MORPHOPHONOLOGICAL ACQUISITION IN A MINIATURE LANGUAGE LEARNING TASK WITH MONOLINGUAL AND BILINGUAL SPEAKERS

By

ZOEY TAYLOR PETITT

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Approved by:

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Dr. Diane K. Ohala

Department of Linguistics

Abstract

This paper explores the role of bilingualism in a person's ability to learn the morphophonological rules of a miniature language - a small, novel language designed to investigate language acquisition. Previous research has investigated whether bilingual speakers show cognitive and linguistic advantages over monolinguals, with mixed results. Some research shows general cognitive advantages for bilinguals, others show advantages with specific linguistic constructions but not others, and still others show no advantages. To inform this debate, participants were taught the pattern of pluralization in a novel language using a miniature-language learning task and were then tested on their ability to apply the rules they learned to new forms. The plural forms illustrated either initial consonant mutation, where the first consonant of a word changes in certain contexts, or infixation, where a morpheme is added in the middle of a word. The proportion of correct responses was compared between monolingual and bilingual speakers for both pluralization patterns, and no significant difference was found. While further research is necessary to determine the specificity of this finding, this experiment suggests that there may be no difference in bilingual and monolingual speaker's ability to learn the morphophonological rules of a language.

1. Introduction and Background

Both general cognitive advantages and linguistic cognitive advantages of knowing two languages have been reported by previous studies. Of interest to the study of language acquisition, researchers have found differences in metalinguistic ability (Bialystok 2001, Adesope, Lavin, Thompson, & Ungerleidere 2010) as well as in the ability to learn a new language (Lerea & Kohut 1961, Jacobsen & Imhoof 1974). Some specific linguistic differences in the ability of bilingual speakers to learn a new language have been found, particularly in acquiring lexical and syntactic features of a grammar (Klein 1995). However, many of the studies done on differences in acquisition for bilingual and monolingual speakers have used natural languages to study acquisition. While the acquisition of natural languages can be probed and tested in either a lab or real-world setting, such studies may not be able to rule out a variety of confounding factors, especially as related to multilingualism. Artificial grammars or miniature languages that reflect properties of natural language offer one method for studying language acquisition that reduces these confounding factors, but they have not been widely applied to the study of the bilingual advantage. Miniature languages can be used to manipulate and test the acquisition of specific aspects of language without the complexity of an entire grammar, and without the complications introduced by prior exposure to the language, which may vary by participants (McLaughlin 1980). Because of these uses, this technique lends itself well to the current debate over the bilingual advantage. Further, few previous studies in this area have focused on the interface between morphology and phonology and how morpho-phonological aspects of language are learned, especially using miniature languages or considering a bilingual difference in language acquisition. Thus, this paper uses a miniature language learning task to test whether there are differences in the acquisition of plural allomorphs and affixation by monolinguals versus bilinguals.

1.1 Cognitive Differences in Bilingual and Monolingual Speakers

Some specific cognitive advantages of bilingualism that have been reported include improved performance on theory of mind tasks (Goetz, 2003), on executive function tasks (Bialystok, 2012), working memory tasks (Blom, Küntay, Messer, Verhagen, & Leseman, 2014), and increased creative thinking (Cenoz, 2003). However, other research suggests that there is no advantage to being bilingual in certain cognitive tasks. For executive function tasks specifically, Paap, Johnson, & Sawi, (2015) explain that inconsistency in research regarding the bilingual advantage may actually be due to the absence of an effect, or an effect only existing in certain specific cases. For further research on the mixed findings regarding a bilingual cognitive advantage, see also von Bastian, Souza, & Gade (2016) and Paap, Johnson & Sawi (2014).

Of particular relevance to the work presented here, there is evidence that knowing two languages influences a speaker's ability to analyze language and to learn a third language. Nation and McLaughlin (1986) provided some of the first evidence for a distinction between multilingual speakers and less experienced language learners in learning the rules of a new language. They tested acquisition by showing participants strings of letters that followed a set of rules, and then asked them to determine whether new strings of letters followed the same rules or violated them. Nation and McLaughlin found that when explicitly asked to learn the rules of an artificial language from the letter string exemplars, there was no difference in performance when participants were tested on applying the rules to identify grammatically correct or incorrect novel exemplars. However, when asked to memorize words instead, multilingual speakers outperformed both monolingual speakers and bilingual speakers when identifying grammatically correct novel exemplars. This work suggests that multilingual speakers who have more experience with language learning are better able to extract information on a grammar's rules from linguistic stimuli when not explicitly told to do so. Further work has provided evidence that bilingual speakers employ different strategies to learn a new language, and that they are better able to switch their strategies

based on the requirements of different learning tasks (McLaughlin & Nayak 1989, Nayak, Hansen, Krueger, & McLaughlin 1990).

Because bilingual speakers have linguistic knowledge from two languages, it has been proposed that there is a difference in metalinguistic ability between monolingual and bilingual speakers. Metalinguistic ability is the ability to use metalinguistic knowledge separately from knowledge of a specific language. Metalinguistic knowledge, though accessible through knowledge of a specific language, is distinct from linguistic knowledge in that it is the "explicit representation of abstract aspects of linguistic structure" (Bialystok 2001). Thus, metalinguistic ability allows speakers to think about language in an abstract way. As discussed by Bialystok (2001) metalinguistic abilities have been found to differ between monolingual and bilingual speakers. Many studies have found that bilinguals outperform monolinguals in metalinguistic word awareness and syntactic awareness tasks. Studies on word awareness generally test an understanding of reference (see Ben-Zeev 1997; Cummins 1978) while studies on syntactic awareness tend to involve making judgements about syntax and correcting syntax (See Galambos & Hakuta 1988; Galambos & Goldin-Meadow 1990; Bialystok 1988). Research has also looked at whether bilingual speakers have differences in their phonological awareness. While the early studies that have conducted this research consisted of small sample sizes or minimally bilingual subjects, some did find that bilingual speakers outperformed monolingual speakers on certain phonological awareness tasks at specific ages (see Rubin and Turner 1989, Bruck and Genesee 1995, Yelland et al 1993). Bialystok, Majumbder, and Martin (2003) conducted multiple tests of phonological awareness with monolingual and bilingual children to examine these previous findings. They only found a bilingual advantage in relatively simple tasks with bilingual children whose known languages had similar sound structures. This suggests that if there is a bilingual advantage for phonological awareness, it only exists in certain circumstances.

