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THE EFFECTS OF LANGUAGE-SWITCHING CONTEXTS ON COGNITION OF POLISH-ENGLISH BILINGUALS

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ABSTRACT

Evidence suggests that bilingualism (speaking two or more languages) may be beneficial for executive cognitive functions. The adaptive control hypothesis proposes that different interactional contexts place different cognitive demands on bilinguals and being in these environments may influence both language and cognitive abilities. In the present study, we investigated whether the amount of language-switching is one factor that leads to increased cognitive demand. Twenty-four Polish-English bilinguals participated in the study; all were native Polish speakers (L1) with high English proficiency (L2). A within-subjects design included 3 sessions in counterbalanced order: L1, L2, or Switch (L1/L2). One session lasted approximately 2 hours and consisted of the participant playing an interactive map game with 2 confederates. This was an adapted task aiming to recreate a naturalistic bilingual experience in a laboratory setting through unscripted verbal communication. Performance on the map game task was also used as an indicator of cognitive demand. At the end of each session, the participant completed a self-report questionnaire of the perceived effort on the task. The results showed that the participants perceived the L1 condition as significantly less effortful than the L2 and Switch conditions. However, in terms of the task performance, there were no differences across conditions: the participants performed very well in every interactional context. This study contributes to the growing field of bilingualism research and explores a novel procedure designed to investigate interactional contexts.

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Chapter 1

Introduction

Bilingualism is ubiquitous. It is estimated that more than half of world's population speaks more than one language (Ansaldo, Marcotte, Scherer, & Raboyeau, 2008; Grosjean, 2010). A growing body of evidence supports the idea that bilinguals have an advantage in non-linguistic cognitive performance (Bialystok, Craik, & Luk, 2012). The findings on bilingualism have gained a lot of attention from researchers and have sparked some controversy due to inconsistent and null results (see Bialystok et al., 2012; Paap & Greenberg, 2013), which shows the need for further investigation. Understanding the effects of the bilingual experience is essential in order to take full advantage of its potential benefits. A fuller understanding of bilingualism will better inform school curricula and foreign language classes. It can also help to destigmatize bilingualism and encourage people to learn and use more languages by informing them of the benefits of doing so.

First, I will define several key terms. In the context of this paper, the term bilingual is applied broadly to anyone who speaks more than one language in their everyday life. The bilingual cognitive advantage is the hypothesis that the experience of using multiple languages has a positive impact on executive control. Executive control refers to the set of cognitive functions that support general processes, such as inhibition, task switching, and attention shifting (Bialystok et al., 2012). There are several theoretical explanations about how bilingualism relates to executive functions.

According to Bialystok et al. (2012), in the past it has been assumed that speaking more than one language would be confusing and harmful to a child's mind. This view started changing in 1960s, when a study by Peal & Lambert (1962) provided surprising evidence to contradict this popular belief: they found that English-French children outperformed their monolingual French peers on most tasks in a battery of tests. Since then, a number of studies have provided robust evidence for the advantage of the bilingual experience in children's cognition (Cromdal, 1999; Kapa & Colombo, 2013; Blom et al., 2014).

The cognitive advantage has been found not only in children, but also in older adults. Some recent studies suggest that the bilingual experience supports brain function in healthy aging and can delay the onset of dementia. Using hospital records, researchers found that bilinguals were diagnosed with dementia approximately 4 years later than monolinguals (Bialystok, Craik, & Freedman, 2007; Alladi et al., 2013).

Compared to children and older adults, studies with college-aged bilinguals have more inconsistent results. Several studies have reported detecting the bilingual advantage in older adults but not younger adults when using the same cognitive tasks and procedure (Bialystok, Craik, & Luk, 2008; Lee Salvatierra, & Rosselli, 2011). One possible explanation is that young adults are already at their peak performance developmentally, compared to other age groups, and thus may benefit less from a cognitive advantage. A fuller understanding of the underlying mechanisms of the bilingual experience may explain the differences across the lifespan.

So how may bilingualism enhance executive control? The parallel activation theory has emerged as a well-supported explanation of this phenomenon (Grosjean, 1985; Kroll, Dussias, Bogulski, & Kroff, 2012). It suggests that in the bilingual mind, all known languages are always active to some degree, even when the external context is entirely dominated by one language.

Evidence to support this model comes from behavioral studies in which bilinguals performed lexical decision tasks in one language, but their speech comprehension and production were still influenced by the currently unused languages. Neuroimaging studies also show the activation of the non-relevant language during linguistic tasks in the target language (Kroll et al., 2012).

The parallel activation of languages requires bilinguals' brains to constantly select the appropriate language and suppress the irrelevant one. This demanding mental process would be expected to come with heavy costs, such as slower processing, and result in speech errors and inappropriate switching. But fluent bilinguals almost never have inappropriate language intrusions or speech errors. The fact that they are able to use their languages with very high accuracy suggests that they have developed sophisticated cognitive control processes, which select the appropriate language and inhibit the others (Kroll et al., 2012).

Building on the parallel activation theory, the adaptive control hypothesis offers a more detailed model of the effect of bilingualism on executive cognitive functions (Green & Abutalebi, 2013). The adaptive control hypothesis proposes that different aspects of the bilingual experience place different demands on the speakers' cognition, forcing the relevant executive functions to adapt to these demands. Eight control processes are identified as relevant: goal maintenance, conflict monitoring, interference suppression, salient cue detection, selective response inhibition, task disengagement, task engagement, and opportunistic planning. The extent to which each one of these processes is needed—and thus becomes trained—in the bilinguals' minds depends on the cognitive demands of their interactional contexts.

