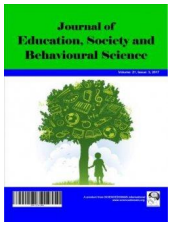

Journal of Education, Society and Behavioural Science

27(1): 1-14, 2018; Article no.JESBS.44400
ISSN: 2456-981X
(Past name: British Journal of Education, Society & Behavioural Science, Past ISSN: 2278-0998)

Laboratory-induced Language Code-switching in Four languages

Lily Halsted[1*] and Aimee Taylor[2]

[1]Queens University of Charlotte, Charlotte, NC, USA.
[2]University of North Carolina Charlotte, Charlotte, NC, USA.

Authors' contributions

This work was carried out in collaboration between both authors. Both authors read and approved the final manuscript.

Article Information

DOI: 10.9734/JESBS/2018/44400
Editor(s):
(1) Dr. Eleni Griva, Associate Professor, University of Western Macedonia, Greece.
Reviewers:
(1) Bui Phu Hung, Van Hien University, Vietnam.
(2) Sameer Hamdan, Jordan.
Complete Peer review History: http://www.sciencedomain.org/review-history/26680

Original Research Article

Received 10 September 2018
Accepted 07 October 2018
Published 19 October 2018

ABSTRACT

Objectives: To examine bilingual code-switching across four languages in an experimental setting. To determine if the nature of a language or the linguistic background of the speakers influence laboratory induced code-switching.
Study Design: Bilingual speakers of English and either Spanish, French, German or Arabic participated in an extensive interview in their heritage language and completed an online survey containing 87 questions about their linguistic background. At a predetermined time during the interview, a monolingual English speaker interrupted the interview and remained in the room for the rest of the interview.
Place and Duration of Study: Department of Psychology, Queens University of Charlotte, January 2015 to March 2018.
Methods: Each language group included 20 subjects for a total of 80 subjects (39 men, 41 women, age range 18-77 years). The subjects included both college students and members of the community. The interviewer only spoke in one of the heritage languages and instructed the participants to only speak in that heritage language. The interview was videotaped and any occurrence of code-switchers after the interruption was recorded.

**Corresponding author: E-mail: halstedl@queens.edu;*

Results: Consistent with the initial prediction, several of the French, Spanish and Arabic subjects code-switched after the interruption. Those subjects who had learned their heritage language earlier in life or were more fluent in their heritage language were found to be less likely to code-switch in the presence of the interrupter (P = .02; P = .03). Subjects with a strong family heritage linguistic background were also less likely to code-switch (P = .006).
Conclusion: Overall, laboratory induced code-switching was found in three out of four languages. Furthermore, across the four heritage languages, the linguistic background and the level of fluency of bilinguals was predictive of code-switching behaviours.

Keywords: Code-switching; bilinguality; heritage language; laboratory-induced.

1. INTRODUCTION

Bilinguality is the ability to speak two or more Languages. Between 50% to 70% of the world population is estimated to be bilingual [1]. Among the population of Europe, 56% consider themselves bilingual [2]. Individuals may be *simultaneous* bilinguals when they acquire both their languages early in childhood at about the same time or *sequentia*l bilinguals when both languages are learned relatively early, but one language is learned first followed later in childhood by the second language. The third type is *late* bilinguality, when the second language is learned much later, after childhood during adolescence or adulthood [3].

Approximately 20% of the population of the U.S. and Canada are bilinguals [4, 5]. The rate of bilinguality has increased significantly since 1980 in the United States. The number of bilinguals in 1980 was reported to be 23.1 million speakers. This number increased to 59.5 million speakers in 2010, an increase of 158%. It is important to note that the overall population of the United States has also increased significantly during those three decades. The most dominant language in the United States is English. However, at least 300 other languages are spoken in this country. The most common languages in the United States aside from English are Spanish, Mandarin, French, Tagalog, and Vietnamese [4].

Historically, bilinguality was far more accepted and common in the United States than seems to be the case today. In the late 1700, the British had no language policy for the New World Colonies but in general, heritage language preservation was encouraged. In fact, when John Adams proposed English as the official language of the United States, other founding fathers opposed his proposal and found it incompatible with the spirit of freedom of the new-found country [6]. Additionally, many official documents from the Continental Congress, including the Articles of Confederation which was an early version of the constitution between the 13 original states in 1777-1781, was initially published in German and French as well as English [7]. In the 1700s, Americans found bilinguality advantageous in trading, education and even preaching. In the late 1800s and early 1900s, several factors came into play which resulted in less interest and appreciation for bilinguality. Among these factors were public education and instruction that now was done in English, the rise of nationalism because of the Spanish-American war and World War I, transition from agricultural to industrialised society with a greater need for a strong centralised government, and a backlash against a wave of immigrants from Europe and China [8, 9]. All these factors played a role in solidifying English as the dominant language of the United States. Despite these historical setbacks, bilinguality is alive and well in America. According to the 2010 US census, out of the 291.5 million people in the U.S. who were above age five, 60.6 million people were considered bilingual [4].

