (word for duck sound) than boys.

Table 5

Nominal Logistic Regression Results

Animal-sound words	Effect	DF	χ^2	p
baa baa	age	1	0.01	>.05
	sex	2	8.60	<.05*
	language	16	1752.98	<.001***
	age x sex	2	9.49	<.05*
	age x language	16	339.51	<.001***
	sex x language	19	44.36	<.001***
cockadoodledoo	age	1	0.01	>.05
	sex	2	1.07	>.05
	language	16	602.83	<.001***
	age x sex	2	3.63	>.05
	age x language	16	176.00	<.001***
	sex x language	21	32.26	>.05
grr	age	1	51.60	<.001***
	sex	2	1.15	>.05
	language	10	181.30	<.001***
	age x sex	2	4.61	>.05
	age x language	10	214.40	<.001***
	sex x language	14	25.19	<.05*
meow	age	1	0.01	>.05
	sex	2	3.19	>.05
	language	19	1327.29	<.001***
	age x sex	2	2.53	>.05
	age x language	19	595.74	<.001***
	sex x language	24	55.66	<.001***
moo	age	1	0.00	>.05
	sex	2	0.44	>.05
	language	17	1464.90	<.001***
	age x sex	2	5.19	>.05
	age x language	17	552.77	<.001***
	sex x language	22	41.52	<.05*
quack quack	age	1	0.00	>.05
	sex	2	1.57	>.05
	language	16	942.51	<.001***
	age x sex	2	13.40	<.001***
	age x language	16	397.82	<.001***
	sex x language	21	62.93	<.001***
woof woof	age	1	0.00	>.05
	sex	2	2.77	>.05
	language	17	1804.08	<.001***
	age x sex	2	2.83	>.05
	age x language	17	543.43	<.001***

DISCUSSION

The purpose of this study is to examine the developmental patterns of animal-sound word production across languages. Not only are animal-sound words among the first words children begin to learn at a young age, but animal-sound word production is also important since it is a form of onomatopoeia and thus can be a sign of further advancements in language (Motamedi et al., 2021). This research could explain one's ability to both understand and produce animal-sound words at ages as young as 12 months old and has implications on children's overall expressive language production. In this study, I examined children's development patterns of animal-sound words using the MB-CDI databases. After the data were downloaded from the website, the data across languages were re-coded so they could be matched with the animal-sound words in English, and an orthographic IPA was written out for each word, within each language. Finally, the data was analyzed to determine if any factors (age, sex, language) were significant in terms of impacting the patterns of animal-sound production for children across the 17 languages.

The present study included three main research questions in which there are key results within each of the categories. First off, the number of syllables were calculated through the orthographic IPA. The IPA was written for each word based on that specific language dictionary or other reference books. Then from there, I was able to listen to the sounds or break them down into their syllables and count how many each animal-sound word consisted of. Overall, the results showed that syllable length was a significant predictor of the proportion of children who were able to produce the animal-sound words. The results showed that a lower proportion of children were able to produce longer words (e.g., 4- or 5-syllable animal-sound words compared to 1 and 2-syllable animal-sound words (see Figure 3), suggesting syllable length plays a role in children's production.

In addition, the logistic regression analyses results showed that the combination of age, gender, and language plays a critical role for the development of the seven animal-sound words. Language was the significant predictors for the production of the seven target animal-sound words, including sheep (*baa baa*), rooster (*cockadoodledoo*), bear (*grr*), cat (*meow*), duck (*quack quack*), cow (*moo*), dog (woof woof). Interestingly, age was the significant predictor for the production of the sounds by bear (English equivalent: *grr*), but not the other animal-sound words. In addition, significant sex x language interactions were found across some animal-sound words, including sheep (*baa baa*), bear (*grr*), cat (*meow*), cow *(moo),* duck *(quack quack),* and dog *(woof woof).* These prove that these factors do play a crucial role in animal-sound word development, which makes sense when compared to the literature surrounding language. These results were somewhat consistent with the initial hypothesis as age, gender, and language play a role in children's animal-sound word production. In addition to this, syllable length also proved to be a significant indicator of animal-sound production for each of the languages.

Language Differences in the Development of Animal-Sound Words

There were language differences throughout the results. For example, different languages use different animal-sound words. Due to them having different words, there are differences within the syllable amounts for each of the seven animal-sound words analyzed for this study. Even when looking up the words in the language-specific dictionaries and reference books, there were times when the word would be different than what was used for the MB-CDI database. Older children who have more experience with the language produced more animal-sound words than younger children. This finding is consistent with the findings by Forbes and Plunket (2020).

Girls also produced more animal-sound words than boys, which is similar to the observations in Huttenlocher et al., (1991). Abbot and others (2001) explain that words are different across languages due to the pronunciation of the imitation. Animals may not sound the same across languages, and therefore, people will imitate the sound they hear. While this study does not examine the imitation of animal-sound words, it displays that animal-sound words are a unique subset of language. This study focuses more on the phonology of animal-sound words, and if a child is able to produce each one of them. For phonology, each language likely has a distinct list of phonemes used in that language, which helps to explain the cross-linguistic variation for animal-sound word production.

While transcribing the words orthographically to IPA (International Phonetic Alphabet), I was only able to provide broad transcriptions, and even these may be different based on how the child individually articulated them. As for semantics, this is greatly observed through Abbott and others' (2001) research as each language may have individualized rules for how to use the words within a sentence, or when describing different categories of items. Morphology and syntax may not be as important in this study as we did not observe the use of these animal sound-words in the context of full sentences and changing the tense used in the conversations. This is consistent with the literature about language, and how the use of it, along with the domains of language, helps contribute to higher-order thinking and speaking skills (Motamedi et al., 2020).