The general trends of bilingual speakers outperforming monolingual speakers were confirmed by a meta-analysis conducted by Adesope et al. (2010). Analyzing data from 63 studies, Adesope et al found that bilingual speakers outperformed monolingual speakers on metalinguistic tasks, although the effect size varied among the studies examined. Beyond this metalinguistic advantage, Adesope et al found that bilingual speakers performed better on measures of metacognitive awareness, abstract and symbolic representation, attentional control and problem solving. The general cognitive advantages of bilingualism that have been found suggest that bilingual speakers may have specific advantages when it comes to language learning.

Further research has attempted to reveal specific advantages of bilingualism related to language learning. Research into this topic began in the 1960's and 1970's, and included work from Lerea and Kohut (1961) and Jacobsen and Imhoof (1974). Lerea and Kohut found that bilingual speakers learned novel words quicker than monolingual speakers, suggesting a possible bilingual advantage in word learning when learning a new language. Jacobsen and Imhoof studied bilingual advantage in language learning more generally, finding that bilingualism or multilingualism during childhood was one of many factors associated with increasing proficiency when learning Japanese as an adult. These studies provided some of the first evidence for possible bilingual advantages in language learning. Follow up research has supported the idea that bilingualism or multilingualism increases proficiency in learning a new language (for a review, see Cenoz 2001), though conflicting null results have also been obtained (see Shoonen et al. 2002). Further, the effects of bilingualism on the ability to learn specific aspects of language are still being researched.

Klein (1995) found that multilingual speakers learning English outperformed bilingual speakers learning English when testing their lexical knowledge and their ability to apply that knowledge to identify syntactic errors in English. The specific lexical knowledge tested was subcategorization knowledge, specifically which prepositions are allowed to accompany certain verbs. However, another study of word learning by Gibson, Hufeisen, and Libben (2001) found no

significant difference between the accuracy of bilingual speakers and monolingual speakers learning German as adults. Their study focused on prepositions as well, though it tested whether participants would choose the correct preposition to go with a certain verb. While these studies investigated similar phenomena, it is important to note that the first study investigated middle school and high school students, and the second study investigated adults. Age of learning may be one of many factors important for understanding the effects of bilingualism on language acquisition.

Proficiency in two languages was also found to be associated with better reading performance when learning a third language (Rauch, Naumann, & Jude 2011). The results from Rauch et al revealed that reading proficiency in third language learners' first and second language is necessary to see a positive effect of bilingualism on third language reading skills. Further, their results suggest that increased metalinguistic awareness skills associated with bilingualism mediate this effect. However, this study was done with monolingual German speakers and German-Turkish bilinguals learning English. There are some external factors that cannot be eliminated when studying bilingualism and language learning using natural languages that include differences in background knowledge, possible transfer from familiar languages, and differences in the new language's acquisition environment. Miniature language learning paradigms are a potential way to eliminate these factors.

1.2 Using Miniature Language Learning to Understand Language Acquisition

Artificial languages, also known as miniature languages, or artificial grammars, are often used in experiments studying language learning. Artificial languages used in research are much smaller and simpler than natural languages. Individual elements of the artificial language are arranged according to a specific grammar, or set of rules. Experiments that utilize artificial languages usually provide subjects with exposure to valid constructions in the artificial language

and then test the subject's ability to learn the artificial language in a variety of ways (McLaughlin 1980; Fezechkina 2016). For example, subjects can be tested on their memory of the elements they were exposed to or on their ability to abstract the rules they learned and apply them to new constructions.

Historically, there are two distinct types of linguistic experiments that use artificial languages created by a researcher. Artificial grammar learning tasks are typically used to investigate speech segmentation, where participants listen to a continuous speech stream with varying transitional probabilities between units (as first used by Saffran, J., Aslin, R., & Newport, E. 1996). Miniature language learning tasks, on the other hand typically involve participants learning the rules to a novel, miniature grammar and then being asked to apply those rules to new contexts. Both types of experimental task will be considered in this section as they provide similar advantages and disadvantages and have similar motivations in linguistic research. In this section, the term artificial languages will be used to refer to both of these task types in order to compare them to natural languages. However, the rest of this paper will focus on miniature artificial languages.

There are a variety of advantages and disadvantages to using artificial languages to study language acquisition. In contrast to studying acquisition of natural languages, studying acquisition of artificial languages allows researchers to control a variety of potentially confounding variables. Researchers can control for the possibility of prior exposure to the novel language and the possibility of differences in learning environment. The experimental setting and ability of the researcher to create the language also allows researchers more control of the linguistic processes they are investigating. Researchers can choose specific linguistic features to study in isolation from a larger system. This allows researchers to answer questions that would be more difficult to answer when studying acquisition of natural languages (Fedzechkina., Newport., & Florian Jaeger (2016), McLaughlin 1980).

Artificial language studies do have their limitations. Artificial languages utilize rule systems that can be viewed as distorted due to their abstraction and simplification of natural language systems, though this limitation should not be seen as grounds to reject the usefulness of artificial language. To understand language acquisition fully, it is important to consider research utilizing artificial languages and natural languages together and to investigate the ways that findings from these methods can inform each other. Another criticism of artificial language acquisition studies is that they may not accurately represent first language learning. Linguistic knowledge from previously learned languages could influence the processing and acquisition of artificial languages. However, this limitation may make artificial languages a great tool for studying second and third language acquisition and investigating language universals (Fedzechkina, Newport, & Florian Jaeger2016, McLaughlin 1980).

