EFFECTS OF LANGUAGE PRIMING ON TIMED SCHOLASTIC TESTS ADMINISTERED TO SPANISH-ENGLISH BILINGUALS

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DEDICATION

I dedicate this to all the special people in my life. To my parents who have always been there for me. They knew to let go when I wanted to go places they nothing about and they trusted my love for them to know I would always be near. To my brother and sisters who will always be a part of me and who I am. To my grandmothers who gave me their names and the inspiration to break boundaries imposed on women. To my grandfathers who indulged my curiosity and encouraged me to be the best at whatever I tried in life. And last but not least, I dedicate this to my best friend Kathy who knew when to give me a push and when to give me a helping hand.

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by

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ABSTRACT

Previous research has demonstrated performance decrements following a switch in cognitive tasks. Similarly, switch costs are reported for bilinguals switching the language of task performance. The present study examined the impact of language switching among bilingual students who completed a task simulating the Standardized Academic Test (SAT). Participants were 227 Spanish-English bilingual university students (mean age = 19.0). Sixty-three percent of the participants were female and 82.7% were native Spanish speakers. An additional 13.8% reported their first language learned was Spanish and English together. Participants were randomly assigned to either the English or the Spanish 15 min priming condition prior to taking a timed scholastic test in English. Bilingual students who were primed in Spanish did not display decrements in test performance compared to bilingual students who were primed in English. The latter findings suggest that previously documented performance decrements following language switching on reaction time tasks may not extend to standardized tests.

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EFFECTS OF LANUAGE PRIMING ON TIMED SCHOLASTIC TESTS ADMINISTERED TO SPANISH-ENGLISH BILINGUALS

1.1 The Hispanic Population in the United States

Many bilingual speakers in border communities use their native language (e.g., Spanish) to interact with friends and family members and then switch to the majority language (e.g., English) in educational arenas. The present study examines whether Spanish-English bilingual students who are primed in Spanish prior to completing timed scholastic tests demonstrate performance decrements compared to Spanish-English bilingual students who are primed in English.

The influence of bilingualism on academic performance is of interest because of the growing number of linguistically diverse groups in the United States. According to the 2000 census data, approximately 47 million people over the age of five spoke a language other than English in the home (U.S. Bureau of the Census, Census 2000). This represents a 31% increase in the number of linguistically diverse people in 2000 compared to 1990. Although many languages were reported in use in the 2000 census data, Spanish was the most prevalent language reported in use other than English. Additionally, approximately 40% of Hispanics reported they spoke English "less than very well" and thereby reported that Spanish remained their primary language (Mellander, 2005; U.S. Bureau of the Census, Census 2000).

Speaking a language other than English was not the only notable difference between Hispanics and the overall U.S. population reported in the 2000 census data. The population

growth rate for Hispanics was 58% compared to a growth rate of 13% for the total U.S. population. The latter statistic highlights that Hispanics are the fastest growing group in the United States (Cavalcanti & Schleef, 2001; Marotta & Garcia, 2003). The Bureau of the Census projected that 20% of the U.S. population will be of Hispanic/Latino descent by the year 2010 (Marotta & Garcia, 2003). Approximately 50% of Hispanics were reported to live in California and Texas. However, the Hispanic population was growing faster in all other states (Marotta & Garcia, 2003; U.S. Bureau of the Census, Census 2000). Furthermore, the median age of the Hispanic population was 26 years versus 35.4 years for the total U.S. population. Therefore, approximately 80% of Hispanics were of school age (Mellander, 2005). The rapid growth rate of Hispanics across the United States and the youthful makeup of the Hispanic population underscores the importance of studying the effects of language on the academic performance of bilingual Hispanics in the U.S. (Marotta & Garcia, 2003; Mellander, 2005).

1.2 Bilinguals and Standardized Testing

Historically in the United States, students from underrepresented minority groups have not performed well on standardized tests (Valdes & Figueroa, 1994). For example, in 2007, most ethnic minority groups scored lower than non-Hispanic Whites on the Scholastic Academic Test (SAT), the nationally recognized college entrance exam (CollegeBoard SAT, 2007; Earl, 2005; Gates, 2001; National Center for Education Statistics, 2005; Rodriguez, 1997). Only Asian-Americans scored higher on the SAT-math component than all other groups including non-Hispanic Whites. Of the total 1,494,531 students who took the SAT in 2007, 55% were White (not of Hispanic origin), 11% were Black/African-American, 9% were Asian/Asian-American/Pacific Islander, 6% were Hispanic/Latino/Latin-American, 4% were