Furthermore, learning onomatopoeic words can help to develop more advanced expressive language skills. As stated in Motamedi's research as well, onomatopoeia is extremely important in language development because it allows children to start understanding the meanings behind what they say (Motamedi et al., 2020). These results explain why there are variations among languages. Specifically, if children are within the developmental stages of language (which all participants in this study are) and are aiming to produce a word with a similar syllable structure and complexity of the phonemes used, they will likely yield similar rates of production. Even across a variety of languages, and groups of languages (such as Germanic, Romance, Sinetic, etc.), there are similarities in animal-sound production. This may be impacted based on their gender, with girls producing more animal-sound words than boys, along with the factors of age and language. Overall, the results show a general pattern that older children tend to produce more animal-sound words than younger children.

Factors that Contribute to the Development of Animal-Sound Words Across Languages

The main factors observed in this study on animal-sound production were age, gender, language, and syllable length. All four of these factors produced significant results, meaning they directly impact the rate of the participants being able to produce the animal-sound words. Only children ranging from 12-30 months of age were used in the present study. Children who did not meet the age criteria were not included in this study's analysis. Motamedi and others (2020) also describe the ages at which children start to learn languages and how infants start to develop their linguistic abilities at an extremely young age. The social stages of development start with the perlocutionary stage from 0-9 months and progresses onto the illocutionary stage at around 10 months. Then, at about 12 months of age, children start to develop more intentional forms of language and communication in the locutionary stage. As explained by Nylund and others (2021), animal-sound words can play a large significance in early expressive language. From here, children may advance in their linguistic capabilities by moving onto more canonical syllables between 9-18 months (Nylund et al., 2021). In terms of gender, Nylund et al. (2021) touches on this a little and found in their study that girls tended to have larger vocabulary sizes at 13 months. This was especially true for sound effects and animal-sound words, along with nouns, people, and games and routines (Nylund et al., 2021). Compared to the present study, similar results were yielded with girls producing more animal-sound words than boys. This helps imply that girls are likely to learn languages at a younger age and are more proficient at producing that language. As for the language factor, there was not as much in the literature about how each language is developed in their children. There is also not as much information about animal-sound production in many languages outside of American English, so this impacts how much is known.

Clinical Implications

The clinical implications of this study are to help clinicians across the world understand that many factors may be contributing to a child's vocabulary development. This study found that age, gender, and language have a significant association with the child's ability to produce animal-sound words so by knowing the factors within each language that may affect their production, clinicians can see a bigger picture of the assessment overall. This can help ensure diagnoses for language disorders or differences are accurate based on the child's language and cultural backgrounds. It also may help bridge the understanding of animal-sound production in America to countries around the world and realize that production is different, especially when considering the number of syllables in the word and the child's ability to imitate. Moreover, this helps clinicians understand that there may be many factors contributing to a child's vocabulary development. Specifically, if they were to evaluate a child at 30 months old who struggles to produce any animal-sound words, that child may have a deficit in expressive language development.

Limitations

There are still a few limitations of this study. The first being that the data used was from the MC-DBIs, which is a collection of parent observations. Parent reports may not always be reliable, and we did not get to hear each child produce the seven animal-sound words, which could affect the number of syllables calculated. Because I could not hear the words pronounced, I was not able to write out narrow transcriptions in the IPA and instead had to rely on orthographic spelling for them. Along with this, it’s hard to know if each of the participants did accurately and correctly produce each of the seven animal-sound words since we only received orthographic information about the lexicon used. However, as described by Feldman et al (2005), there have been positive substantial correlations between parent report measures and scores from concurrent language samples. Another interesting limitation of this study is about how each language uses these words because as seen in Abbott and other’s research (2001), there can be a variation in the words used to talk about the same concept. American English consists of a complicated vocabulary where many categories are over-generalized to represent a variety of items, such as the words seen in Abbott and other’s (2001) language table. This could have a huge impact on the ability to produce the different animal-sound words, but also knowing which words should be used when. This information may make it harder to compare the animal-sound words across languages in terms of syllable structure and exposure to the animal.

CONCLUSION

In conclusion, this study found significant cross-linguistic differences in the developmental patterns of animal-sound word production by children from 12 to 36 months. Multiple factors, including syllable length, age, sex, and language, contribute to children's animal sound production. Across all 17 languages, there were varying proportions of the participants who could produce animal-sound words. For some languages, there was a variety in the number of syllables included in each of the words. Syllable length displayed significant results, which indicated that they do play a role in children's production. Other factors such as age, sex, and language were also included to see if they had an impact on language. All three of these factors were significant predictors for the following animal words sheep (English equivalent: *baa baa*), duck (English equivalent: *cockadoodledoo*), cat (English equivalent: *meow*), duck (English equivalent: *quack quack*), and cow (English equivalent: *moo*). As for the sounds of the bear (English equivalent: *grrr*), only age and language produced significant results proving that the original hypothesis is supported in the data. There are still limitations to this research because the data was collected using parent reports through the MB-CDI and we were not able to hear each child to determine if they accurately produced each animal-sound word. In addition to this, there is a lot of information about American English vocabulary production, but it is much harder to find resources in other languages. All in all, the present study supports the hypothesis that the development of animal-sound words varies cross-linguistically depending on the age, gender, language, and the number of syllables in targeted words.

REFERENCES

Abbott, D., Lindgard, P.-A., van Beijeren, H., Irving, L., Soskin, S., Smelyanski, V., Fuchikami, N., Kurahashi, M., Giamarino, L., Mannella, R., Kish, A., Bergou, J., Singer, A., Tanatzi, A., Hajnsek, I., Pitz, I., Behrends, E., Bonnet, F., Jauho, A.-P., ...Shalizi, C. (2001). Animal sounds. *School of Electrical and Electronic Engineering*. http://www.eleceng.adelaide.edu.au/Personal/dabbott/animal.html

Bauer, R. S. (2021). *ABC Cantonese-English Comprehensive Dictionary*. Berlitz Publishing.