The adaptive control hypothesis also outlines three different types of interactional contexts, with each one placing unique demands on the executive control processes. The three

contexts are: single-language, dual-language, and dense code-switching. They are outlined below:

1. *The single-language context* is defined by the use of one language in one environment, and another language in a completely different environment. One example is an individual who speaks only Spanish at home with his family and only English in his workplace. There is no frequent language switching.
2. *The dual-language context* includes the use of both languages in the same setting, but to different speakers. For example, a bilingual who works with a German colleague and an American colleague needs to switch between German and English depending on who she is addressing. The language switch is cued by the addressed speaker, and may occur within a single conversation, but not within a sentence.
3. *The dense code-switching context* occurs between bilingual speakers that share knowledge of the same language. In this interaction, the speaker routinely mixes words and phrases from different languages within the same conversation. The language switching occurs within the same sentence or utterance.

The adaptive control hypothesis is a complex model that identifies different cognitive functions and three types of bilingual interactions which require the use of those functions to varying degrees. This account of the bilingual experience improves and expands on previous, more simple theories. For example, it was believed that inhibition is solely responsible for resolving parallel language activation, but numerous studies have shown the significance of other cognitive processes as well (Kroll et al., 2012). The current model also modifies the traditional dichotomy of comparing monolinguals and bilinguals and accounts for variation *within* bilingualism.

Several research studies have attempted to provide evidence in line with the adaptive control hypothesis. Verreyt, Woumans, Vandelanotte, Szmalec, & Duyck (2016) examined the relationship between language switching experience and executive function performance. They did so by classifying Dutch-French bilinguals into three different groups: those who were equally fluent in both languages and switched often, those who were equally fluent but switched rarely, and those who were more proficient in one of the languages and switched rarely. The participants were placed into these groups based on self-report questionnaires, where they indicated their language proficiencies and typical daily usage, including how often and if they switched between languages. Then the participants were tested on two tests which required executive control processes: the flanker and Simon arrow tasks. Bilinguals fluent in both languages and who switch often outperformed the other groups on both tests, on both congruent and incongruent trials. Moreover, there was a significant correlation between language-switching experience and cognitive performance. This study provides evidence for the importance of the type of language use—in particular, switching—in improving executive control.

The method of classifying bilinguals into separate groups based on their typical language use is a popular approach in investigating the adaptive control hypothesis. Two other studies using a similar classification procedure found that cognitive advantage is modulated by language switching. Prior & Gollan (2011) recruited Spanish-English and Mandarin-English participants and classified them into four groups: monolinguals, early and late bilinguals, and codeswitchers. Codeswitchers, who reported the most frequent switching, had smaller switching costs on a non-linguistic task, whereas the other groups of bilinguals did not have an advantage compared to monolinguals. Similarly, Hartanto & Yang (2016) grouped bilingual participants into either single-language or dual-language contexts based on their reported language use. Consistent with

predictions, the dual-language group, who switched languages more, outperformed the single-language group on a color-shape switching task.

The discussed studies provide support for the adaptive control hypothesis, but they all share the same limitations: group classification based on self-report and correlational results. The participants' language proficiency and language-switching experience were determined through self-report questionnaires, which likely do not fully represent each individual's sociolinguistic experience. Each study came up with a different set of bilingualism groups, which indicates at least some arbitrariness in group classification and makes it more difficult to compare results across studies. Finally, the findings are correlational which limits the opportunity for causal inference about the role of interactional contexts and language-switching.

In a recent study, Timmer, Calabria, & Costa (2019) used a different approach which can address these limitations. Instead of assessing the bilinguals' daily language use, Timmer et al. (2019) recreated two different interactional contexts in a laboratory setting. They randomly assigned bilingual participants into two groups which parallel the interactional contexts: the single-block condition is similar to the single-language context, and the task-switching condition is similar to the dual-language context. Participants completed two training sessions, approximately a week apart, and took a pre- and post- test which included one linguistic and one non-linguistic switching task. In both conditions, the training consisted of participants naming pictures that appeared on the computer screen. In both conditions, participants had to name pictures in both of their languages. However, in the single-block condition participants switched languages after each block, whereas in the task-switching condition participants had to switch within each block, cued by the color of the picture frame.

The results showed that both groups reduced switching costs after the training, but the dual-language group showed greater benefit from the training. The findings are consistent with the adaptive control hypothesis, which suggests that the dual-language context requires more switching and greater adaptation of the relevant executive functions. Timmer et al. (2019) study was novel in employing a true experimental design with random assignment and high degree of control over the manipulation. Additionally, they showed that even a short intervention can detect the transference of language switching training to improvements in non-linguistic domains.

The present study extends the research on the adaptive control hypothesis with the introduction of a novel procedure intended to simulate different interactional contexts. The experimental design provided a naturalistic environment for the participants to engage in meaningful conversations. Participants were asked to play an interactive game (map game task), which required extensive communication with two other speakers. Because of the social component and continuous verbal communication, this procedure more closely resembles daily language use than picture-naming from a computer screen.