Bilinguals in addition to the dominant language of their society, speak a more private language that they share with their family and cultural group. This language is termed “heritage language” and is often the first language that emigrants learn from their parents or grandparents who in turn brought it with them from their country of birth [10]. Unfortunately, heritage languages are often forgotten in a few generations and gradually the children of bilinguals become monolinguals. Despite this common trend, there are social and emotional advantages in the preservation of one’s heritage language. Aside from facilitating communication between different generations, preservation of one’s heritage language is often an integral part of keeping cultural and family traditions alive [11,12]. In fact, the bilingual speakers of heritage languages, who are fluent in

their first language, reported a sense of comfort in using their language and feel a sense of pride about their bilinguality [13]. In addition to social and emotional benefits, bilinguality, has many well-documented cognitive advantages for its speakers. Currently, a strong body of evidence suggests that bilinguality is associated with better executive control, which is involved with working memory, inhibition, attending to a given task as well as switching between tasks. Bilinguals tend to manage distraction better, which in turn, results in better academic achievement in school and even helps to delay cognitive decline among the elderly population of bilinguals [14,15,16]. There are naturally some disadvantages to bilinguality as well, including having a smaller vocabulary in each of one's languages and slower and less accurate response in picture naming tasks than monolinguals [17,18,19]. Overall, the advantages of bilinguality clearly outweigh the disadvantages and gives the speaker an added tool to cope both cognitively and in their social and emotional life. These advantages are more evident for earlier bilinguals, as well as those who have a strong mastery of two or more languages.

In the past few decades, many investigators have attempted to examine whether there are structural or functional differences in the brain of bilinguals as compared to monolinguals. Based on their findings several differences have emerged between these two groups. Before the examination of some of these results, it is important to point out that bilinguality and its impact on the brain is a matter of degrees. For simultaneous or sequential bilinguals who acquired their second language early on and are fluent in two or more languages, clearly the structural and functional changes are more significant and evident than with late bilinguals or those who have limited mastery of their second language. Structurally there is some evidence of a more dominant language becoming lateralised earlier in 19- to 22-month-old children who were English-Spanish bilinguals [20]. In another study [21], Evidence has also been found of these changes in the grey matter [21]. Mechelli and her colleagues reported that grey-matter density in the inferior parietal cortex is greater in bilinguals than monolinguals. This effect was found to be greater in those who acquired their second language earlier. Another study [22] reported an "adaptation" in the anterior corpus callosum, the bundle of axons that connect the right and left hemispheres of the brain, possibly to increase the speed of communications between the two hemispheres for bilinguals, as needed during language switching.

Bilinguals deal with more than one language at a given time and depending on their linguistic environment, they constantly must decide which language they need to use in each conversation and situation. This requires them to switch between languages frequently, sometimes in a single conversation. This phenomenon is called code-switching which is a continuous stream of words in a different language in a given conversation. Sometimes, code-switching involves just a phrase but other times it could be as long as a complete conversation. Simply borrowing a word or two from another language is considered code-mixing. Using words or phrases learned from another language is considered borrowing [23].

Code-switching is a common and natural linguistic occurrence. In fact, some researchers have suggested that code-switching occurs subconsciously [24,25]. The reasons for code-switching are diverse and complicated. An obvious explanation of code-switching is a lack of sufficient linguistic knowledge in a language which results in switching to another language [26]. This explanation may be plausible in some instances, especially in the case of language borrowing or code-mixing. In other instances, switching may occur when the speaker needs to paraphrase or cannot think of an exact equivalent in their language [27]. However, lack of sufficient fluency does not explain most cases of switching. Even if the knowledge of vocabulary is a factor, researchers argue that the problem is more likely the efficient word retrieval from that given lexicon rather than the lack of knowledge [28].

Aside from the linguistic reasons, there are many social factors that influence code-switching. The bilingual speaker may code-switch to include or exclude a monolingual who is present, in the conversation [29]. Social context can also influence code-switching. When the conversation is taking place in a casual setting like a home or social gathering versus school or work [30]. Code-switching may also serve as a means of distancing oneself from expressing embarrassing ideas in one's native language or as a response to a stressful situation [31,32]. The picture that emerges from the current research is that code-switching is one phenomenon with many explanations. Diverse and complicated cognitive and social interactions can bring about code-switching in bilinguals.

Based on the current scholarship and different aspects of code-switching that have been studied, this phenomenon can be examined from two points of view. One is psycholinguistic, which helps us look at the structural characteristics and grammatical aspects of code-switching, while the other is a more sociolinguistic view which examines possible social influences on code-switching [33]. The latter perspective is the focus of the current research. To determine the possible social factors that can control code-switching, in a series of studies, we have tried to isolate this phenomenon in a laboratory setting. In one of the earlier studies in this series, an attempt was made to intentionally induce code-switching under experimental conditions in Spanish-English bilinguals. During this study, one-on-one interviews were conducted with 24 Spanish-English bilinguals ranging in age from 17 to 82 years old. The participants were asked to only speak in Spanish during the interview and their Spanish interviewer was instructed to avoid code-switching during the entire interview, regardless of the behaviour of the participants. After the interview the participants were asked to complete an in-depth survey about their linguistic background, family structure and the languages spoken at home. Based on the results of this study, we found that despite clear instructions to speak only in Spanish, 33% of the participants code-switched to English when a mono-lingual researcher entered the room and addressed the interviewer in English. The analysis of the language history survey showed that the participants who code-switched were older than non-switchers, 38 years versus 24 year [29]. Now that it is possible to induce code-switching in a controlled environment, the question becomes is this effect language dependent and likely to occur only with Spanish bilinguals? Alternatively, are bilinguals who speak other languages as likely to code-switch under the same laboratory situation? In other words, is there something about the Spanish language or certain cultural aspects associated with Spanish speakers which makes them more likely to code-switch in the presence of non-Spanish-speakers? Perhaps people from Spanish speaking countries are more inclusive or polite in the presence of monolinguals.