Cassani G., Chuang Y.-Y., Baayen R. H. (2020). On the semantics of nonwords and their lexical category. *Journal of Experimental Psychology. Learning, Memory, and Cognition, 46*(4), 621–637. https://doi.org/10.1037/xlm0000747

Collins Dictionaries. (2018). *Collins Fltrp English-Mandarin Chinese dictionary: Over 105,000 translations*. HarperCollins UK.

Devescovi, A., Caselli, M. C., Marchione, D., Pasqualetti, P., Reilly, J., & Bates, E. (2005). A crosslinguistic study of the relationship between grammar and lexical development. *Journal of Child Language*, *32*(4), 759-786. https://doi.org/10.1017/S0305000905007105

Haugen, E. (1974). *Norwegian English dictionary*. University of Wisconsin Press.

Diggle, J., Fraser, B. L., James, P., Simkin, O. B., Thompson, A. A., & Westripp, S. J. (2021). *The Cambridge Greek Lexicon*. Cambridge University Press.

Dudschig, C., Mackenzie, I. G., Strozyk, J., Kaup, B., & Leuthold, H. (2016). The Sounds of Sentences: D. *Cognitive, Affective & Behavioral Neuroscience, 16*(5), 940–961. https://doi.org/10.3758/s13415-016-0444-1

Feldman, H. M., Campbell, T. F., Kurs-Lasky, M., Rockette, H. E., Dale, P. S., Colborn, D. K., & Paradise, J. L. (2005). Concurrent and predictive validity of parent reports of child language at ages 2 and 3 years. *Child Development*, *76*(4), 856–868. https://doi.org/10.1111/j.1467-8624.2005.00882.x

Forbes, S. H., & Plunkett, K. (2018, October 13). Linguistic and Cultural Variation in Early Color Word Learning. *Child development*, *91*(1), 28–42. https://doi.org/10.1111/cdev.13164

Frank, M. C., Braginsky, M., Yurovsky, D., & Marchman, V. A. (2017). Wordbank: An open repository for developmental vocabulary data. *Journal of Child Language*, *44*(3), 677–694. https://doi.org/10.1017/S0305000916000209

García, R. R., Zamorano, F., & Aboitiz, F. (2014). *From imitation to meaning*. Frontiers in Human Neuroscience. https://doi.org/10.3389/fnhum.2014.00605

Garde, A. (2006). *Danish dictionary*. Routledge.

Huttenlocher, J., Haight, W., Bryk, A., Seltzer, M., & Lyons, T. (1991). Early vocabulary growth: Relation to language input and gender, *Developmental Psychology*, *7*(2), 236. https://doi.org/10.1037/0012-1649.27.2.236

Jarman, B. G., Russell, R., Carvajal, C. S., & Rollin, N. (2008). *The oxford Spanish dictionary: Spanish-English, English-Spanish* (4th ed.). Oxford University Press Inc.

Katzner, K. (2006). *English-Russian Dictionary* (2nd ed.). John Wiley & Sons, Inc.

Kirmse, U., Jacobsen, T., & Schröger, E. (2009). Familiarity affects environmental sound processing outside the focus of attention: An event-related potential study. *Clinical Neurophysiology*, *120*(5), 887–896. https://doi.org/10.1016/j.clinph.2009.02.159

Kornrumpf Hans-Jürgen, & Akdikmen, R. (2009). *Langenscheidt üniversal sözlüğü: Türkçe-ingilizce, ingilizce-türkçe.* Altın Kitaplar.

Laing C. (2019). A role for onomatopoeia in early language: Evidence from phonological development. *Language and Cognition, 11*(2), 173–187.

Lee, J., & Yi, K.-jin. (2010). *Korean standard dictionary: Korean-English/English-Korean comprehensive: 20,000*. Hippocrene Books.

Marchman, V. A., & Martínez-Sussmann, C. (2002). Concurrent validity of caregiver/parent report measures of language for children who are learning both English and Spanish. *ASHA Wire 45*(5). https://doi.org/10.1044/1092-4388(2002/080)

Martini, U. (2016). *Italian-English dictionary*. Barron's Educational Series, Inc.

Merriam-Webster. (2003). *Merriam-Webster's English dictionary* (11th ed.). Merriam-Webster Inc.

Merriam-Webster. (2005). *Merriam-Webster's French-English dictionary* (11th ed.). Merriam-Webster's Inc.

Motamedi Y., Murgiano M., Perniss P., Wonnacott E., Marshall C., Goldin-Meadow S., Vigliocco G. (2020). Linking language to sensory experience: Onomatopoeia in early language development. *Developmental Science*, 24, Article e13066. htpps://doi.org/10.1111/desc.13066

Nylund, A., Ursin, P. af, Korpilahti, P., & Rautakoski, P. (2021). Vocabulary growth in lexical categories between ages 13 and 24 months as a function of the child's sex, child, and family factors. *Frontiers in Communication*, 6, 709045. https://doi.org/10.3389/fcomm.2021.709045

Rigdon, J. C. (2016). *Swahili - English dictionary (Kamusi Ya Kiswahili - Kiingereza)*. Eastern Digital Resources.

Roy, M., & Cornwall, J. (2016). Does your pig go 'knor'?. *Medical Education,* 50, 1211-1213. htpps://doi.org/10.1111/medu.13085

Sivan, R., Levenston, E. A., & Melcer, I. (2009). *The New Bantam-Megiddo Hebrew & English Dictionary*. Bantam Books.