Our study investigated two of the three interactional contexts outlined by Green & Abutalebi (2013), single-language and dual-language, because voluntary codeswitching is extremely difficult to elicit in a laboratory setting. The single-language context was represented by a single switch into L2 based on the setting (in this case, the experimental session). The dual-language context was represented by switching languages, L1/L2, based on which speaker the participant was addressing. Additionally, the study included a baseline condition in L1 with no switching at all. All participants engaged in every interactional context condition, with counterbalanced order.

Unlike previous correlational studies, our experimental design allows us to look directly at the amount of language switching and the effect on bilinguals' cognitive performance. In line with the adaptive control hypothesis, we predicted that interactional contexts with more language switching would produce higher cognitive demand leading to more challenge in completing the map game task. In our study, the dual-switching context condition was expected to be the most demanding, and the single language L1 condition the least so. Cognitive demand was measured by a self-report questionnaire at the end of every session. Additionally, performance on the map task game was used as an indicator of cognitive demand, with better performance indicating lower demand. The three measures of performance included the language error rate, map game accuracy, and map game completion time.

Chapter 2

Method

Participants

Twenty-four participants completed the study, 11 were female. Basic demographic and linguistic information is reported in Table 1 below. The participants were recruited through an advertisement on the Psychology Department Facebook page of the Jagiellonian University.

All participants were native Polish (L1) speakers, with both parents also native Polish speakers. They all reported high proficiency in English (L2). Most reported to have started learning English in elementary school. Twenty-two of 24 participants also indicated limited knowledge of a different foreign language (L3). During the screening process, they all passed two English proficiency tests, LexTALE and Cambridge Assessment, in order to participate in the study. Lextale is a validated assessment of English vocabulary knowledge and general English proficiency (Lemhöfer & Broersma, 2012). The Cambridge Assessment is an online tool for quickly assessing English proficiency in language learners (Cambridge Assessment, General English). The participants needed to score in the high-proficiency bracket on both tests: 70/100 or above for LexTALE and 20/25 or above for Cambridge. Participants also completed a Ravens advanced progressive matrices test as a short form assessment of their IQ (Sefcek, Miller, & Figueredo, 2016). See Table 1 for performance details.

All participants received 100.00 PLN (28.00 USD) for taking part in the study, which is in line with typical participant compensation in Poland. In accordance with the initial agreement, the full compensation was disbursed after the completion of the experiment, at the end of the third session.

Table 1. Participants' demographics and language proficiency

	Mean	SD
Age	22.33	2.23
Years of education	14.56	1.98
Ravens APM-18	14.17	3.09
Age of Exposure		
L1 (Polish)	0.39	0.95
L2 (English)	5.72	1.87
L3 (Other)	13.47	3.92
L2 Tested Proficiency		
Cambridge	24.00	1.08
Lextale	85.50	7.22
Self-rated Language Proficiency		
L1 (Polish)	8.92	0.34
L2 (English)	7.94	0.75
L3 (Other)	3.43	1.30

Procedure

The experiment used a within-subject design. The key manipulation was the interactional context condition. The condition had three levels: L1, L2, and Switch. In the L1 condition, the session took place in L1 and required no language switching. In the L2 condition, the participant had to make a single switch into L2 and use it for the duration of the whole session. In the Switch condition, the participant had to continuously switch between L1 and L2 depending on which speaker they were addressing. Each participant was scheduled for three sessions, where each session was a different interactional context condition. The order of conditions was counterbalanced across participants. There was at least one full day between any two sessions to

limit lingering effects. The study took from 5 to 15 days to complete, depending on participants' availability.

During each session, the following people were present: the investigator, two confederates, and the participant. The confederates were undergraduate psychology students interested in gaining experience as a research assistant. All confederates were informed about the purpose of the study without disclosing the main hypotheses and all were trained to behave consistently across all sessions and to maintain confidentiality. The sessions are summarized in Figure 1 and outlined in more detail below.

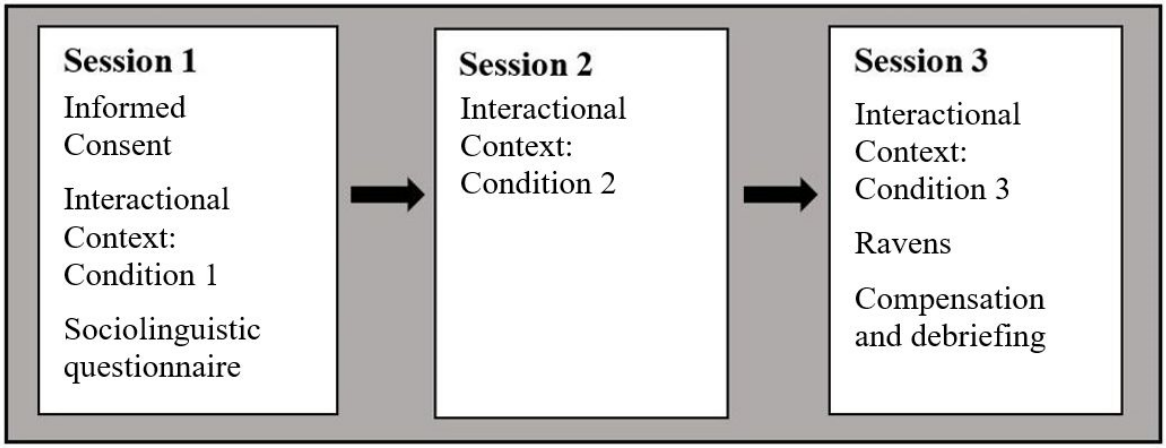

Figure 1. Summary of the procedure

Session 1. Informed consent was obtained from the participant. The participant was introduced to the confederates and led to believe that they were also participants in the study. The map game was explained and the language condition was established. The participant and the confederates played the game for approximately two hours, with the researcher supervising and scoring their performance. After the game, the participant completed the socio-linguistic questionnaire and the perceived effort scale.