Artificial languages have been used to study language acquisition in infants and adults. For example, in infants, artificial languages have been used to study the learning of word segmentation, word order, abstraction beyond learned words, and abstraction in categories (Gomez & Gerken, 2000). With artificial grammar learning paradigms, artificial languages have also been used to study the learning of non-adjacent dependencies and speech segmentation to further research on statistical learning theories (Saffran et al 1996, Newport and Aslin, 2003; Gomez 2002, LaCross 2013). To study acquisition of morphological non-adjacent dependencies, Drake (under revision) has used both artificial grammar learning and miniature language learning paradigms to investigate how the characteristics of a learners first language influence acquisition of artificial languages. Morphosyntax is another aspect of linguistics that has been studied with artificial languages. DeKeyser (1997) used an artificial language to study how different learning paradigms influenced the acquisition of morphosyntactic rules using an artificial language.

However, artificial language learning experiments could play more of a role in the study of the bilingual acquisition difference. Because of the advantages described above, artificial language

experiments could be used to help inform the debate on whether bilingual speakers show an advantage in acquiring a new language, and if they do, in which aspects of acquisition they do so. Specifically, morphophonological rule acquisition is an area of language acquisition that could benefit from being studied with an artificial learning experiment, as research in this specific area is underrepresented in the literature to date. Using an artificial language that consists of nouns and distinct rules for pluralization, this research aims to address whether bilingualism makes it easier to learn the morphophonological rules of an artificial language. Because there is conflicting data on whether bilingualism influences specific aspects of language acquisition, this work considers two hypotheses. Bilingualism may mediate a positive effect on acquisition of the morphophonological rules of a language, in which case bilingual speakers would outperform monolingual speakers in the miniature language learning paradigm described in the next section. This hypothesis would be supported by the literature described that has found a difference in cognitive ability, metalinguistic awareness, and language learning ability between bilingual and monolingual speakers. However, morphophonological language acquisition may be one of the areas of acquisition that are unaffected by bilingualism. If this is the case, bilingual speakers and monolingual speakers would show similar performance on the miniature language learning task tested. Of particular relevance to this hypothesis, prior research has found conflicting results when comparing phonological awareness in monolingual and bilingual speakers, as well as when comparing acquisition of syntactic rules using different tasks or different subject groups. Overall, bilingual speakers seem to show some advantage in certain tasks, and no advantage in other tasks; this paper is therefore investigating where morphophonological acquisition tasks fall on this spectrum.

2. Methods

2.1. Participants

28 people participated in this experiment (11 male, 15 female, 1 non-binary, and 1 transgender participant) with ages ranging from 18-47. 10 participants were identified as bilingual, while 18 participants were identified as monolingual English speakers. Of the bilingual speakers, 5 identified their gender as female, 4 as male, and 1 as non-binary. Of the monolingual speakers, 10 identified their gender as female, 7 as male, and 1 as transgender. All participants were students at the University of Arizona in Tucson, AZ, who participated either for course credit or on a voluntary basis. Of these, 3 participants were excluded for not following the directions and 4 were excluded for concerns related to speech, hearing, and language (see Section 3.1 for further details regarding the latter.) The remaining 21 subjects (9 male, 11 female, and 1 transgender) had an average age of 22.3.

2.2. Materials

All participants were taught the same novel language. Materials consisted of 15 training items and 60 test items with an equal number of associated visual stimuli. The training items were all non-occurring but possible words of English, which were created by randomly selecting one of 5 initial consonants ('s', 'l', 'p', 't', or 'k'), one of 14 vowels or vowel combinations, and one of 25 codas. The randomly selected components were then joined together. If the created word was not a real word in English and did not contain any real words in English (as confirmed using Dictionary.com), it was considered as a training word or test word. The possible components of the language are shown in Appendix A.

The artificial grammar followed initial consonant mutation patterns seen in Welsh. Initial consonant mutation is a language feature that consists of phonological changes that occur regularly to the first consonant in a word. These changes are unique in that they are triggered by non-

phonological contexts. The contexts that trigger initial consonant mutation are usually morphosyntactic environments, and the triggers, or specific features that cause the mutation, can be lexical or syntactic. Mutation is not a feature of every language, but it is grammaticalized in the Celtic group of Indo-European languages (Ball & Müller, 2002). Initial consonant mutation was considered in this experiment because it requires an interface between phonology, morphology, and syntax. Further, its uniqueness makes it an unfamiliar language feature for speakers of many languages, which could prevent transfer in language learning.

In Welsh, mutations can be classified as soft mutations, nasal mutations, aspirate mutations, and pre-vocalic aspirations. The aspirate and soft mutation are the most common mutation types in Welsh and other Celtic languages, and were the only mutations used in this experiment. When undergoing soft mutation, voiceless stops become voiced, so /p, t, k/ become /b, d, g/, and voiced /g/ deletes (/g/-->0). The phenomenon is more complex when other types of initial consonants undergo soft mutation, but that is out of the scope of this paper. In the aspirate mutation, the voiceless stops /p, t, k/ become /f, θ, x/ respectively (Ball & Müller, 2002). Because /x/ is not a phoneme that occurs in English, the latter mutation was not used in this study.

Three out of the five initial consonants used in this study are mutable in appropriate contexts (Table 1, c-e) and two out of the five are not mutable (Table 1, a-b). A combination of mutable and non-mutable words was used in order the make the novel language sufficiently complex. Initial consonant mutation was used as a form of pluralization for the initial consonants that were mutable. Words with consonants that were not mutable were pluralized with infixation. While the ability of subjects to learn infixation patterns for pluralization was not of interest in this study, this pattern was added to the miniature language to more closely mimic natural languages, as many languages have more than one way to express the plural, if they express the plural at all. Infixation also added to the complexity of the miniature language.