Mexican/Mexican-American, 1% were Puerto Rican, and 1% were American Indian or Native Alaskan. An additional 4% reported their ethnicity as "Other" and 9% did not answer the ethnicity question. Table 1 contains SAT mean scores reported by ethnicity for students taking the SAT in 2007. The SAT also uses a single item to assess students' native language; "What was the first language you learned?" Students taking the SAT could answer "English", "Something other than English", or "English with another language". Higher SAT scores were reported for students who indicated that the first language they learned was English (CollegeBoard SAT, 2007). However, language information reported for students who took the 2007 SAT was insufficient to determine whether they were dominant in their native language or dominant in the host language (e.g., English). In other words, to what degree were the Spanish native speakers bilingual? Therefore, it was difficult to hypothesize a relationship between bilingualism and SAT performance based on the available data. Mean SAT scores reported by the category "first language learned" are included in Table 2.

Several explanations have been offered for the lower test scores among bilingual students. For example, Abedi and Lord (2001) propose that the SAT is linguistically biased. Therefore, the affect of language on test performance has been the subject of many studies. Abedi and Lord (2001) offered evidence that SAT scores may be related to language proficiency rather than cognitive processes. Abedi and Lord tested 1,174 eight-grade students in the greater Los Angeles area. Students completed a math test that consisted of 10 problems from the National Assessment of Educational Progress (NAEP) test and 10 linguistically modified math problems. The modified math problems were NAEP math word problems that were reworded to remove complex vocabulary and complex sentence structures that were not related to the math task being tested (e.g., ..."approximately how many?" instead of, ..."which is the best

approximation of the number?"). The modified problems were evaluated by a panel of experts in mathematics education and were judged to test similar math skills as the standardized test questions. An additional five math problems from the NAEP test that were judged by the researchers to present the least amount of linguistic challenge in their original form were also included in the math test. Abedi et al. reported that all students scored slightly higher on the modified test questions than on the original NAEP test questions. However, students classified as English Language Learners (i.e., not proficient in English) had higher mean scores on the modified version ($M = 5.72$, $SD = 2.83$) than on the original version ($M = 5.46$, $SD = 2.89$) of the math test; $F=6.41$, $df = 1, 1172$, $p=.012$. Therefore, complexity of the wording used to construct test questions affected students' test scores even on a math test. Additionally, Abedi et al. reported that testing bilingual students in their primary language did not increase test scores. Only a few students who were taught math in Spanish scored higher on a Spanish version of the math test. Therefore, Abedi and Lord (2001) recommended that students be tested in the language of instruction for specific subject matter.

Similarly, although testing students' vocabulary is a critical component of the SAT test, the phrasing of SAT test questions may challenge students linguistically without necessarily testing their academic skills. The current study expands this focus and examines whether Spanish-English bilinguals who switch from Spanish to English prior to a timed test in English display performance decrements not present for Spanish-English bilinguals who do not switch language prior to a timed test in English. For example, if a student speaks Spanish at home for an hour prior to going to school, does the transition to English at school affect the student's academic performance. Evidence from studies of the Stroop effect, language priming, and switch-costs address this issue and are reviewed below.

1.3 Stroop Effect

The Stroop effect is an index of interference on attention brought on by the presence of conflicting information (MacLeod, 1992; Stroop, 1992). In a classic Stroop study, participants begin by naming colors of neutral stimuli such as colors of shapes, letters, or non-words. Participants are then asked to name colors when the color-words and ink color are incongruent (i.e., the word red written in blue ink). The increase in response time from naming colors of neutral stimuli to naming colors incongruent with the color-words is the measure of interference on attention. In other words, it is the degree to which reading color-words interferes with naming colors. Participants consistently take longer to name colors when the ink color and the color word do not match. Bilingual participants fall prey to the Stroop effect regardless of the language of stimulus presentation (English or Spanish). Similarly, bilingual students fall prey to the Stroop effect regardless of the language (English or Spanish) they use to respond to the Stroop stimuli (MacLeod, 1992; Stroop, 1992).