Session 2. The participant was introduced to the confederates; the interactional context was established. The participant engaged in the game for 2 hours and then completed the perceived effort scale.

Session 3. The same procedure was followed as the first two sessions. Additionally, the participant took the Ravens test at the end of the session. Once the study was completed, the participant was debriefed and given full monetary compensation.

Map game. The map game was used to simulate a natural interaction between the participant and the confederates and facilitate verbal communication. The game was adapted from the map task used by Beatty-Martinez & Dussias (2017). The game involved three players: the instructor and two agents. The participants were always assigned to the role of the instructor, and the confederates played the agents. The players were seated at a table with laptops such that they could easily communicate and see each other but could not see each other's screens. See Figure 2 for a graphic representation of the map game set up.

The instructor's screen displayed an image with all elements assembled correctly. The other two players, the agents, saw a similar image on their screens, but the elements were in different locations. The goal of the game was for the players to work together so that the agents could recreate on their laptops the correct image with the elements in correct positions. Since they could not see each other's screens, and gesturing was discouraged, they had to work through verbal communication only. The instructor did the majority of the talking by providing instructions about the correct arrangement, while the agents moved the elements accordingly. The agents asked questions and requested clarifications on the exact position of the elements.

The instructor spoke to one agent at a time, switching after each image. The inactive agent measured the time and listened for language switches while she waited for her turn. At the

end of the game, the investigator reviewed the completed images and assigned points based on accuracy. The players were encouraged to complete the game as quickly as possible while maintaining accuracy and speaking the appropriate language.

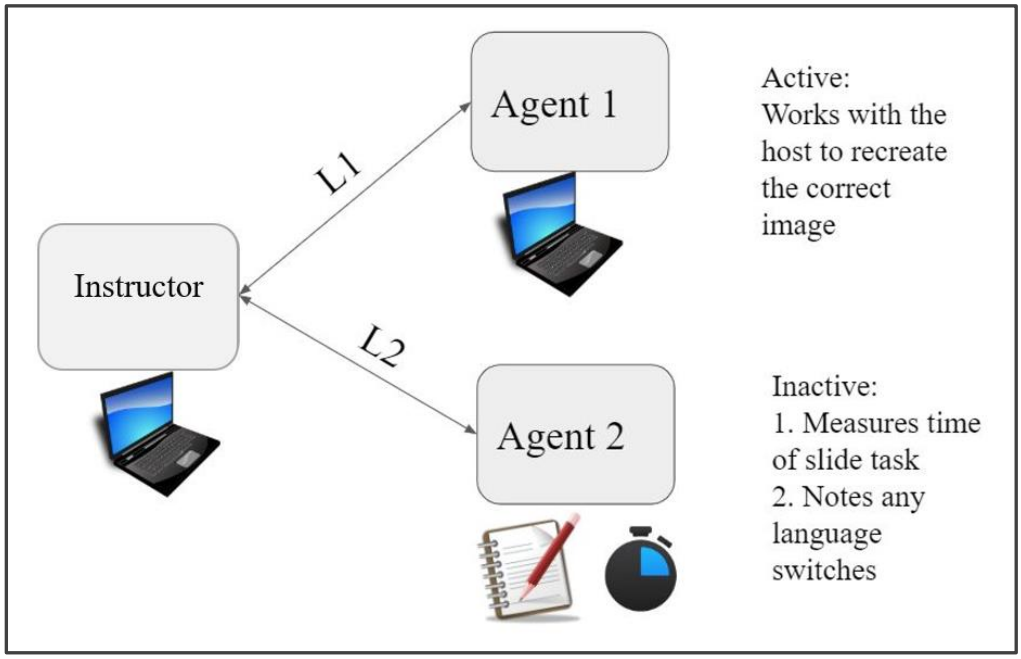

Figure 2. Schematic representation of the Switch condition set up

The instructor (participant) communicated with agent 1 (confederate) in L1 only. While they worked on completing the first image, agent 2 (confederate) timed the task and monitored any unintended language switching. After the first image was completed, the instructor worked on the next image with agent 2, speaking in L2 only, while agent 1 monitored and timed them.

Materials

The visual materials for the game were slides in PowerPoint. All slides were created for this study by the researchers. There was a total of 9 unique sets, and each set included 6 different

images (slides). One full game consisted of 3 unique sets and represented the duration of one session. The order of the sets was counterbalanced across participants.

There were 3 levels of difficulty. The easy level included 5 elements, the medium level had 8 elements, and the hard level included 12 elements. The backgrounds and the elements themselves also varied in difficulty, with the medium and hard levels requiring more elaborate descriptions to distinguish the elements from each other and describe their exact position. See figures 3, 4, and 5 for example images of varying difficulty.