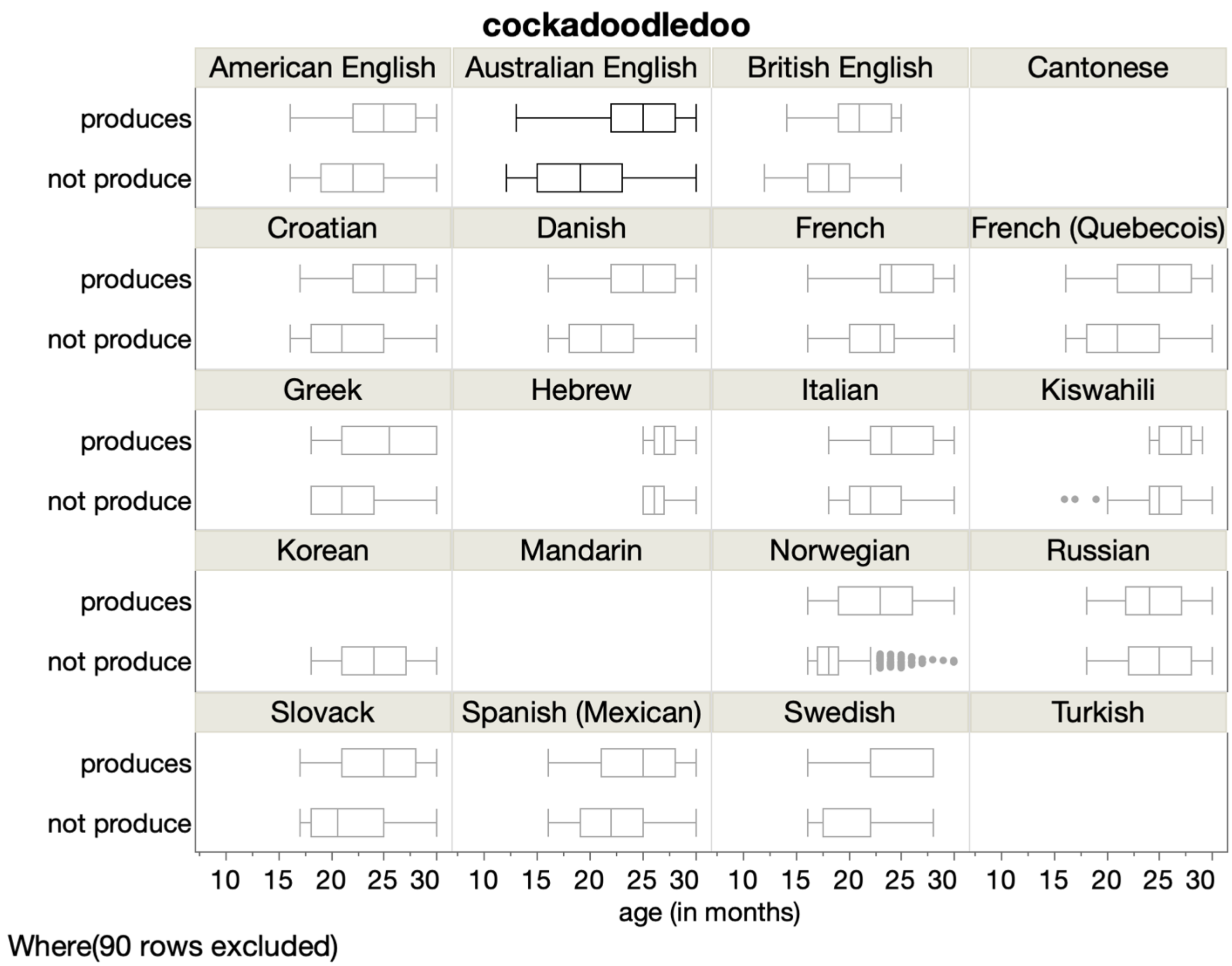
Susnjar, A. (2000). *Croatian-English/English-Croatian Dictionary and Phrasebook*. Hippocrene Books.

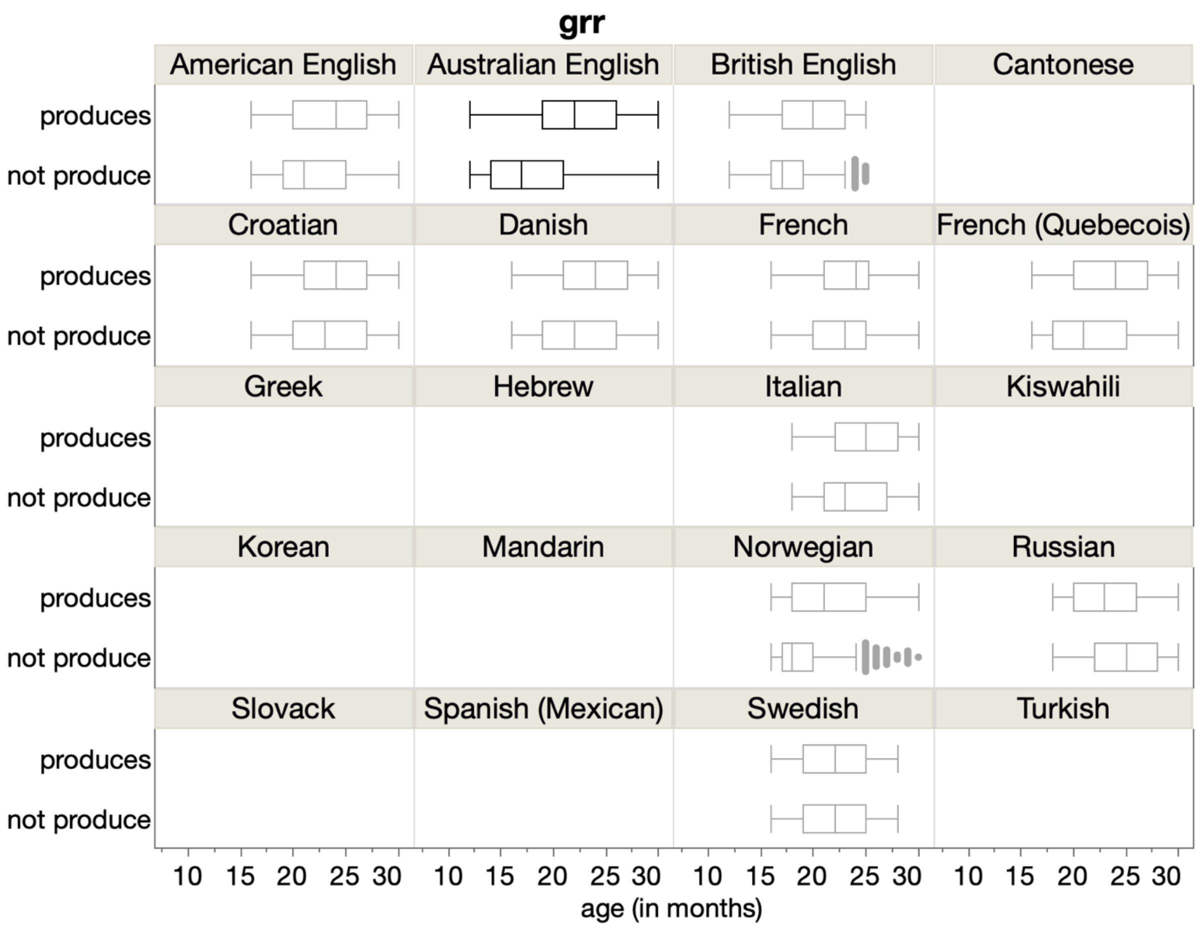
Trnka, N. (1992). *Slovak-English, English-Slovak dictionary*. Hippocrene Books.