In an integrative literature review of 400 studies using the Stroop paradigm, MacLeod (1991) identified 18 studies that used a bilingual Stroop task. Francis (1999b) identified an additional eight studies published after the Macleod review that used various bilingual Stroop tasks. Both reviewers concurred that most studies reported the slowest response times for participants' when the response language and the language of the experimental stimuli are the same (*intralingual* condition). Bilingual participants also demonstrate slower response times (interference on attention) when the response language and the language of the experimental stimuli are different (*interlingual* condition). However, the degree of interference from the interlingual conditions was less than the interference from the intralingual conditions. MacLeod reported the degree of interference in the interlingual (cross-language) conditions was typically

75% of the interference noted in the intralingual (same-language) conditions. Similarly, Francis (1999b) reported the proportion of interference for the interlingual conditions when compared to the intralingual conditions ranged from 22% to 140%, $M = 72\%$. Francis (1999b) and MacLeod (1992) reported the most often cited reason for the variability in degree of interlingual (cross-language) interference noted was differences in participants' language dominance and bilingual proficiency.

For example, Preston and Lambert (1969) examined the influence of language for bilingual students performing color-naming Stroop tasks. Participants were asked to respond in each of their two languages in the control, interlingual, and intralingual conditions. Therefore, in a *control* condition, an English-French bilingual participant names colors of neutral stimuli (i.e., shapes, asterisks or wavy lines) in English and then in French. In the intralingual conditions, an English-French bilingual participant names colors in French when presented with French color-words and in English when presented with English color-words. In the interlingual conditions, he or she names colors in English when presented with French color-words and in French when presented with English color-words. Overall, bilingual participants in the Preston and Lambert experiments were faster when naming colors in the control conditions. In addition, bilingual participants in the control conditions were equally fast at naming colors in either of their languages (i.e., mean response times for the two control conditions were not significantly different regardless of the response language). Only the English-French bilinguals in Preston and Lambert's third experiment had significantly faster response times when naming colors in English. However, Preston & Lambert reported that the English-French bilinguals in their third experiment demonstrated greater language proficiency in English than in French (*unbalanced*

bilinguals). Therefore, *balanced bilinguals* demonstrated equal facility using either of their languages to name colors in the control conditions not demonstrated by unbalanced bilinguals.

Balanced bilinguals, in the Preston and Lambert experiments, also demonstrated the same degree of Stroop interference when naming colors in the interlingual and intralingual conditions. In other words, response times for balanced bilinguals were not significantly influenced by the language of the stimuli (e.g., French or English). Response times for balanced bilinguals were also not significantly influenced by the language (e.g., French or English) that participants used when responding to the Stroop stimuli. Finally, response times for balanced bilinguals were not significantly influenced by the interaction of the language of the Stroop stimuli and the language that participants used when responding to Stroop stimuli (e.g., French, English). However, the unbalanced bilinguals demonstrated significantly different response times in the interlingual and intralingual conditions. In other words, these unbalanced bilinguals were slower when naming colors in French when the color-words were also in French (i.e., intralingual condition). These unbalanced bilinguals were faster when naming colors in English when the color-words were in French (i.e., interlingual condition). Therefore, these unbalanced bilinguals demonstrated less interference from their non-dominant language (French) when naming colors in their dominant language (English) and more interference from their non-dominant language when naming colors in their non-dominant language. In sum, language proficiency influenced the magnitude of performance decrements displayed by participants. Ironically, participants who were proficient in both languages displayed larger performance decrements than participants who were not equally skilled in both languages, that is language proficiency impeded performance. Notably many students living in border communities are equally proficient in the host language and their native

language. This conceivably may lead to performance decrements in school if these students switch from one language to another when completing a school task.

1.4 Switch Costs

Studies of "switch costs" also provide indirect support for the hypothesis that bilingual students demonstrate performance decrements on academic test when switching to English from another language. "Switch costs" refer to performance decrements associated with switching attention from one task to another task. For example, in a bilingual Stroop task, participants read color-words presented only in English. This trial is a *repeat- trial* because participants are performing only one task, reading colors in English. In a *switch- trial*, participants read color-words presented alternately in English and Spanish (Monsell, 2003; Rogers & Monsell, 1995). Using a classic color-naming Stroop task, Wylie and Allport (2000) demonstrated that performance on switch-trials was slower than performance on repeat-trials for monolingual English speakers. Participants named colors and read colors presented in three experimental formats. In the first format, labeled the all-neutral format, participants either named colors of a series of colored X's or read color-words printed in either black ink or in the corresponding color ink. Therefore, the all-neutral format presented no conflicting stimuli to the tasks of naming colors or the tasks of reading colors. In the second format, labeled the color-neutral format, participants either named colors of a series of X's or read color-words printed in incongruent color-ink. In the color-neutral format, only the color-reading task presented conflicting stimuli. In the third format, labeled the all-Stroop format, participants named colors of incongruent color-words and read color-words printed in incongruent color-ink. Within each format, participants either performed the same task (repeat-trial) or switched between naming colors and reading