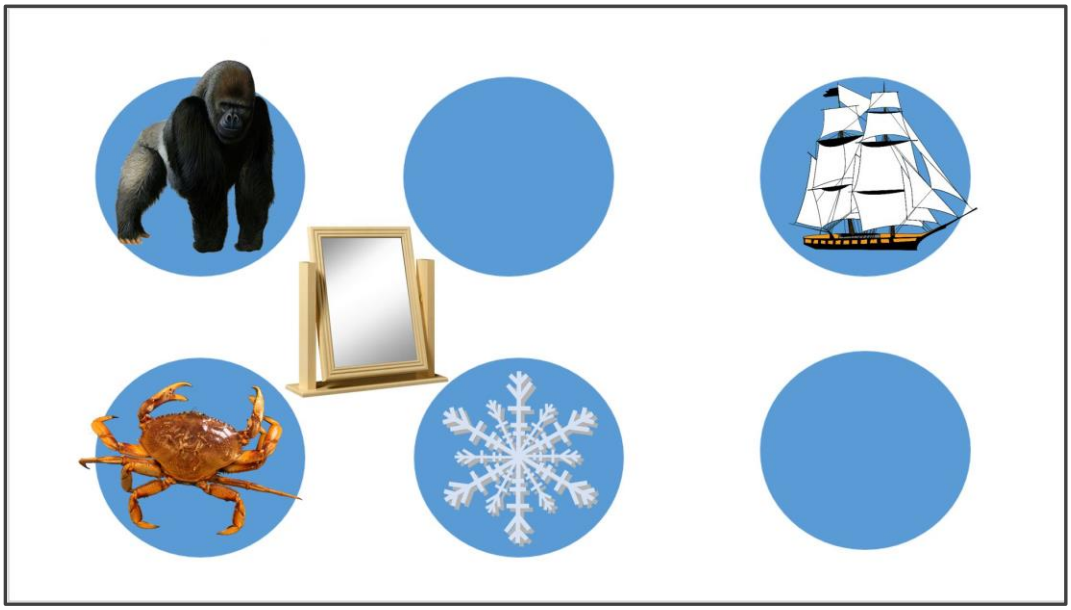

Figure 3. Example image of difficulty level: easy

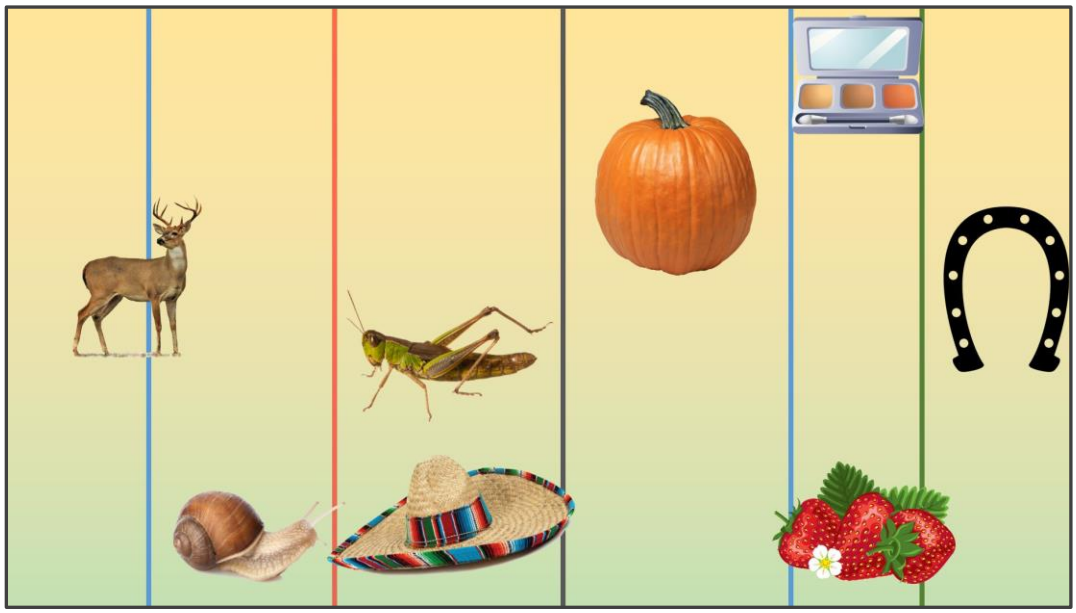

Figure 4. Example image of difficulty level: medium

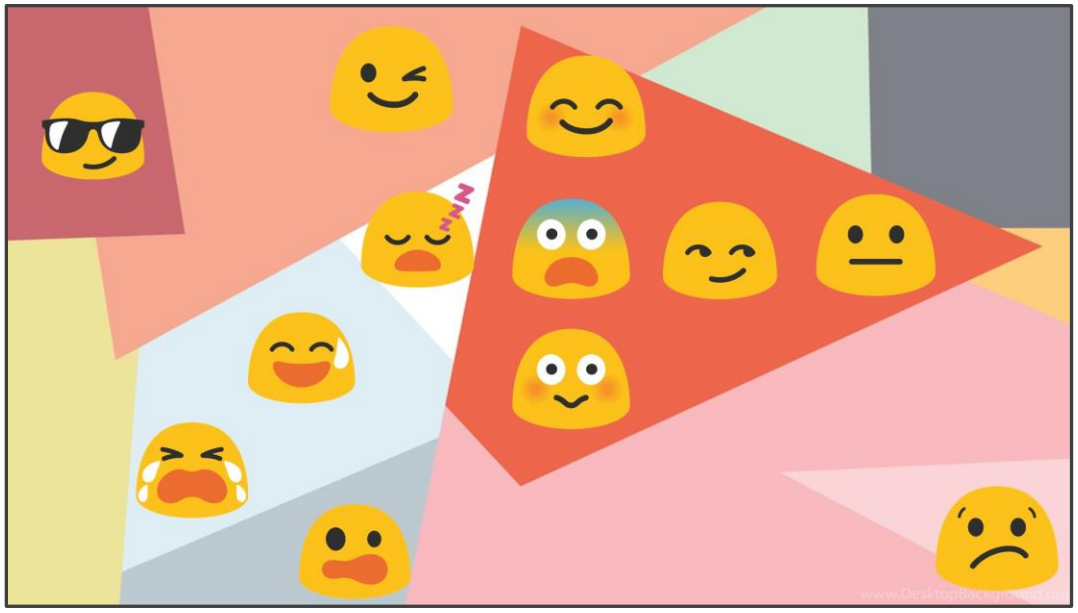

Figure 5. Example image of difficulty level: hard

Data Analysis

There were four dependent variables. Three were recorded by the researcher during the experimental session and measured the participants' performance on the map game task. These measures included accuracy, completion time, and language error rate. The last dependent variable, self-rated perceived effort, was collected once at the end of each session.

The participants were highly accurate in using the appropriate language, with very few instanced of unintended language switching. Since all performed near ceiling, the language error rate was excluded from further analysis. For the rest of the measures, we excluded outliers, defined as values falling outside of 2.5 standard deviations from the mean, before proceeding to the main analyses. We conducted ANOVAs on accuracy, completion time, and perceived effort to test for main effects and interactions.

Chapter 3

Results

Performance Measures

We performed one 3x3x3 ANOVA for each of the measured variables: completion time (in minutes) and accuracy (percentage). The ANOVAs had three within-subjects variables: Interactional Context Condition (L1, L2, Switch), Session Number (1, 2, 3), and Image Difficulty (Low, Medium, High).

Completion time. There was no significant main effect of the interactional context condition on completion time, $F(2,180) = 1.46$, $p = .234$. Regardless of whether the participants were asked to speak L1, L2, or to switch languages, it took them a similar amount of time to finish the game. (L1: $M = 3.28$, $SD = 1.89$, L2: $M = 3.32$, $SD = 1.91$, Switch: $M = 3.37$, $SD = 1.93$)

There was no significant main effect of session number on completion time, $F(2,180) = 0.347$, $p = .707$. No training effect was observed, the participants' performance remained stable across the three sessions they completed. (1: $M = 3.37$, $SD = 1.96$, 2: $M = 3.31$, $SD = 1.91$, 3: $M = 3.28$, $SD = 1.87$)

Although there were no effects of condition or session number, there was a strong main effect of image difficulty on completion time, $F(2,180) = 2792.35$, $p < .0001$. Low difficulty images required the least amount of time to complete, while high difficulty images took the longest to complete, with medium difficulty images falling in the middle. (Easy: $M = 1.35$, $SD = .18$, Medium: $M = 2.79$, $SD = .30$, Hard: $M = 5.82$, $SD = .53$) A post-hoc Tukey test showed that all three levels of difficulty differed significantly at $p < .0001$.