Table 1: Examples of the Words Used in the Miniature Language Learning Task

	Singular Consonant	**Singular**	**Dual**	**Plural**
a.	s	soid	soimoid	soimoid
b.	l	loz	lomoz	lomoz
c.	p	palch	balch	falch
d.	t	tep	dep	thep
e.	k	kilp	gilp	ilp

As discussed, miniature languages are smaller than natural languages because they are learned in a shorter amount of time. The number of exemplars used in miniature languages varies from as small as four to as large as one thousand, though the typical number of exemplars is between four and 15 (Fedzechkina et al. 2016). In this study, 15 words were chosen to be presented as training materials, and 60 words were chosen to be presented as test materials.

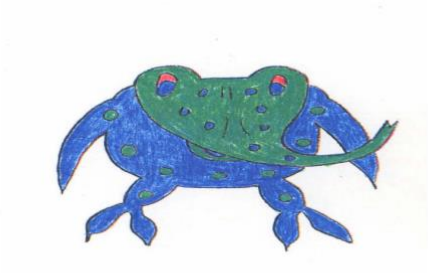
2.3. Procedure

After obtaining consent, the experiment was conducted in a sound attenuated booth at the University of Arizona with participants sitting at a computer and typing their answers using a keyboard. After participants completed the experimental task, they completed a language background survey adapted from Twist (2006) and Drake (under revision). This survey, which can be seen in Appendix C, assessed participants' language use in a variety of settings. Questions revealed the languages that participants spoke and the extent that they used the languages in different settings. It also helped screen for potential hearing, speech, and language impairments that could have influenced the results. Because all participants spoke English, the survey was

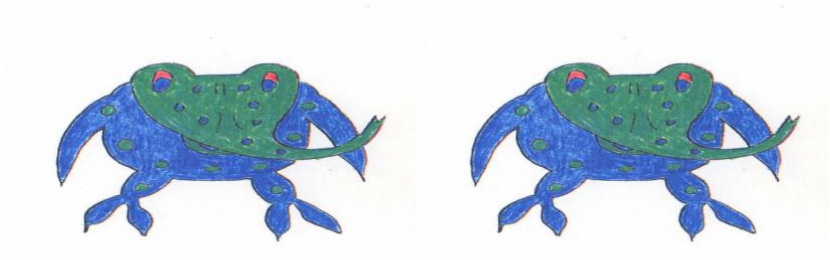
administered in English. It was given after the experimental task was completed to avoid any bias related to acknowledging bilingual status.

Psychopy was used to present stimuli (Pierce 2007, Pierce 2009; version 1.83.00). The experiment consisted of a training phase and a testing phase. During the training phase, participants were shown how to form a plural in the artificial language. They were shown the singular form of a training word along with an image showing one novel animal (from Ohala 1999, see Figure 1 for examples). Then they were shown the dual form of the word paired with an image showing two of the same animal. A number marker, "dai," was used before the word to indicate that there were two animals. Then they were shown the plural form of the word paired with an image showing three animals. A number marker, "tri," was shown before the word to indicate that there were three animals. This is shown in Figure 1.

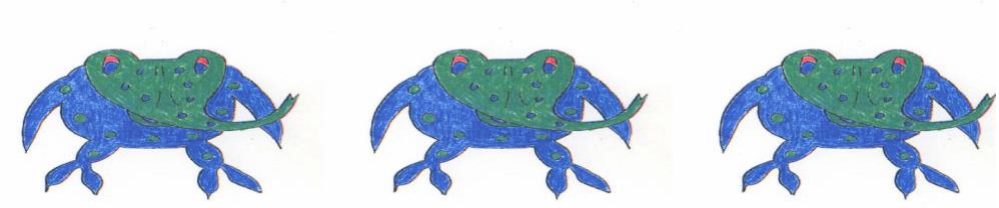
Figure 1: Training Phase Stimuli



tep



Dai dep

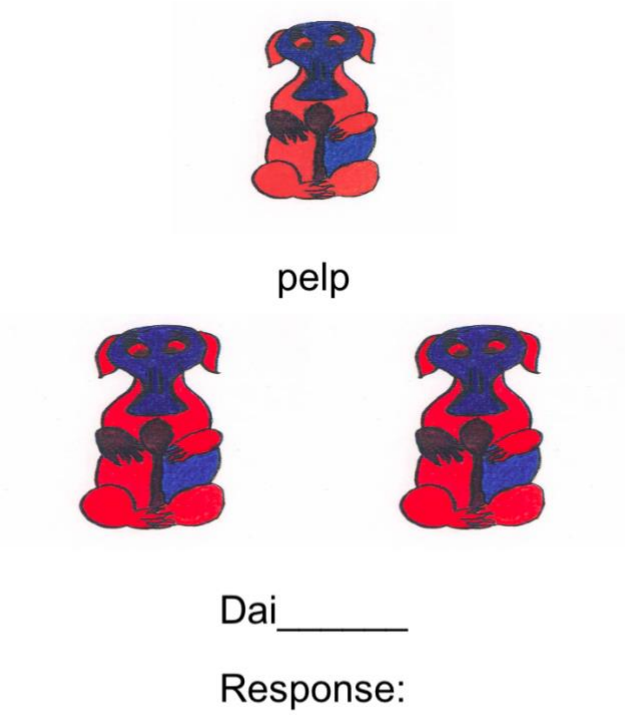


Tri thep

This training procedure was repeated 15 times using 15 separate exemplars. Words were taught in a random order that was different for each participant, but the singular, dual, and plural form of the word was always presented consecutively in that order.

After completing the training phase, participants began the testing phase. During the testing phase, participants were tested on 60 novel words paired with 60 animal images. All images and words had not been used in the training phase. Participants were given the singular form of a word and instructed to provide the correct plural form of the word after a written prompt (See Figure 2).[1] They were tested on the dual form and plural form of each testing word. Responses were typed on a standard QWERTY keyboard.

Figure 2: Testing Phrase



[1]Subjects 1-22 completed the experiment with an error in the testing phase. The screen prompted the plural form of the novel word with the word "Trai" instead of the word "Tri" that they were taught in training. There was no statistically significant difference in performance on the task for both forms of the testing phase.