To answer this question and determine whether the same experimental setting can induce code switching in other languages, the same procedure was employed for 80 participants in four different languages: French, German, Spanish and Arabic. The first three of these four languages belong to the Proto-Indo-European family of Languages. French and Spanish are from the Italic (Romance) branch of the Proto-Indo-European family. German, on the other hand, is rooted from the Germanic branch of the Proto-Indo-European tree which also includes English. Finally, Arabic is an Afro-Asiatic language. Part of the reason for choosing these four languages is the fact that they are more common among the student population of Queens University. Another reason is to see if the speakers of more similar languages coming from the same language sub-branches like French and Spanish, are more likely to show similar code-switching behaviours than speakers of different branches (German) or a completely different family of languages like Arabic. In short, is there something in the vocabulary or grammatical structure of these languages that makes their speakers more likely to code-switch in a social situation? Conversely, if bilinguals code-switch because their language is very different from English, then this would lead to the prediction of more code-switching for the Arabic speakers.

It is important to note that based on our current understanding of the code-switching phenomenon, another possible explanation of code-switching is the level of fluency of the speakers, while other plausible explanations are more social in nature such as, wishing to include others in the conversation, stress or embarrassment [28,31,32]. In short, the three likely explanations for code-switching under such laboratory conditions are: the linguistic structure and compatibility to English, fluency and level of linguistic competence of individuals and social pressure.

Considering these different possible influences, the following are the hypotheses for the current study:

I. Laboratory induced code-switching will occur, as seen in the previous study [29]. This phenomenon will be seen not only among Spanish speaking bilinguals, but for all four languages examined here.
II. The level and the frequency of code-switching is not expected to be uniform across the four languages, with switching observed more frequently among the speakers of languages that are most remote from English, in this case Arabic. It is expected that German speakers, the closest language to English, will be less likely to code switch.

III. Another hypothesis for this study considers the linguistic history and the level of fluency of the code-switchers. The age of acquisition of English should not have an impact on the code-switching behaviours of the participants; however, the age of acquisition of their heritage language, most likely plays a role in participants' self-reported fluency. Therefore, those subjects who acquired their heritage language at an earlier age are anticipated to be more fluent, and consequently more confident about speaking in the presence of others. It is expected that these individuals will be less likely to code-switch when interrupted by a monolingual.

IV. If social influences are important, those subjects who have reported being ridiculed for speaking their heritage language or ever felt embarrassed about their heritage language will be more likely to code-switch in the presence of a monolingual English speaker.

V. In line with our previous findings on the role of family structure in bilinguality [34,13], it is predicted that bilinguals whose parents were born outside of the United states and the parents' first language is the heritage language, will be more fluent and consequently less likely to code-switch.

VI. In our earlier code-switching study, we found greater code-switching among the older community participants. In line with this previous finding, it is expected that code-switchers in the present study will be older and more likely to be members of the community rather than undergraduate students.

2. MATERIALS AND METHODS

2.1 Participants

The bilinguals who took part in this study were recruited from Queens University of Charlotte students, as well as member of the local community in Charlotte, North Carolina. The participants were 80 fluent speakers (20 per language) of one of the four target languages (Arabic, French, German and Spanish), who were also fluent in English. The age of the participants of this study ranged from 18-77 years, with a mean age of 28 years. The average age of acquisition of the second language for these bilinguals was 4.5 years. Consequently, they are more likely to be Simultaneous or Sequential bilinguals. To compensate the subjects for their time, all the students received extra credit points for their psychology classes and the members of the community received a $5 Starbucks gift card. The gender ratio of our participants varied across the different language groups, but overall, both males and females were equally represented in our sample (39 men, 41 women).

The subjects of this study were divided into four distinct groups based on their heritage language (Arabic, French, German, Spanish). A detailed listing of the characteristics of the participants is presented in Table 1.

2.2 Procedures and Measures

2.2.1 Experimental Design

The participants were asked to take part in a 30-40 minutes interview in their heritage language. This necessitated that each subject be fluent enough in their language to complete such an interview. For each group a fluent native speaker was recruited and trained as the interviewer. It is important to note that all four interviewers for this study were native speakers of those languages and all were born outside of the United States. The Spanish Interviewer was born in Mexico, the German interviewer was from Germany, the Arabic interviewer was from Saudi Arabia and the only male interviewer was a French native speaker from the Republic of Congo. All the interviewers at the time of the interview were seniors at Queens University of Charlotte and all except the French interviewer were psychology majors. The French interviewer was a business major.