There were no significant interactions on completion time.

Accuracy. There was no significant main effect of language condition on accuracy, $F(2,180) = 1.68$, $p = .189$. Regardless of whether the participants were asked to speak in L1, L2, or to switch languages, they performed with similar accuracy. (L1: $M = .93$, $SD = .05$, L2: $M = .91$, $SD = .08$, Switch: $M = .91$, $SD = .05$)

There was no significant main effect of session number on accuracy, $F(2,180) = 2.767$, $p = .066$. No training effect was observed, the participants' performance remained stable across the three sessions they completed. (1: $M = .90$, $SD = .08$, 2: $M = .92$, $SD = .05$, 3: $M = .92$, $SD = .05$)

There was no significant main effect of image difficulty on accuracy, $F(2,180) = 1.371$, $p = 0.257$. The participants maintained consistently high accuracy on images of low, medium, and high difficulty. (Easy: $M = .92$, $SD = .08$, Medium: $M = .92$, $SD = .06$, Hard: $M = .90$, $SD = .05$)

Thus, the accuracy measure did not detect any significant effects. All participants performed near ceiling and maintained their high performance across the three sessions, language conditions, and levels of task difficulty. There were no significant interactions on accuracy.

Perceived Effort

For perceived effort ratings, we performed a 3x3 ANOVA with two within-subjects variables: Interactional Context Condition (L1, L2, Switch) and Session Number (1, 2, 3).

There was a significant main effect of the interactional context condition on perceived effort, $F(2,60) = 7.02$, $p = .002$. Participants rated the sessions in L1 as significantly less effortful than sessions when they were required to speak in L2 or to switch (L1: $M = 5.46$, $SD = 2.57$, L2:

M = 8.17, *SD* = 2.40, Switch: *M* = 7.63, *SD* = 3.18). A post-hoc Tukey test showed that the L1 condition was significantly different from both L2 (p = .002) and Switch (p = .017) conditions, which were not significantly different from each other (p = .760).

There was no significant main effect of session number on perceived effort, F(2,60) = 1.19, p = .311. No training effect was observed, and the participants did not rate the later sessions as less effortful despite familiarity with the map game task. (1: *M* = 7.14, *SD* = 2.23, 2: *M* = 7.60, *SD* = 2.79, 3: *M* = 6.52, *SD* = 3.60)

However, there was a significant interaction of the interactional context condition and session number, F(4,60) = 2.67, p = .041. A post-hoc Tukey test showed that participants who completed the L1 condition in session 3 rated it as significantly easier than those who were in L2 or Switch language conditions for session 3.