Participants were not allowed to review words they had already seen, and the task was self-paced with no breaks. The training words were not used in testing because this experiment was focused on whether the acquired rules for pluralization in the miniature language could be applied to new words. Including the training words in testing could have altered the results by serving as a memory cue for participants and providing additional learning when participants were only meant to be tested on what they had already learned. Further, this work was focused on whether participants could abstract general patterns for pluralization, which would not be tested by including the training words in the testing phrase.

3. Results

3.1 Language Background Survey Results

The results from the questions regarding speech and language related concerns are shown in Appendix C. This figure shows the total number of participants who responded "Yes" to each of the questions in the language background survey relating to speech and language concerns. Participants may have responded yes to more than one question in this section of the survey. Of the 28 participants, 16 responded "yes" to at least one of the speech and language concern questions (Questions 7-17 in the Language Background Survey, Appendix D). It is important to note that the survey asked if participants had ever experienced the phenomenon in question, not whether they were currently experiencing it, nor whether the concerns had been resolved. Because of the ambiguity of the survey questions, only Question 13, which asked whether participants had ever participated in speech or language therapy, was used to exclude participants. 4 participants answered yes to this question and were not considered in further data analysis. The participants who answered "Yes" to any of the other language concern questions were not excluded from data analysis. Initial analysis of the data with and without these 16 subjects revealed no significant

difference in accuracy between the subjects who did report having speech and language related concerns and those who did not ($p > .05$).

The results from the Language Background Survey were also used to assess whether participants were monolingual or bilingual. Questions 18-31 of the Language Background Survey were used for this classification. If participants listed only English when asked to list the languages that they speak in Question 18, they were considered monolingual speakers. If they listed English and another language, and they stated that they were native speakers of the other language, they were considered a bilingual speaker. If they listed English and another language, but they did not say that they were native speakers of that language, their status as bilingual or monolingual was determined from the remaining questions. If they stated that the language was spoken in their home, now or when they were growing up, or responded that, "Yes," they spoke a language other than English, they were considered a bilingual speaker. Participants that listed a language other than English and listed that they had taken classes to learn that language, but did not meet any of the other criteria, were considered monolingual speakers.

3.3 Miniature Language Learning Task Results

The data from the miniature language learning task was analyzed by calculating each participant's proportion of correct responses. A response was classified as correct if it exactly matched the expected response based on the stimuli presented in the training phase. This conservative coding procedure likely underestimates the amount of learning over the course of the study. For example, responses that correctly included an infix but one that did not match exactly the expected infix were coded as incorrect. This was done to quantify how well participants learned the more general plural patterns as well as the specific details of each. Please see Section 4 for further discussion of this point.

A proportion of correct responses was determined for each pluralization type for each participant. Words that should have been pluralized with initial consonant mutation were considered separately from words that should have been pluralized using infixation. Beyond the exclusions previously discussed based on the language background survey, three other subjects were excluded. These subjects were excluded because they did not follow or understand the experiment's instructions.

The proportion of correct responses for bilingual speakers and monolingual speakers in the miniature language learning task was compared using multivariate analysis of variance (MANOVA) with R (R Core Team 2013). The dependent variables used in this analysis were the proportion of correct responses for the initial consonant mutation pluralization and the proportion of correct responses for the infixation pluralization. The independent variable tested was whether the participant was monolingual or bilingual. The MANOVA showed no significant multivariate effect for the proportion of correct responses for the two word types tested in relation to whether the participant was monolingual or bilingual ($p=.86$).

Follow-up ANOVAs were completed with each of the dependent variables. The proportion of correct responses for initial consonant mutation pluralization and for infixation pluralization showed no significant effect in relation to whether the participant was monolingual or bilingual ($p=.65$ and $p=.58$ respectively). The mean proportion correct for each group was also calculated. For bilingual speakers, the mean proportion of words correct for the mutation pluralization was .4266, and for monolingual speakers it was 0.5018. The mean proportion of words correct for infixation pluralization was .369 for bilingual speakers and .471 for monolingual speakers. Figures 3 and 4 show box and whisker plots of the proportion correct for monolingual and bilingual speakers, separated by pluralization type.