Table 1. Participant characteristics

Characteristic	Heritage language				Total
	Arabic	French	German	Spanish	
# of participants	20	20	20	20	80
Mean age	25 years	31 years	30 years	27 years	28 years
Age range	20-52 years	19-62 years	18-77 years	18-60 years	18-77 years
% female	35%	65%	40%	65%	51%
% student	40%	55%	70%	80%	61%

Each participant was greeted at the beginning of the experiment and escorted into a room by a monolingual English speaker and introduced to the interviewer. The interviewer ONLY spoke to the subjects in one of the target languages throughout the entire interview. The monolingual research assistant who ushered the subject in the room would then immediately leave. At this point, the interviewer explained that the interview was being video-recorded and in accordance with the Institutional Review Board regulations, the participant was reminded that they could stop the interview at any time or refuse to answer any or all questions. At the outset, all participants were instructed to only speak in their heritage (target) language (Arabic, French, German or Spanish) during the entire interview.

The interview consisted of between 25 and 38 questions about the participants' and their family's linguistic background, and where, when and how often they used their heritage language. They were also asked where and how they acquired their heritage language. Toward the end of the interview, at a predetermined point, the interviewer by using her/his cellphone secretly signalled the monolingual research assistant to come back into the room. At this time, the research assistant entered and addressed the interviewer in English, pretending to have a research question. The interviewer would answer the research assistant in English and resume the interview in one of the target languages. The interrupter remained in the room for the rest of the interview pretending to do paper work but did not interrupt the interview. The interviewer completed a sheet for each subject and recorded their observations including any occurrence of code-switching following the interruption by the research assistant. The subjects were only considered to be code-switching if they used at least two or three sentences or utterances in English following the interruption.

2.2.2 Online survey

At the end of the interview, all subjects were asked to complete an extensive online survey on the designated lab computer. The survey consisted of 87 questions in English. Some of the questions were demographic in nature while others dealt with the linguistic history of the participating bilinguals and their family, including their attitudes and social challenges of using their heritage language and culture. Some of the questions on the survey were similar to the questions that were asked during the interview. However, overall the survey questions were more probing and detailed than the interview questions. The complete set of written questionnaire items is included in the Appendix. After the participants completed the questionnaire they were debriefed about the study.

3. RESULTS

3.1 Language-related Code-switching

The most important question that this study attempted to answer was whether laboratory-induced code-switching could be observed again and if this phenomenon could be seen in more than one language. Based on the results of the current study, the answer to both questions is yes.

As shown in Table 2, despite clear instructions to speak only in their heritage language, 21% of all subjects code-switched in the presence of an English-speaking monolingual research assistant. The percentage of code-switchers was not the same for all four languages. Among the French speaking participants, 55% switched to English, while only 10% of the Spanish bilinguals switched in the presence of the monolingual interrupter. Arabic bilinguals switched 20% of the time, while none of the German subjects switched after the monolingual interrupted the interview.

Table 2. Prevalence of code-switching from heritage language to English

Heritage language	Percent code-switching
Arabic	20%
French	55%
German	0%
Spanish	10%
Total	21%

These findings are consistent with the hypothesis that laboratory-Induced code-switching will be observed among Spanish speakers as well as some or all of the three other languages examined in this study. The Arabic bilinguals were predicted to be the ones who code-switched the most, and they did switch their language in the presence of the interrupter, but not as much as the French-speaking participants in this study. Because both English and German are rooted from the same Germanic branch of the Proto-Indo-European family tree and the similarity between these two languages, German bilinguals were predicted to revert to code-

switching less frequently than the speakers of the other three languages in this study. In line with this prediction, none of the German bilinguals code-switched during their interview. An example of code-switching is as follows. When the interrupter entered the room, the interviewer was asking about the participant's grandparents and their heritage language. After the interruption, a French speaking subject answered; "Well my grama didn't speak much English so with us it had to be mostly French, but she died when I was a teenager."

3.2 Characteristics of Code-Switchers

The next hypothesis dealt with the linguistic characteristics of code-switchers: the age of acquisition, and consequently, the level of fluency of their heritage language. It was expected that the participants who acquired their heritage language at an earlier age would be more fluent. The fluent bilinguals, in turn, were expected to be more confident in their language skills and less prone to code-switching. On the other hand, less fluent heritage speakers were predicted to be more insecure about their level of knowledge of the language and more likely to code-switch.

Our findings confirmed the prediction that self-described fluency in the target language would be inversely related to code-switching; as a result, less fluent bilinguals were more likely to code-switch. The average age of acquisition of the heritage language for the code-switchers (7.5 years) and non-switchers (4.0 years) was significantly different (t= 2.37, df = 79, *P* =.02). Also, self-reported fluency on a four-point scale was significantly higher for non-code-switchers (3.5) than code-switchers (2.9) (t=2.18, df = 79, *P* = .03). Therefore, both the age of acquisition and level of self-reported fluency were found to be associated with code-switching.

It was also predicted that heritage language speakers who reported being embarrassed of using their heritage language in the presence of others or individuals who reported ever being made fun of about their language, would be more likely to code-switch in the presence of the monolingual interrupter. This code-switching behaviour was also predicted for the participants whose cultural group was ridiculed. Surprisingly, the factors related to social embarrassment or being made fun of, were not found to be related to code-switching in any of the language groups or for the combined participants across the four languages. Finally, unlike our previous study, neither the age of the bilinguals nor being a student versus a member of the community were found to be significant correlates of code-switching behaviours in this study. Table 3 presents the differences in linguistic backgrounds and characteristics between code-switchers and non-code-switchers.