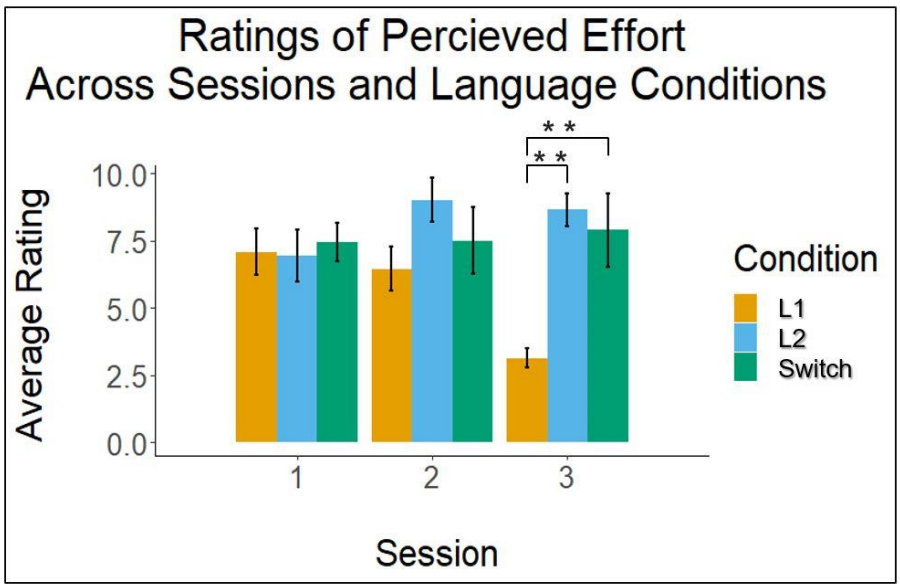

Figure 6. Ratings of Perceived Effort

The graph shows perceived effort ratings of the map game task collected at the end of each session. Participants who completed their last 3rd session in L1 rated it as significantly easier than participants whose last session was either in L2 or switching languages.

Chapter 4

Discussion

Evidence suggests that bilingualism may be beneficial for executive functions. The adaptive control hypothesis proposes that different interactional contexts of language use place different cognitive demands on bilinguals, with higher demands leading to more adaptation and increased efficiency of different aspects of cognitive functions (Green & Abutalebi, 2013). In the present study, we investigated whether the amount of language switching within different interactional contexts is one factor that is related to increased cognitive demand in bilinguals. Twenty-four Polish-English bilinguals participated in the study; all were native Polish speakers (L1) with high English proficiency (L2). Every participant engaged in three interactional contexts: speaking in L1 only with no switching, switching into L2 once for the duration of the session, and switching between L1 and L2 continuously throughout the session as cued by the confederates. Cognitive demand was measured by the performance on the map game task and through self-report questionnaires on perceived effort.

The key component of the study was the map game task, adapted from Beatty-Martinez & Dussias (2017), who used it to study natural, unscripted speech of Spanish-English bilinguals. For our study, the task was modified to include two confederates as opposed to one, and the duration of the session was extended from 20 to 120 minutes. The purpose of the map game was to foster natural verbal communication and to promote language switching (particularly in the Switch condition, when the participant used a different language with each confederate). To our knowledge, this was a novel procedure in the research on the adaptive control hypothesis.

The self-report measure of perceived effort indicates that the participants were challenged by the map game task. There was a main effect of the interactional context: the participants rated the Polish condition as significantly less effortful than the English and Switch conditions. It appears that the participants were challenged by the increased amount of language switching. In the Polish condition, no switching was required, whereas the English condition required a single switch into L2 and the Switch condition required continuous L1/L2 language switching. Another possibility is that English and Switch conditions were rated as more difficult because they required extensive use of L2. Despite high L2 proficiency, the participants may have found it more challenging to communicate in their non-native language. In future studies, it would be essential to untangle the effects of language switching and less-dominant language use, for example through language habits questionnaires and more rigorous proficiency testing.

Despite reporting that the map game task was quite effortful, the participants performed very well. As expected, the participants needed more time to complete more difficult images, but their accuracy remained high for all difficulty levels. There was no main effect of interactional context condition on the map game performance measures of accuracy and completion time. Additionally, there were almost no off-target language errors; even in the Switch condition, the participants were highly successful in using the appropriate language when addressing the confederates. This high performance may be partly attributed to age: our sample consisted primarily of young adults (M =22.33, SD= 2.23), whose cognition is thought to operate at peak efficiency. Our findings are consistent with previous studies that have failed to detect the bilingual advantage in young adults (Bialystok, Craik, & Luk, 2008; Lee Salvatierra, & Rosselli, 2011). Future research should replicate the study with populations in which benefits of bilingualism are more commonly detected such as children or older adults.