Figure 3: Proportion Correct for Infixation Pluralization

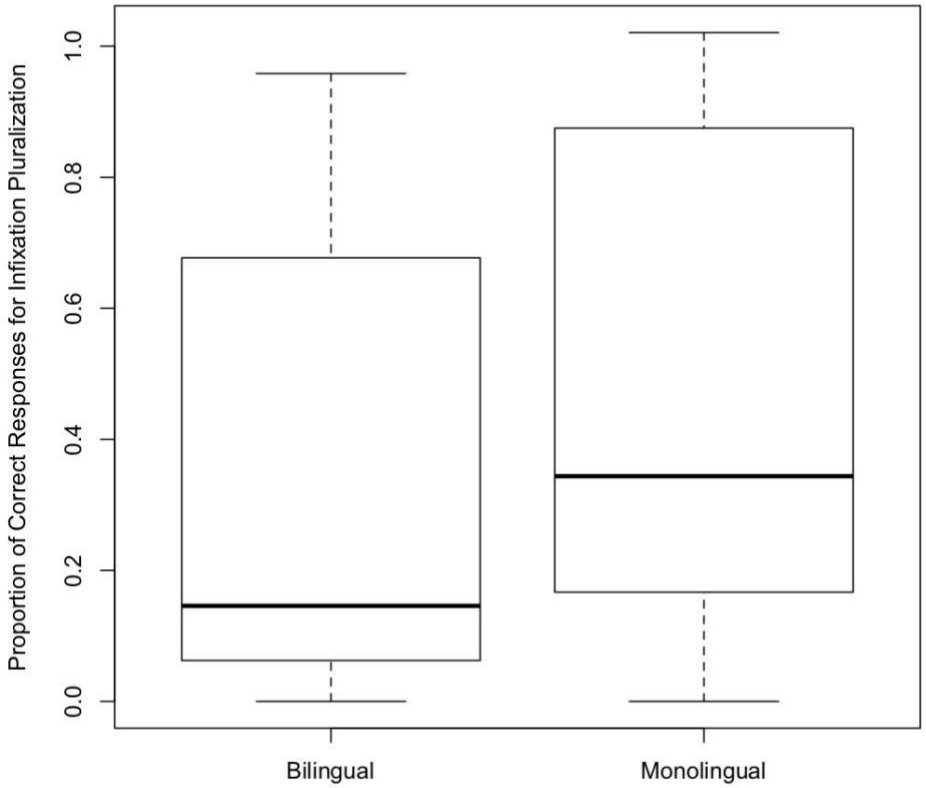
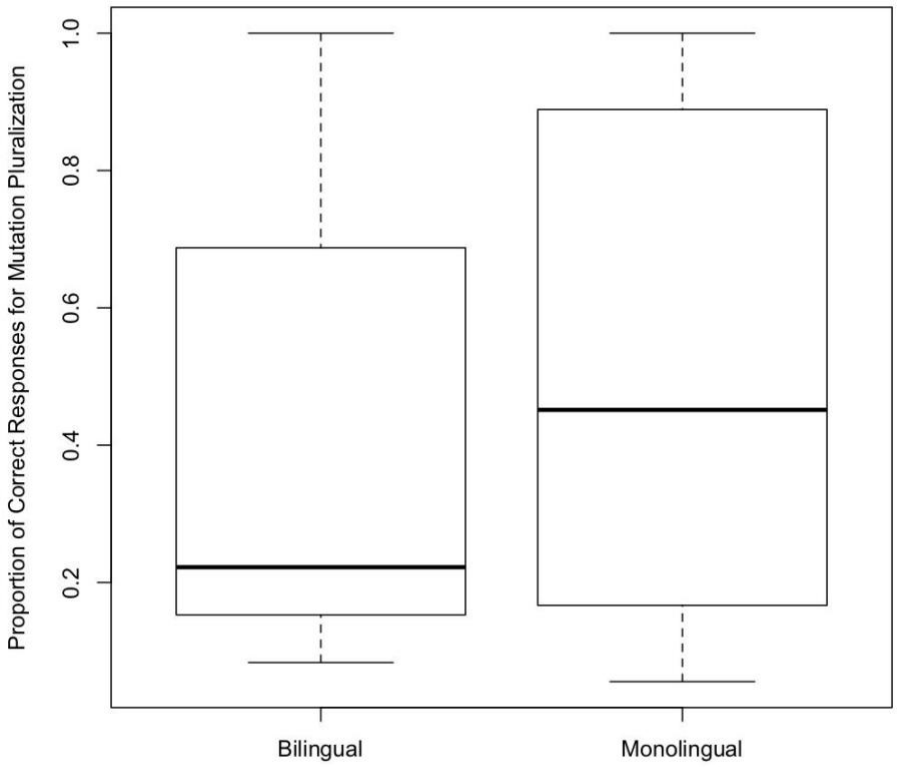


Figure 4: Proportion correct for Mutation Pluralization



As illustrated in the box and whisker plots, performance on this task was widely variable for both monolingual and bilingual subjects. For the monolingual subjects, the total percentage of correct responses ranged from 15% to 99%, and, for the bilingual subjects, the total percentage of correct responses ranged from 5% to 96% correct. This variability likely contributed to the null results and suggests that some factor besides bilingual status may be influencing the results. Many participants performed below chance on this task, which could be a result of participants not learning the morphophonoligical rules or not understanding the task. To determine whether being bilingual influenced performance for participants who understood the task and learned something from the training phase, the MANOVA was repeated with only data from the participants who performed above chance. The mean proportion of total words correct (.4607) was used as a cut-off

to eliminate participants who performed below chance. Using the same variables as the initial MANOVA, this analysis, as well as follow-up ANOVA tests, revealed no significant difference between monolingual and bilingual speaker's performance on the task ($p>.05$). However, after eliminating participants whose performance was below the mean, the bilingual group only had 2 participants and the monolingual group only had 5 participants. This limits the statistical power of these findings.

4. Discussion/Conclusion

This study found no effect of bilingualism on morphophonological acquisition in the miniature language learning task studied. There were no significant differences in the acquisition of plural allomorphy or plural affixation when comparing monolingual and bilingual speakers. Previous research into whether there is a bilingual advantage in general cognition, in metalinguistic awareness tasks, and in specific aspects of language acquisition found mixed results. This suggests that advantages could be specific to certain tasks, certain subject groups, or certain linguistic processes. The results from this research suggest that the task tested may be one of the tasks unaffected by bilingualism. However, further research is necessary to determine if bilinguals and monolinguals have a difference in their ability to learn the morphophonological rules of a language.

In this experiment, there were more monolingual participants than bilingual participants, and a small sample size was used. The results include data from 7 bilingual speakers and 14 monolingual speakers. It would be beneficial to repeat this experiment with a greater number of participants to verify the results. Additionally, as discussed in section 3.1, the survey questions used to determine whether participants had language concerns had some ambiguity. Further research could test the task again with a larger sample size and a more specific survey. Questions that ask about current speech and language concerns would likely be more relevant to the experiment. They would help determine which participants were currently concerned about something that could

influence speech and language, rather than if they had ever had a concern. Using the original survey to eliminate anyone who had ever had a speech or language concern likely would have overestimated the number of people with current speech and language concerns. Thus, future research should consider a modified version of this survey.

While the results from this experiment suggest that there may be no advantage for bilingual speakers learning the morphophonological rules of a language, further research is necessary to determine whether similar morphophonological rule acquisition tasks would provide similar results. Miniature language acquisition tasks testing different morphophonological phenomena would help determine whether the results from this experiment are task specific. The processes tested in this experiment were very unusual, which may have made the pluralization trends more difficult to track for the participants attempting to learn them. It is possible that more familiar processes applied in a miniature language learning task would produce different results. Research on morphophonological acquisition of natural languages would also be important in determining whether the results from this experiment are unique to this task.