Table 3. Code-switching participant characteristics

Characteristic	Code-switchers	Non-code-switchers	Significance
Percent of participants	21%	79%	
Percent female	65%	48%	*P* = .21
Percent community members	29%	41%	*P* = .37
Percent born outside of US	71%	71%	*P* = .95
Average subject age	25.5 years	28.7 years	*P* = .10
Percent of subjects 25 years+	24%	38%	*P* = .26
Average age of acquisition of heritage language	6.9 years	3.4 years	*P* = .02
Average age of acquisition of English	6.9 Years	7.7 years	*P* = .65
Self-reported heritage language fluency (1-4 scale)	2.9	3.5	*P* = .03
Percent who speak heritage language every day	33%	49%	*P* = .27
Percent who learned heritage language before English	59%	75%	*P* = .20
Average years speaking heritage language	19 years	25 years	*P* = .10
Percent very comfortable speaking heritage language in public	38%	56%	*P* = .19
Percent ever embarrassed speaking language in front of non-heritage language speakers	13%	24%	*P* = .33

Table 4. Code-switching family characteristics

Characteristic	Code-switchers	Non-code-switchers	Significance
Mother born outside of US	71%	78%	*P* = .46
Father born outside of US	71%	78%	*P* = .46
Participant learned heritage language from parents	63%	78%	*P* = .21
Mother learned heritage language first	53%	76%	*P* = .06
Father learned heritage language first	41%	76%	*P* = .006

Table 4 presents the differences in family characteristics between code-switchers and non-code-switchers. There were no significant differences between the two groups on whether the mother or father had been born in the US versus outside of the US. Likewise, there was no significant difference on whether the two groups of participants reported learning their heritage language from their parents. However, there was a significant difference between code-switchers and non-code-switchers on whether the heritage language was the first language their fathers had learned (Chi-square = 7.64, DF = 1, *P* = .006). A similar difference was observed for the mother's first language, but this result was not significant (*P* = .06) using a conservative two-tailed test of association.

Many of the language attributes in this study were strongly correlated with one another. To identify unique sources of variance that could explain code-switching behaviour a multiple regression analysis was conducted. Table 5 presents the results of the multiple regression analysis used to identify significant predictors of code-switching behaviour. The multiple R value for this linear regression analysis was .59, with an adjusted R square = .32 (F (3,77) = 13.7, *P* < .001). Three attributes were found to be significant: age of acquisition, participant learning the heritage language first and father learning the heritage language first.

Finally, Table 6 presents the linguistic characteristics of participants and families for each of the four heritage language groups. The French-speaking participants had the oldest average age of language acquisition and the lowest percent of fathers whose first language was French. The French group had, by far, the highest percent of code-switchers among the four languages studied here. Toward the other extreme, the German-speaking participants had the second youngest age of heritage language acquisition and the second highest percent of fathers whose first language was German. This was the group in the current study where no one code-switched. The Spanish-speaking participants fell between the German-speaking and French-speaking participants on age of acquisition and percent of father first learning the heritage language. The rate of code-switching also fell between that of the French and German groups. Only the Arabic-speaking participants deviated from the expected level of code-switching based on key factors like age of acquisition and father's first language.

4. DISCUSSION

This study confirmed that code-switching can be induced under laboratory conditions for more than one heritage language. The mere fact that code-switching behaviour was seen in a significant percentage of the subjects in three out of the four languages, affirms that this is not an artifact, nor a narrow finding relevant only to a specific language or cultural group. Over half of the French bilinguals code-switched despite the specific and clear instructions to speak only in French during the interview. Considering this finding, the question is not if the participants will code-switch, but rather, what are the factors that lead some bilinguals to switch under these controlled circumstances. There are many dynamics that can increase the possibility of code-switching under experimental conditions.

Table 5. Multiple regression to identify predictors of code-switching

Variable	Standardised coefficient	Significance
Intercept	0	
Age of heritage language acquisition	0.0297	*P* < .001
Participant learned heritage language first	0.5524	*P* < .001
Father learned heritage language first	-0.4396	*P* = .007

Table 6. Linguistic background of participants and families by heritage language

Characteristic	Heritage language				Total
	Arabic	French	German	Spanish	
Average age (in years) subject acquired heritage language	1.3	7.9	2.2	5.5	4.3
Subject born in US	5%	45%	5%	55%	28%
Mother born in US	0%	55%	10%	30%	24%
Father born in US	0%	50%	5%	35%	23%
Participant learned heritage language first	95%	40%	80%	55%	68%
Mother learned heritage language first	95%	35%	85%	70%	71%
Father learned heritage language first	100%	30%	85%	60%	69%

If the social pressure of the presence of the interrupter was the only factor at play, then the percentage of code-switchers should have been very similar across all four languages. This clearly was not the case and one important factor may be the nature of the specific languages studied. Once again, Arabic is vastly different from English. Arabic is from a different family of languages, the Proto-Afro-Asiatic tree, with a completely different phonological system, grammar and, unlike English, verb-subject-object word order. Translation of terms from English into Arabic and vice versa is fairly challenging for any Arabic bilingual. Therefore, it is not surprising that 20% of Arabic speakers switched to English in the presence of a monolingual.