Prisma. (1998). *Prisma's English-Swedish Dictionary*. University of Minnesota Press.

APPENDIX A

Distribution of the production of animal-sound words across languages





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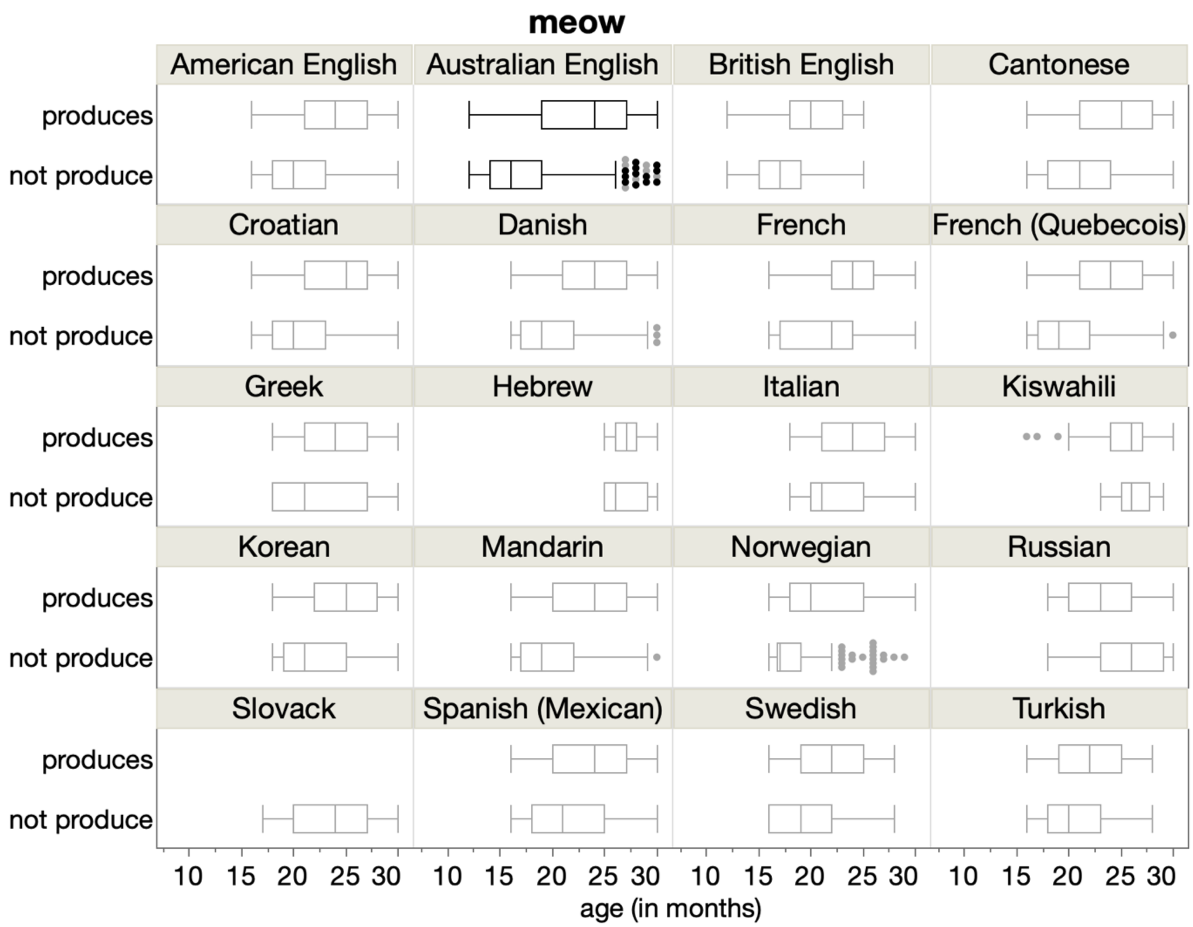