color-words (switch-trial). In Wylie and Allport's first experiment, participants ($N = 10$) were relatively faster when reading color-words than when naming colors and faster on repeat-trials than on switch-trials regardless of the experimental format. For example, an analysis of mean response times confirmed that participants read color-words faster than they named colors [$F(1, 9) = 69.83$, $p < .0001$] and performed faster on repeat-trials than on switch-trials [$F(1, 9) = 65.13$, $p < .0001$]. Overall, participants had the longest response times when switching from naming colors to reading color-words in the All-Stroop condition [$F(1, 9) = 9.17$, $p < .015$] (Wylie & Allport, 2000).

Performance decrements on switch-trials have also been noted when bilingual participants switch languages in the middle of a cognitive task. For example, von Studnitz and Green (2002) had German/English bilingual University students judge whether a target word presented in either German or English was an animate or inanimate object. Participants demonstrated greater performance decrements when they switched language ($M = 836$ ms, $SD = 165$) than when they did not switch language ($M = 820$ ms, $SD = 142$). Additionally, the largest performance decrement in (slowest response times) was observed in the language-switch condition when the response type stayed the same. The response type is *repeated* when there is no change in required response from the prior trial (i.e., the experimental trial is an animate object followed by an animate object). The response type is *non-repeated* when there is a change in required response from the previous trial (i.e., the experimental trial is an inanimate object followed by an animate object). Similarly, response times were slower in the first half of the session when participants had to switch between German and English whether the response type (animate vs. inanimate) was repeated or switched. Von Studnitz and Green (2002) suggested that response times were shorter in the second half of the experimental session because switching

response language did not help participants decide whether the target word represented an animate or inanimate object. Therefore, participants stopped attending to the change in language. However, even though participants improved performance in the second half of the experimental session, there was not a complete elimination of switch costs (see Table 3). Other researchers (Waszak, Hommel & Allport, 2004; 2005) have reported a similar persistence of switch costs. Such findings imply that even though bilingual students may be fully aware that an academic test is in English, the cost of switching languages prior to a timed test may still adversely affect performance.

Altmann (2007) reviewed findings from thirty-four studies related to switching tasks. A consistent finding reported in the review was that participants demonstrate performance decrements on switch trials. Response times reported for participants' performance on switch-trials differed from response times reported on repeat-trials. The mean difference between these two conditions ranged from 6 ms to 308 ms. Altmann noted that switch costs varied based on the type of cue used to signal a switch in task. In the studies Altmann reviewed, researchers alternated experimental tasks either predictably with no associated cue to signal the switch or randomly with an explicit cue preceding the switch in tasks. Participants demonstrated significantly smaller switch costs in studies that used explicit cues to signal a switch (ECS) than in studies that did not use cues to signal a switch; the latter procedure is referred to as an alternating-runs switch (ARS). Findings from thirty-four studies were reviewed. The mean response time for ECS trials was 94 ms. The mean response for ARS trials was 172 ms. Statistical analyses revealed a significant effect due to cueing, F (1, 32) = 14.2, p = .001. The latter finding suggests that performance on cognitive tasks is facilitated when bilingual participants are cued (alerted) to an impending switch in language presentation. These findings

suggest that bilingual students who speak Spanish at home should have no problem switching to English when arriving at school. From this standpoint, the school itself serves as a cue for the impending switch in language presentation. However, no study has addressed this applied research issue. Specifically, no study has examined if students who speak Spanish prior to arriving at school show performance decrements during school. The next section reviews additional research addressing this issue.

1.5 Priming

The priming effect is a measure of facilitation (e.g., improved response time) or inhibition (e.g., slowed response time) following exposure to a stimulus that may be related, similar, or unrelated to the target response (Hernandez, 1996; Paradis, 2004). For example, a prime can be the same word as the target (hose, hose), a semantically related word (dog, cat), a semantically unrelated word (cat, car), or part of the target word (hou, house). Bilingualism researchers have studied the effects of language priming (i.e., Spanish, English) on tasks such as picture naming, pronunciation, and word translation (Paradis, 2004). In bilingual studies, the priming stimuli can be in the same language as the target stimuli (i.e., English to English or Spanish to Spanish) or in the alternate language, such as a translation of the target word (i.e., English to Spanish or Spanish to English) (Allport, 2000; Hernandez, 1996; Jiang, 1999; Paradis, 2004). The mode of presenting the priming stimulus and target stimulus can also be different. For example, participants are presented a priming stimulus through headphones but have to read aloud a word that is flashed on a computer screen.