By the same logic, it is also not surprising that German speakers did not code-switch. After all, English and German come from the same language branch and have many similarities both in their phonological system and grammar. Indeed, German has 60% lexical similarity to English [35]. The surprising finding is the 55% of French speakers who code-switched. French is from the Italic branch of Proto-Indo-European tree. It has %75 lexical similarities to Spanish but only 27% to English. Not a close language to English by any means, but certainly closer than Arabic. So, based on pure linguistic similarities and differences, we cannot explain the large number of French speakers who code-switched. Again, based on a linguistic argument, perhaps the answer lies in the cultural norms of the speakers as much as the languages themselves. One could speculate that the French speakers are more concerned about including others in a conversation than following instructions. Furthermore, one can assert that culturally, French speakers are less concerned with following rules and instructions than Germans, who did not code-switch at all. However, it is not possible to closely examine the possible impact of these cultural differences from the current data.

Another possible explanation for the differences in the code-switching behaviours among the different language groups, may be in the linguistic background of the participants. The age of acquisition of the heritage language was found to be significantly related to self-reported fluency. The average age of heritage language acquisition among the German bilinguals was two years old, which was the youngest acquisition age of all four groups. On the other hand, the average age of heritage language acquisition for the French group was eight years old. This was the latest acquisition age of all the language groups. Furthermore, the most fluent bilinguals across all language groups were less likely to code-switch. It is conceivable that the level of mastery of language plays an important role in increasing the possibility of code-switching in the presence of others. Here it is important to remember that all the subjects for this study had to have a fairly high level of mastery of their heritage language to be able to engage in a half-hour long conversation. What is at question here is not if these participants were fluent, but how fluent they were based on a self-reported rating. We can only speculate about the reasons behind more fluent speakers' lower rate of code-switching. Perhaps they were more confident in their heritage language and were not concerned about speaking in the presence of monolinguals; or, with their high level of fluency, they automatically continued in their heritage language. They may also have been less concerned about including others in the conversation. Higher level of fluency may also be accompanied by cultural pride in one's heritage language and reluctance to code-switch. Whatever the reason, as this effect was observed in more than one language most likely is not exclusive to cultural norms and traditions.

In another study, currently in progress in this series, we are adopting the same method except after the conclusion of the interview, the code switchers are asked why they switched. This pointed question should shed more light on the possible causes of code-switching.

Additionally, based on the current results of the self-reported questionnaire, no connection was found between social embarrassment or being made fun of and code-switching. Therefore, one cannot infer that the code-switchers were hesitant to speak their language in presence of others, due to negative past experiences. This study had a limited number of subjects, and in the past, other studies have found evidence that some bilinguals find their language to be viewed of lower prestige by English speakers. This in turn can make those speakers more hesitant to use their heritage language in presence of English monolinguals [36,37]. This factor may have played a role in the current study as well; in that case, one would expect that the speakers of French, a high prestige language, would be less likely to code switch. Similarly, Arabic speakers, due to recent waves of Islamophobia, or Spanish speakers, considering the current US political climate, would be expected to be more likely to switch to English. However, no evidence of such linguistic insecurities due to societal pressure or discriminatory policies, practices or attitudes was found in the current study.

Finally, the role of family structure in code-switching and the preservation of heritage languages was gleaned from the survey data. The heritage language of the parents was found to play a role in code-switching behaviour of the bilinguals. The bilinguals whose father's first language was the heritage language, were less likely to code-switch. A similar but non-significant result was found when the heritage language was the first language of the mothers of bilinguals. This may not seem as an important indicator, especially when no significant difference was found in whether the parents of participants were born in or outside of the United States. Nevertheless, the country of birth may play as crucial a role as the first language of parents in the overall linguistic development of a bilingual and how well they learn or preserve their heritage language. When parents have learned a heritage language as their native language and teach this language to their children, perhaps culturally and linguistically, these languages are more likely to be preserved.

To sum up, the code-switching behaviours among the speakers of four languages that were observed in this study seem to be more related to the level of fluency of the participants, which in turn is associated with a younger age of acquisition and the first language of the parents of our bilingual participants. Seemingly, the heritage language of the family and the linguistic background of the participants determines the level of fluency, and at least based on the current data, less fluent speakers are more likely to code-switch.

Many of the available code-switching studies in the current literature have attempted to examine code-switching observationally as it occurs naturally in bilinguals. In the previous studies of this series, we were able to show that code-switching can be induced in laboratory conditions among bilinguals during an interview in Spanish. At that time, it was unclear if this was due to specific cultural or linguistic features of the Spanish language and its speakers or if code switching could be induced in speakers of other languages coming from very different cultural backgrounds. The first contribution of this study is that it reveals this type of induced code-switching is neither language nor culturally dependent and can be seen in very different languages and among participants coming from different corners of the world. The second contribution is the discovery that code-switching under such conditions more likely hinges upon the degree of fluency and linguistic competence of the bilingual speakers, which in turn, is determined by their linguistic background. From the sociolinguistic framework, it seems that the more confidence and mastery a bilingual has in their language, the more likely they are to resist code switching under any conditions.

One of the unanswered questions in the present study is whether some of the bilinguals might have code-switch spontaneously, even without any interruption during the interview. In order to answer this question, we have designed another experiment with control and experimental groups that is currently being conducted in our lab. In this new study, to see which group is more likely to code-switch, half of the Spanish-speaking participants will go through an interview and interruption similar to the procedure of the current study, while the other half will experience an interview with no interruption (control group). The results of this upcoming study will shed more light on the causes of code-switching under such conditions. Overall, code-switching is an

extremely common phenomenon with many causes and still unanswered questions as to when and why it occurs.