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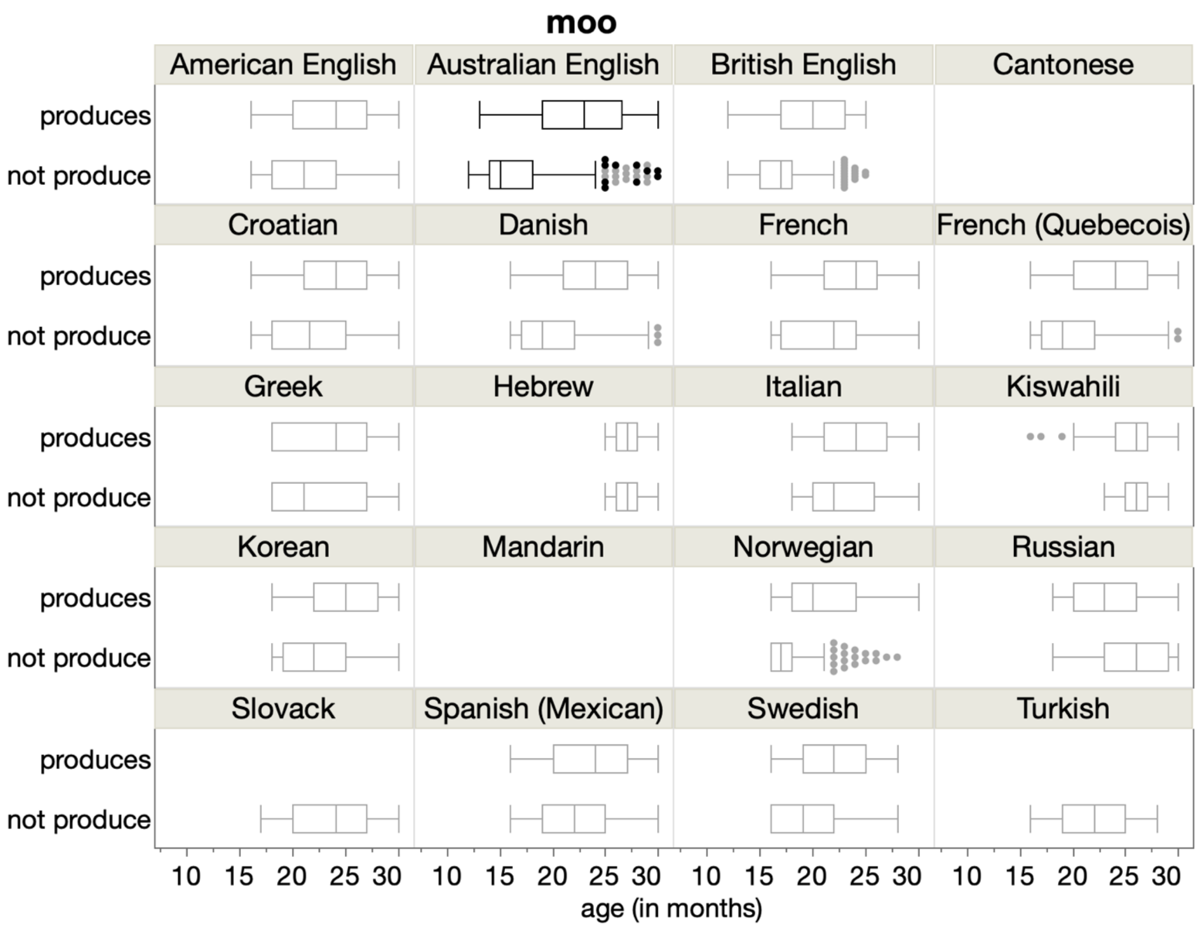

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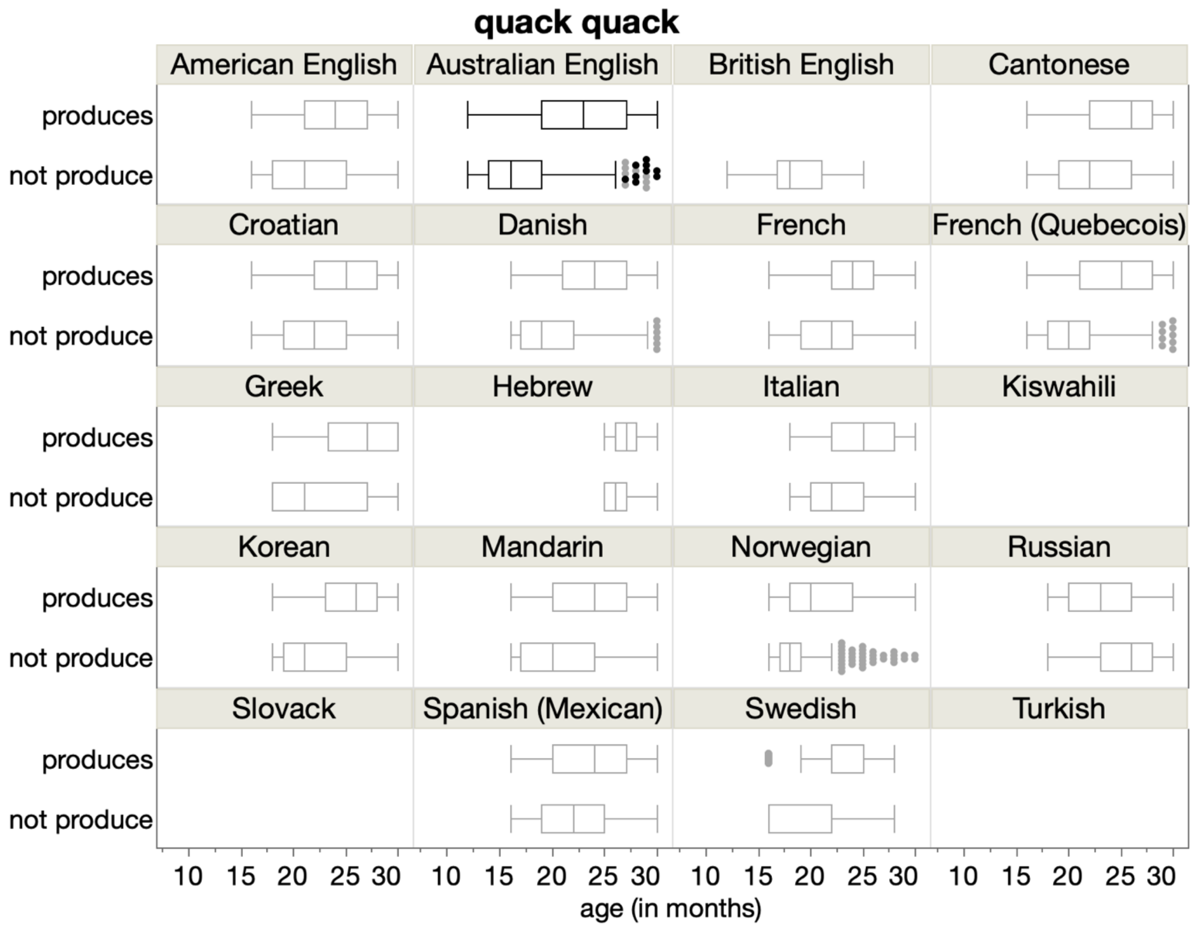