Further research is also necessary to determine whether the results seen in this experiment would be different in another subject group. Only native bilingual speakers were considered bilingual for the purposes of this study, but other types of bilingual speakers did participate. Some participants were learning multiple languages and still considered monolingual, but these speakers could have been considered as a separate group. With more subjects, multiple bilingual groups could have been considered. It is also possible that the subject group that participated in this experiment had an atypical representation of language concerns. As described previously, 44% of the participants reported ever having some kind of language background concern. If the language concerns reported were abnormal compared to the general population and did influence the results, it would be helpful to conduct this experiment with a subject more representative of the general population. Age is another factor that could have influenced the results found in this

experiment. All the participants in this experiment were adults, but some bilingual advantages have been found in children and not adults. Studies of the acquisition of syntactic knowledge in natural languages, specifically of preposition and verb pairing, found a bilingual advantage when studying children (Klein 1995), but not when studying adults (Gibson et al. 2001). While different tasks were used in these studies, and they studied different learned languages, mixed results like these raise questions about which factors cause conflicting results in similar studies. Further research would be necessary to determine whether age plays a role in the lack of a bilingual advantage in the morphophonological task considered in this paper.

Another question that was not considered in this paper is whether bilingual speakers and monolingual speakers make the same types of errors when learning the morphophonological rules of an artificial language. Some specific types of errors were seen when analyzing the results from the miniature language learning task, but it was not determined whether the same types of errors were made by both groups. Some participants applied the infixation pluralization rule to novel words that should have undergone initial consonant mutation, while others applied the wrong mutation pattern to certain initial consonants. For example, one participant produced “koimoim” from the word “koim”, using infixation instead of applying the initial consonant mutation rules shown in the training phase of the experiment. Another participant provided the word “barsh” instead of “darsh” from the singular word “tarsh,” applying the pluralization pattern for words with an initial consonant of “p” rather than “t.” Other participants made errors in which mutation pluralization form to apply in the dual or plural context. Because some patterns were seen in the types of errors made, further work could investigate whether bilingual and monolingual speakers made the same types of errors.

When considering these consistent error types, along with the low mean proportion correct for the task that indicates poor performance across subjects, it is possible that the method for determining a correct response was ultimately too conservative to reflect all aspects of

performance on the task. Because a response was only considered correct if it completely matched the correct response, the results only indicate how well people learned the exact details of the patterns taught. It does not account for the learning of general patterns, like knowledge of what contexts the different pluralization patterns were used in. Many responses reflected some learning of the pattern without reflecting knowledge of the pattern's exact details. One example, also described above, is that subjects often applied the wrong initial consonant mutation pattern, but still used initial consonant mutation to derive their response (for example, the subject who responded "barsh" instead of "darsh"). These subjects did learn something from the task even though they did not learn the exact details of mutation. An analysis of the results with less conservative criteria for a correct response would likely reveal more general learning patterns during the experiment than those analyzed here.

While further work is necessary to fully understand the implications of these findings, they do add an important trend to the investigation into the bilingual advantage. Research into the bilingual advantage has found mixed results when considering cognitive skills, metalinguistic awareness skills, and the ability to learn a new language. Thus, it is important for the field to determine which specific tasks and processes do provide evidence for a bilingual advantage, and whether such an advantage is specific to certain subsets of the population. This paper provides evidence for no difference in the ability of monolingual and bilingual speakers to acquire the morphophonological rules of a miniature language, but further research is necessary to fully understand these results.

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Appendices

Appendix A

Table 2: Possible components of the miniature language

Possible Initial Consonants	Possible Vowels	Possible Codas
s	a	f
l	ae	b
p	au	g
t	aw	t
k	e	d
	ee	s
	eu	r
	ew	p
	i	d
	o	z
	ai	k
	oi	v
	u	th
	oo	sh
		m
		n
		l
		w
		rt
		lp
		st
		rk
		lt
		ck
		th

Appendix B:

Appendix B shows the words used for the training and testing phases of the experiment. Table 3 shows the 15 words used for training, while Table 4 shows the 45 words used for testing.

Table 3:

Singular	**Dual**	**Plural**
soid	soimoid	soimoid
siv	simiv	simiv
sork	somork	somork
pof	bof	fof
paz	baz	faz
palch	balch	falch
loz	lomoz	lomoz
luush	luumuush	luumuush
leerm	leemeerm	leemeerm
tep	dep	thep
tav	dav	thav
tolb	dolb	tholb
keert	geert	eert
kilp	gilp	ilp

koith	goith	oith

Table 4:

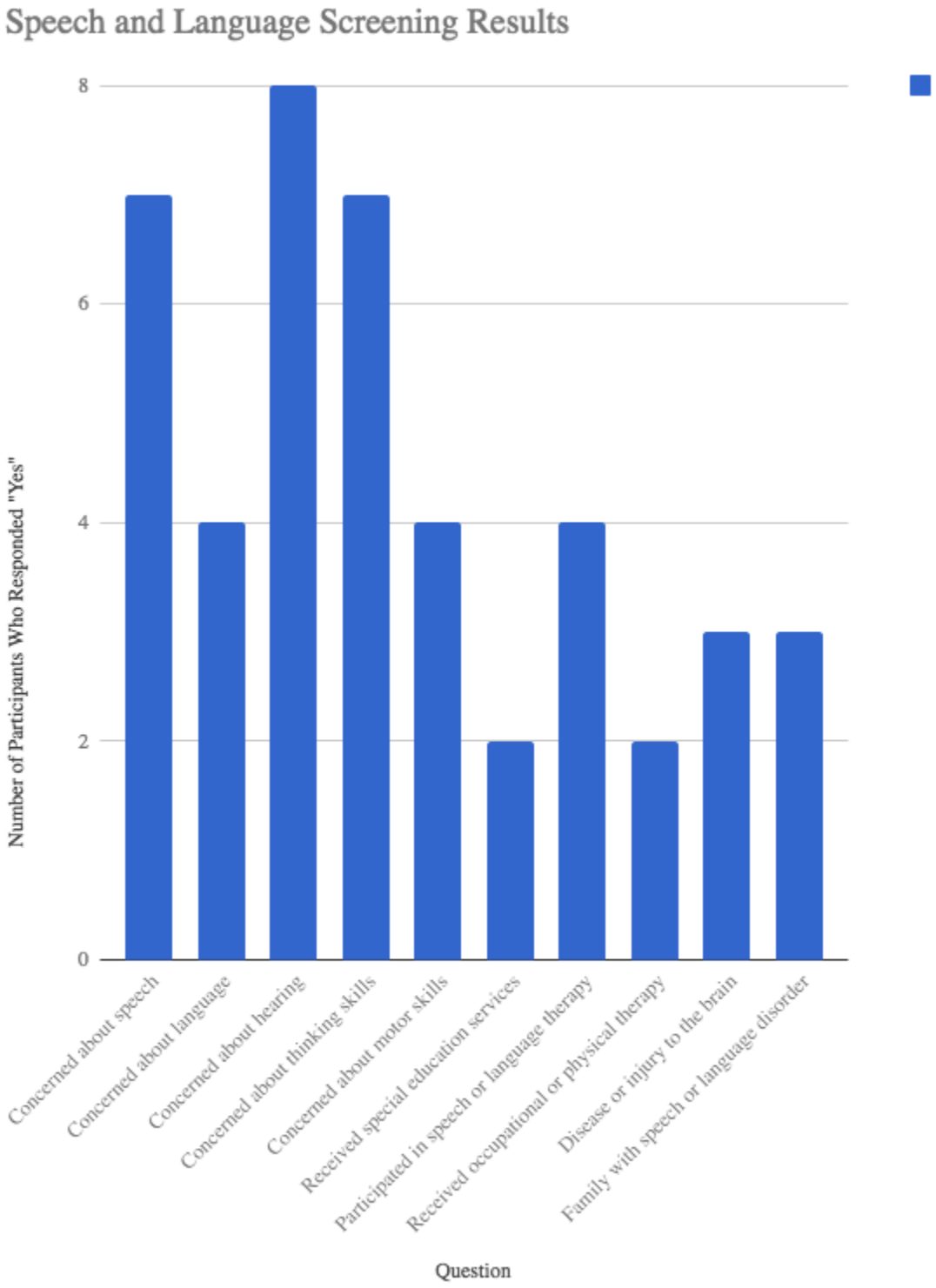
Singular	**Dual**	**Plural**
sast	samast	samast
soip	soimoip	soimoip
sov	somov	somov
sek	semek	semek
seeg	seemeeg	seemeeg
spruth	sprumuth	sprumuth
sulp	sumulp	sumulp
smork	smomork	smomork
swev	swemev	swemev
soob	soomoob	soomoob
silp	similp	similp
soin	soimoin	soimon
piv	biv	fiv
pelp	belp	felp

pirt	birt	firt
pesh	besh	fesh
poid	boid	foid
perb	berb	ferb
prav	brav	frav
plen	blen	flen
ploth	bloth	floth
paish	baish	faish
poig	boig	foig
pesk	besk	fesk
lutch	lumutch	lumutch
lork	lomork	lomork
loz	lomoz	lomoz
luus	luumuus	luumuus
loip	loimoip	loimoip
leelt	leemeelt	leemeelt
lup	lumup	lumup
ladge	lamadge	lamadge

losh	lomosh	lomosh
lun	lumun	lumun
larth	lamarth	lamarth
laish	lamaish	lamaish
tesh	desh	thesh
tath	dath	thath
telp	delp	thelp
toid	doid	thoid
teest	deest	theest
tarsh	darsh	tharsh
trut	drut	thrut
troik	droik	throik
trast	drast	thrast
trev	drev	threv
taalt	daalt	thaalt
toin	doin	thoin
kolt	golt	olt
kuur	guur	uur

kauv	gauv	auv
koim	goim	oim
kert	gert	ert
kur	gur	ur
krish	grish	rish
klart	glart	lart
kroiv	groiv	roiv
kaich	gaich	aich
kersh	gersh	ersh
kaup	gaup	aup

Appendix C: Language Background Survey Results- Summary of Language Concerns



Appendix D: Language Background Survey

The following questions make up the language background survey:

1. How old are you?

2. Which hand do you write with?

3. What is your gender?

4. What is your occupation?

5. Where did you grow up? (example: Denver, CO; Buenos Aires, Argentina)

6. Where do you live now?

Please answer 'YES' or 'NO' for each question:
Have YOU ever been concerned about your:

7. Hearing?
8. Speech?
9. Language?
10. Motor Skills?
11. Thinking Skills?

12. Have you ever received any special education services?
13. Have you ever participated in speech or language therapy?
14. Have you ever had occupational or physical therapy?
15. Have you ever had seizures?
16. Have you ever had a disease or injury to the brain?
17. Do you have any family members with a speech or language disorder?

18. Please list the languages that you speak, your proficiency (native speaker, excellent, good, fair, poor) in each of them, and when you learned this language. If you have taken one of these languages

as a university course, include the number of years/semesters you have taken the class. (example: English - native; Arabic - good - 7 semesters starting at age 16)

19. Which language(s) were spoken in your home growing up?

20. If you selected a language or languages other than English, about how much did you (or others) use those languages when you were growing up? (example: English: 50%, Spanish: 40%, Navajo: 10%)

21. Which language(s) are spoken in your home now? Select all that apply.
22. If you selected a language or languages other than English, about how much do you use those languages? (example: English: 70%, Spanish: 30%)

23. Which language(s) do you usually use with your parents?

24. Which language(s) do you usually use with your grandparents?

25. Which language(s) do you usually use with your siblings?

26. Which language(s) do you usually use with your children?

27. Which language(s) do you usually use with your friends?

28. Which language(s) do you usually use with your co-workers?

29. Which language(s) do you regularly read in (e.g., newspapers, magazines, books, internet articles, etc.)?

30. Which language(s) do you regularly watch TV or listen to music in?

31. Which language(s) do you usually use on social media (e.g., Facebook, Twitter, Tumblr, Instagram, etc.)?