5. CONCLUSIONS

This study was an attempt to induce code-switching under laboratory conditions and identify participant characteristics that were predictive of this phenomenon. Code-switching was observed to different degrees in three of the four languages studied (French, Spanish and Arabic). The age of acquisition of the heritage language, the level of fluency of the bilinguals and the first language of their fathers were all found to be significantly associated with code-switching behaviours in a laboratory setting. Based on the current findings, it is reasonable to assume that more fluent bilinguals learn their heritage language early from their parents and they are less likely to revert to code-switching in the presence of monolingual speakers.

ETHICAL APPROVAL

This research project was reviewed and approved by the Queens University Institutional Review Board on January 11, 2015, file # 11-15-CAS-0124.

All authors hereby declare that all experiments have been examined and approved by the appropriate ethics committee and have therefore been performed in accordance with the ethical standards laid down in the 1964 Declaration of Helsinki.

ACKNOWLEDGEMENTS

The authors would like to acknowledge Dr. Marc Halsted for his many contributions throughout this research project. We would also like to thank the following individuals who served as interviewers, experimenters, subject recruiters and data collectors: Natalie Murphy, Laila Aldandan, Alvan Makoundi-Tchibinda, Lena Etzel, Jimena Watts, Sarah Lucich, Grace Chammas, Drew Underwood and Robert Williams.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

REFERENCES

1. Trask R. Key Concept in language and linguistics. London. Routledge; 1999.
2. European Commission Special Eurobarometer. Europeans and Their Languages; 2006.
Available:http://ec.europa.eu/public_opinion/archives/ebs/ebs_243_en.pdf
(Retrieved April 1, 2018)
3. Bialystok E, Hakuta K. In other words: The Science and psychology of second language acquisition. New York: Basic Books; 1994.
4. United States Census Bureau. American Community Survey.
Available:http://www.census.gov/acs/www
(Retrieved, April 1,2018)
5. Statistics Canada.
Available:https://www12.statcan.gc.ca/census-recensement/2006/dp-pd/hlt/97-555/T402-eng.cfm?Lang=E&T=402&GH=4&SC=1&S=99&O=A
(Retrieved, April 4, 2018)
6. Hakuta K. Mirror of language. New York. Basic Books; 1986.
7. Crawford J. Bilingual education: History, politics, theory and practice. Trenton, NJ: Crane; 1989.
8. Frick E. Metaphors and motives of language restriction movement. In H.A. Daniels (Ed), Not Only English: Affirming America's Multilingual Heritage: Urbana, IL: National Council of Teachers of English. 1990;27-35.
9. Fitzgerald J. Views on bilingualism in the United States: A selective historical review. Bilingual Research Journal. 1993;17:1&2.
10. Rothman J. Understanding the nature and outcomes of early bilingualism: Romance Languages as heritage languages. International Journal of Bilingualism. 2009; 13(2):155-163.
11. Portes A, Hao L. The price of uniformity: Language, family and personality adjustment in the immigrant second generations. Ethic and Racial Studies. 2002;25:889-912.
12. Anderson R. First Language Loss in Spanish-Speaking Children: Patterns of Loss and Implication of Clinical Practice. In B. Goldstein (Ed), Bilingual Language Development and Disorder in Spanish-English Speakers, Baltimore: Brookes. 2004;187-212.
13. Halsted L. Social aspects of bilinguality, International Review of Social Sciences and Humanities. 2015;8(2):38-49.
14. Bialystok E, Craik F, Klein R, Viswanathan M. Bilingualism, aging and cognitive