The present study is unique in its usage of the map game task to simulate the bilingual experience in a controlled laboratory setting. Previous studies have relied on self-report of typical language use to classify bilinguals into appropriate groups (Hartanto & Yang , 2016; Prior & Gollan, 2011; Verreyt et al. 2016). Similar to the present study, Timmer et al. (2019) attempted to simulate interactional contexts in a laboratory setting, but they did so through picture-naming tasks. In our study, we aimed to recreate the interactional contexts as they occur in daily life by fostering unscripted, natural communication in a social setting while engaged in an interactive game. This is both an advantage and a limitation of the study. The map game task increased the ecological validity of the experiment and introduced a new paradigm for studying language-switching in bilinguals. At the same time, it is still only a proxy for real-life interactional contexts but may not fully replicate them. Another limitation is the participation of multiple confederates, introducing potential inconsistencies and possible influence of interpersonal factors. Finally, performance on the map game task may not be an accurate indicator of cognitive demand. The participants' performance could have been influenced by additional factors, such as interpersonal partiality or bias towards confederates. In the future it would be beneficial to replicate the study with additional and more direct cognitive demand assessment, for example, employing neuroscience methods.

The results of the present study do not support the adaptive control hypothesis because there were no measured differences in cognitive demand depending on the interactional context. There is not enough evidence to conclude that the amount of language-switching affects the amount of cognitive demand in bilinguals. Unlike Timmer et al. (2019), who showed that the group with the higher amount of language-switching benefitted more from picture-naming training, we found no effect on cognition based on simulated interactional contexts. However,

the present study provides a starting point for further exploration of how bilingualism affects cognition. The current paradigm can be replicated with other participant populations and with inclusion of additional measures of cognitive demand and linguistic habits and abilities. The map game task can provide a useful tool for studying structured yet natural and unscripted speech not only in bilingualism research but also more broadly in language science.

The present study adds to the growing pool of research on the bilingual experience. With more than half of the world being bilingual, there is a great diversity of languages and language uses, bilingual communities, and variation in individual experiences. We must recognize that not every bilingual experience is the same and strive to unravel the key components of this phenomenon, including the underlying cognitive mechanisms. That knowledge can inform real-life applications, including destigmatization of bilingualism, improved foreign language curricula, and enhanced language use habits.

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ACADEMIC VITA

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EDUCATION

08/2016 – 05/2020 **The Pennsylvania State University**, University Park, PA
- Bachelor of Arts in Psychology with honors
- Bachelor of Arts in Russian

09/2012 – 05/2016 **Central Dauphin High School**, Harrisburg, PA

RESEARCH EXPERIENCE

01/2017 – Present **Language and Aging Lab,** University Park, PA
Research Assistant
Supervisor: Dr. Michele Diaz
- Write an honors thesis on bilingualism and executive cognitive function
- Assist and collaborate with graduate students on projects examining bilingualism, language, and aging
- Manage, transcribe, code, and analyze data
- Recruit, schedule and test participants on behavioral studies
- Shadow MRI testing sessions

05/2019 – 08/2019 **Applied Cognitive and Media Psychology Lab,** Tübingen, Germany
DAAD RISE Fellow
Supervisor: Dr. Frank Papenmeier
Student-mentor: Ms. Sandra Grinschgl
- Completed an internship at the University of Tübingen researching cognitive offloading
- Designed and preregistered a novel experiment
- Recruited, scheduled and tested participants
- Analyzed data and created figures
- Completed a 2-week intensive German language course in Cologne

05/2018 – 07/2018 **Langusta Lab,** Krakow, Poland
PIRE Undergraduate Fellow
Supervisor: Dr. Zofia Wodniecka
- Received an NSF grant to travel and work at the partner site, The Jagiellonian University
- Proposed and conducted a research project on language-switching and inhibition in Polish-English bilinguals
- Created experiment materials
- Scheduled and tested participants
- Gained experience in EEG technique

PRESENTATIONS

08/2019 **The RISE of Cognitive Offloading**
- IWM Institute lab meeting
- University of Tübingen, Tübingen, Germany

12/2018 **Investigating the effects of language switching contexts on inhibition in Polish-English bilinguals**
- CLS (Center for Language Science) Distinguished Speaker Series
- The Pennsylvania University, University Park, PA

05/2018 **PIRE: Experimental design**
- Langusta lab meeting
- The Jagiellonian University, Krakow, Poland

HONORS AND AWARDS

08/2016 – Present **Schreyer Honors College**
- Honors program for top 5% of undergraduate students
- Emphasis on academic integrity, career enrichment activities, and global awareness

08/2016 – Present **Paterno Fellows Program**
- Honors program for Liberal Arts students which promotes ethics study, leadership, and professional networking

08/2016 – Present **Dean's List**

08/2016 – Present **Academic Excellence Scholarship**

01/2017 – 12/2017 **Women In Science and Engineering Research (WISER) Scholarship**

05/2017 **The President's Freshman Award**

CULTURAL EXPERIENCES

09/2018 – Present **Mt. Nittany Residences**
Volunteer Interpreter
- Assist Russian-speaking residents with daily tasks, such as making a doctor's appointment
- Translate written materials like information about available resources into Russian

08/2018 – 12/2019 **Penn State Students in Russian**
Vice president, secretary
- Coordinated club events, including day trips to New York and Washington DC
- Planned and conducted club meetings
- Provided consistent communications and announcements to the club members

05/2017 – 08/2017 **Nikolai Gumilev's Africa**
Translator, Editor
Supervisor: Dr. Michael Naydan

- Co-authored a collection of translated works by Nikolai Gumilev
- Translated prose and poetry from Russian into English
- Edited the text, added footnotes, and proofread for grammar and punctuation

09/2016 – 05/2018 **The Globe Special Living Option**

President

- Supervised a floor of 74 residents from over 20 different countries
- Organized internationally focused events to build community and promote cultural awareness