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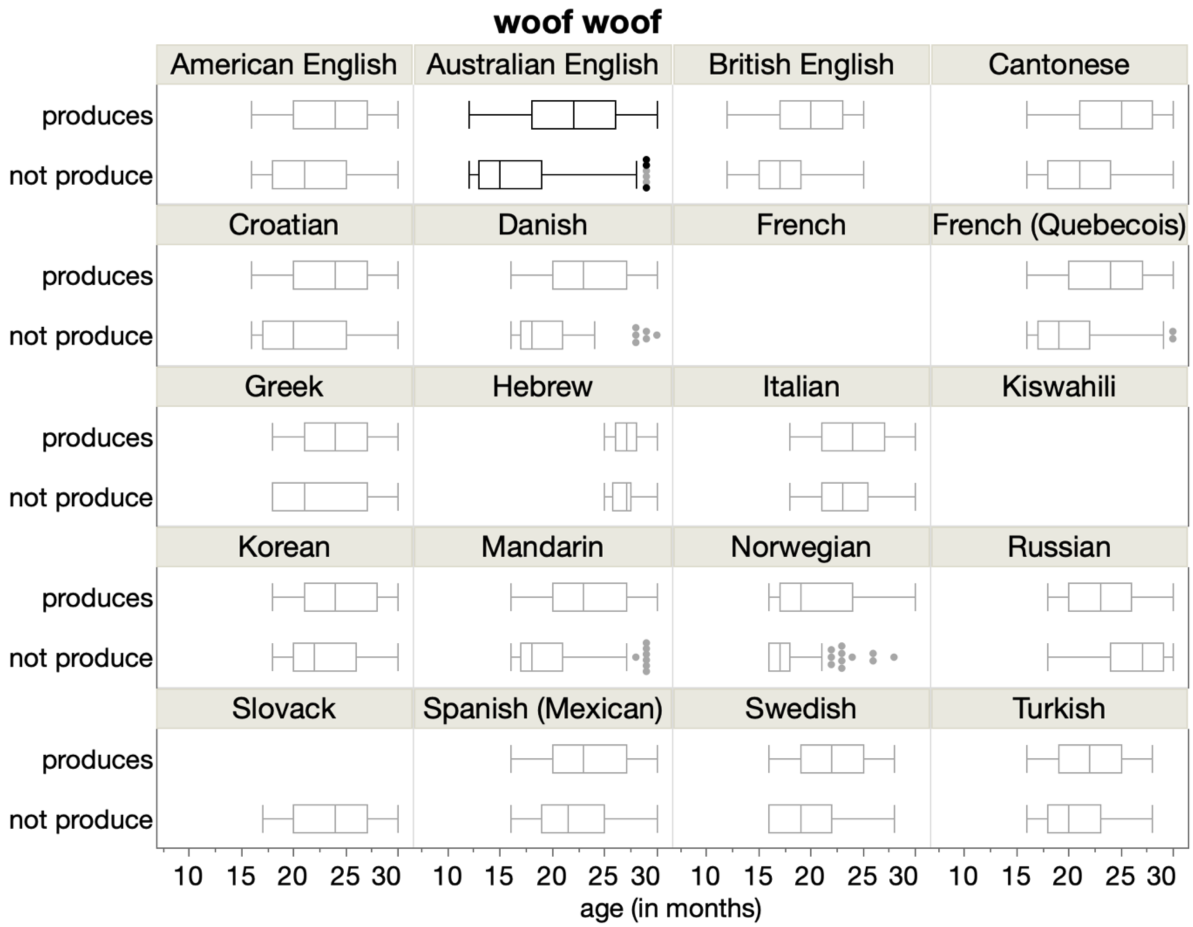

Where(90 rows excluded)