control: Evidence from the Simon Task. Psychological Aging. 2004;19(2):240-303.
15. Bialystok E, Craik F, Luk G. Bilingualism: Consequences for mind and brain. Trends in Cognitive Sciences. 2012;16:240-250.
16. Salvatierra J, Rosselli M. The effect of bilingualism and age on inhibitory control. International Journal of Bilingualism. 2010;15:26-37.
17 Bialystok E, Luk G, Peels K, Yang S. Receptive vocabulary differences in monolingual and bilingual children. Bilingualism: Language and Cognition. 2010;13:525-531.
18. Bialystok E, Craik F, Luk G. Lexical access in bilinguals; Effects of vocabulary size and executive control. Journal of Neurolinguistics. 2008;21:522-538.
19. Roberts P, Garcia L, Desrochers A, Hernandez D. English performance of proficient bilingual adults on the Boston Naming Task. Aphasiology. 2002;16:635-645.
20. Conboy T, Mills D. Two languages one developing brain: Event-related potentials to words in bilingual toddlers. Developmental Science. 2006;9:f1-f12.
21. Mechelli A, Crinion J, Noppeney U, O'Doherty J, Ashburner J, Frackowiak R, Price C. Structural plasticity in the bilingual brain. Nature. 2004;431:757.
22. Coggins P, Kennedy T, Armstrong T. Bilingual Corpus Callosum variability. Brain and Language. 2004;89:69-75.
23. Marian V, Kaushanskaya M. Cross linguistic transfer and borrowing in bilinguals. Applied Psycholinguistics. 2012;28:269-390.
24. Woolard K. Code-Switching in durante: Companion to linguistic anthropology. Oxford: Blackwell; 2004.
25. Auer P. Code-switching/mixing. The Sage Handbook for Sociolinguisitics. 2010;460.
26. Grosjean F. Life with two languages: An Introduction to Bilingualism. Cambridge, MA: Harvard University Press; 1982.
27. Baker C. Foundations of bilingual education and bilingualism. Multilingual Matters, Ltd.; 2001.
28. Heredia R, Altarriba J. Bilingual language mixing. Why do bilinguals code-switch? Current Directions in Psychological Science. 2001;(10)5:164-168.
29. Halsted L, Murphy K, Nieuwenhuizen A. Influences on language code-switching induced in social setting. British Journal of Education, Society & Behavioral Science. 2015;11(4):1-13.
30. Wardhaugh R. An introduction to psycholinguistics. USA: Blackwell Publishing; 2011.
31. Bond M, Lai T. Embarrassment and code-switching into a second language. The Journal of Social Psychology. 2001; 126(2):179-186.
32. Javier R, Marcos L. The role of stress on the language independence and code-switching phenomena. Journal of Psycholinguistic Research. 1989;18(5): 449-472.
33. Shay O. To switch or not to switch: Code-switching in a multilingual country. Procedia-Social and Behavioral Sciences. 2015;209:462-469.
34. Halsted L. The effects of family structure on the development of bilinguality. Psychology. 2013;4(9):688-694.
35. Gordon R, Grimes B. (Eds). Ethnologue: Languages of the World. Dallas: SIL International; 2017.
36. Valdes G, Fishman JA, Chavez R, Perez W. Developing minority language resources: The case of Spanish in California, Clevedon, UK: Multilingual Matters; 2006.
37. Caldas SJ, Caron-Caldas S. A sociolinguistic analysis of the language preferences of adolescent bilingual: Shifting allegiances and developing identities. Applied Psycholinguistics. 2002; 23:490-540.

APPENDIX

Bilingualism Online Survey

Age:
Sex:
Place of birth (City, State, Country):
What is your Major?
What Year are you in school?
How well do you think you fit in with other students at Queens?
How well do you think you fit in with other students here at Queens?
How well did you fit in with other students at your High School?
How well did you fit in with other students at your Middle School?
What kind of High school did you attend?
Do you speak any languages other than English?
What is your other ("second") language?
Did you learn to speak your "second" language Before you learned to speak English?
How old were you when you first learned your "second" (non-English) language?
Approximately how many years have you spoken this second language?
Do you speak a third language? If so what is that language?
Where did you learn to speak this second language?
Growing up who else in your family spoke this second language?
In what situation do you currently use your second language? Check all that apply.
Currently how much of the time do you use your second language?
How much do you like speaking in your second language?
How well can you speak your second language?
Are you able to read in your second language?
Are you able to write in your second language?
Do you ever read books or magazines in your second language for pleasure?
Do you ever watch TV shows or movies in your second language?
Do you feel proud to be able to speak a second language?
How comfortable are you speaking your second language in public?
Do you belong to a cultural or ethnic group?
If yes, what is the group?
Do you feel proud of being a member of a cultural or ethnic group?
Do you feel supported by your cultural or ethnic group?
Do your family members belong to a cultural or ethnic group?
Do your family members feel proud of belonging to a cultural or ethnic group?
Do your family members feel supported and valued by a cultural or ethnic group?
Do you regularly socialise with the members of your cultural or ethnic group?
Do you attend the celebrations and events of your cultural or ethnic group?
Do your family members socialise with the members of your cultural or ethnic group?
Do your family members attend the celebration and events of your cultural and ethnic groups?
Has anyone ever made fun of you speaking your second language?
Has anyone ever made fun of your ethnic or cultural group?
To your knowledge has anyone ever made fun of your family members speaking their second language.
Do you ever feel embarrassed to speak your second language in front of non-second language speakers?
To your knowledge do your family members ever feel embarrassed to speak their second language in front of non-second language speakers?
Did you ever attend second language schools or classes?
If yes when?
How often?
Do you plan to continue or improve your second language?
Growing up, were there other family members who lived in your home who regularly spoke a language other than English?

What is their relationship to you? (Check all that apply)
Where was your mother born? (City, state, country)
If your mother was not born in the United States, how long has she lived in the states?
What is the first language of your mother?
How often does she speak that language?
What other languages if any does she speak well?
What language does she usually speak at home?
What is the highest level of education attained by your mother?
Where was your father born? (City, state, Country)
If your father was not born in the United States, how long has he lived in the US?
What is the first language of your father?
How often does he still speak that language?
What other languages does he speak well?
What Language does he usually speak at home?
What is the highest level of education attained by your father?
Do you have any sisters? If yes how many?
Do/does your sister/s speak a second language?
How often does she speak her second language?
Do you have any brothers? If yes how many?
Do/does your brother/s speak a second language?
How often does he speak his second language?
Do you have any step sister?
Do/does she speak a second language?
How often does she speak her second language?
Do you have any step brothers?
Do /does he speak his second language?
In what language do you communicate with your sibling?
In what language do you communicate with your step siblings?
Do you have any grandparents who lived with you?
Did your grandparent/s speak a second language?
In what language did your grandparent/s communicate with you?
What year were you born in?

Peer-review history:
The peer review history for this paper can be accessed here:
http://www.sciencedomain.org/review-history/26680