APPENDIX B

International Phonetic Alphabet (IPA) Table

Language		Cockadoodledoo	Meow	Moo	Quack Quack	Woof Woof	Baa Baa	Grrr
English (American)		cockadoodledoo	meow	moo	quack quack	woof woof	baa baa	grrr
	IPA Transcription	/kɔkədudldu/	/miaʊ/	/mu/	/kwæk kwæk/	/wʊf wʊf/	/ba ba/	/gr/
	Syllable Length	4	2	1	2	2	2	1
English (British)		cockadoodledoo	meow	moo	quack	woof	baa baa	grr
	IPA Transcription	/kɔkədudldu/	/miaʊ/	/mu/	/kwak/	/wʊf wʊf/	/ba ba/	/gr/
	Syllable Length	4	2	1	1	1	2	1
English (Australian)		cockadoodledoo	meow	moo	quack quack	woof woof	baa baa	grr
	IPA Transcription	/kɔkədudldu/	/miaʊ/	/mu/	/kwak kwak/	/wʊf wʊf/	/ba ba/	/gr/
	Syllable Length	4	2	1	2	2	2	1
Croatian		kukurikuuu	mijau	muu	kva-kva	vau-vau	Ga-ga	grr
	IPA Transcription	/kukuriku/	/mio/	/mju/	/kʊa kʊa/	/væu væu/	/ga ga/	/gr/
	Syllable Length	4	2	1	4	2	2	1
Danish		kykliky	mjav	muh	rap	vov	mæh	grrrr
	IPA Transcription	/kyklegy/	/mjaʊ̯/	/mu/	/ʁɑb/	/vɒʊ̯/	/mɛ/	/gr/
	Syllable Length	4	2	1	1	1	1	1
French (French)		cocorico	miaou	meuh	coin coin	--	--	grrrr
	IPA Transcription	/kokoʁiko/	/mjau/	/mœ/	/kwɛ̃kwɛ̃/	--	--	/gr/
	Syllable Length	4	2	1	2	--	--	1
French (Quebecois)		cocorico	miaou	meuh	coin coin	wouf wouf	bêêêê bêêêê	grrr
	IPA Transcription	/kokoʁiko/	/mjau/	/mœ/	/kwɛ̃kwɛ̃/	/wuf wuf/	/be be/	/gr/
	Syllable Length	4	2	1	2	2	2	1
Greek		κικιρίκου	μιάου	μουουου	κουάξ κουάξ	γαβ γαβ	μπεεε	--
	IPA Transcription	/kikiriku/	/miaʊ/	/mu/	/kuɑks kuɑks/	/gav gav/	/beɪ/	--
	Syllable Length	4	1	1	2	2	1	--
Hebrew		קוקוריקו	מיאו	מו	געגע	הב הב	מה מה	--
	IPA Transcription	/kəkuwikə/	/miʊ/	/mu/	/gɣ gɣ/	/hʊvʊv/	/bɑhɑ/	--
	Syllable Length	4	2	1	2	2	2	--
Italian		coccodè	miao	muh	qua qua	bau bau	beh beh	grr
	IPA Transcription	/kɔkkodeɪ/	/mjao/	/mu/	/kwɑ kwɑ/	/baʊ/	/bɛ bɛ/	d͡ʒiɛrre/
	Syllable Length	4	2	1	2	2	2	1
Kiswahili		Kukuriukuu	miau miau	mooh mooh	--	--	Baa baa, mmee mmee	--
	IPA Transcription	/kɔkədudldu/	/miaʊ miaʊ/	/mu mu/	--	--	/ba ba/, /me me/	--
	Syllable Length	4	4	2	--	--	2	--
Korean		꼬끼오	야옹	음매	꽥꽥	멍멍	--	--
	IPA Transcription	/kokio/	/yaoŋ/	/ɯmmɛ/	/kwɛk kwɛk/	/mʌŋmʌŋ/	--	--
	Syllable Length	4	3	1	2	2	--	--
Norwegian		kykeliky	mjau	møø	gakk gakk	voff voff	bææ	grr
	IPA Transcription	/kikiləki/	/mijau/	/mø/	/gʌ gʌ/	/vaf vaf/	/bæ/	/gr/
	Syllable Length	4	2	1	2	2	1	1
Russian		кукареку	мяу	му	кря	ав	бе, ме	ррр
	IPA Transcription	/kukʌriku/	/mɑu/	/mu/	/kra/	/ɑf/	/bwe mə/	/pipipi/
	Syllable Length	4	1	1	2	1	1	1
Slovack		kikirikí (kohút)	mňau (mačka)	mú (krava)	--	hav (pes)	--	--
	IPA Transcription	/kikiɾiki/	/mɪnaʊ/	/mu/	--	/haʊ/	--	--
	Syllable Length	4	2	1	--	2	--	--
Spanish (Mexican)		quiquiriquí	miau	muu	cuacuá	guaguá	bee/mee	--
	IPA Transcription	/kikiɾiki/	/miaʊ/	/mu/	/kwakwa/	/gwaɣwa/	/be/	--
	Syllable Length	4	2	1	2	2	1	--
Swedish		kuckeliku	mjau	mu	kvack kvack	vov vov	bä bä	grrr
	IPA Transcription	/kukɛliku/	/miaʊ/	/mu/	/fakt fakt/	/vʉ vʉ/	/væ væ/	/jə/
	Syllable Length	4	2	1	2	2	2	1
Cantonese		--	喵 (貓叫聲)	--	呷呷 (鴨叫聲)	Wou Wou (狗吠聲	咩咩 (羊叫聲)	--
	IPA Transcription	--	/miu/	--	/haap haap/	/kɐu fɐi sɪŋ/	/mɛ5 mɛ5/	--
	Syllable Length	--	2	--	2	2	2	--
Mandarin		--	喵（猫叫）	--	嘎嘎（鸭子叫）	旺旺（狗叫）	咩咩（羊叫声）	--
	IPA Transcription	--	/mjaʊ/	--	/ka ka/	/wɑŋ wɑŋ/	/mjɛ mjɛ/	--
	Syllable Length	--	1	--	2	2	2	--
Turkish		--	Pisi-pisi	Möö	--	Havhav	Mee	--
	IPA Transcription	--	/pisi-pisi/	/mø/	--	havhav	me:	--
	Syllable Length	--	2	1	--	2	1	--