For example, Hernandez, Bates, and Avila (1996) used audiotapes to prime Spanish-English bilingual students who responded verbally to visual stimuli presented on a computer

monitor. Hernandez et al. (1996) recruited fifteen bilingual university students for each of six experiments. The mean age of the participants in the six experiments ranged from 19.9 to 22.3 years. All participants reported their first language was Spanish. Hernandez et al. taped short passages with priming words embedded in the text. The audiotape stopped after the presentation of an oral prime; a word then appeared on a computer monitor. The audiotape resumed once participants read the target word aloud. The researcher instructed participants to read the words as quickly and accurately as possible and to listen carefully to the audiotapes because they would have to answer multiple-choice questions presented at the end of each passage. Passages were recorded in either English or Spanish. The recorded audiotape and verbal instructions were presented in the same language that was used during the experimental session. Additionally, participants were instructed to speak only in the language assigned for use during that testing session. Students participated in two sessions separated by at least one day to safeguard the purity of language experience within each experimental session. Hernandez et al. presented target words in the "same language" or "mixed language" format. In addition, the priming words that were embedded in the audiotape and the target words that were displayed on the computer monitor were presented in one of four formats: semantically and linguistically congruent (cat, dog), semantically congruent but linguistically incongruent (cat, gato), semantically incongruent and linguistically congruent (car, jar), and semantically and linguistically incongruent (toro, phone). Experiments *2A* and *2B* used degraded stimuli (words had an asterisk between each letter of the word). Experiment *3A* delayed the onset of participants' responses and experiment *3B* speeded the onset of participants' responses.

As noted above, the language of the target words in experiment *1A* was alternated. In experiment *1A*, participants' response times were faster when the audiotape text was in English

(644 ms) and slower when the audiotape text was in Spanish (698 ms), $F\ (1, 14) = 4.425$, $p < .05$. Additionally, participants' response times were slower when the priming word was semantically incongruent with the target word (688 ms) and faster when the priming word was congruent with the target word (655 ms), $F_1\ (1, 14) = 11.520$, $p < .004$. A significant *semantic* by *linguistic-congruence* interaction effect [$F_1\ (1, 14) = 10.790$, $p < .005$] confirmed that response times were faster in the semantic congruent/language congruent condition and slower in the three conditions in which target and prime did not match semantically or on language. A consistent outcome emerged across studies: bilingual participants performed faster when the response language and the priming language were the same but the same participants performed slower when the response and the priming language alternated. Although Hernandez et al. examined priming as a means of improving bilingual participants' performance; their findings elucidate the conditions under which language switching adversely affects cognitive performance. Therefore, the pattern of priming reported by Hernandez et al. supports the hypothesis of the proposed study. Specifically, bilingual students who switch from Spanish to English are expected to display performance decrements on academic tests such as the SAT.

1.6 Measuring Degree of Bilingualism

The literature related to bilinguals suggests that switch-costs and priming effects vary based on participants' bilingual proficiency as well as on how frequently or how recently bilinguals used each language (Meuter & Allport, 1999; Athanasopoulos, 2006; Hakuta & Diaz, 1985; Hernandez, et al., 1996; Jiang, 1999; Lemmon & Goggin, 1989; Paradis, 2004; Valdes & Figueroa, 1994). Therefore, bilingual researchers recommend measuring essential properties of language proficiency across a variety of daily situations to capture the practical use of language.

Currently there are no “gold-standards” for the measurement of bilingualism (Bialystok, 1998; Paradis, 2004; Valdes & Figueroa, 1994). The objective measures that are frequently used are limited in scope. For example, the Woodcock-Muñoz Language Survey (WMLS) is an objective measure of a bilingual person’s ability to name pictures, form verbal analogies, identify words and take dictation in English and Spanish. Although the WMLS measures several modes of language use, it does not measure frequency or effectiveness of language-use in a variety of contexts. Researchers have also used self-report questionnaires to measure language use and or language proficiency. The more extensive questionnaires measure language proficiency in different settings and in different modes. Because language proficiency is reported to vary based on communication demands in the home and in the community, it is essential to measure language use and language proficiency in a wide range of contexts (Valdes & Figueroa, 1994).

Measuring language proficiency in a border community may be especially challenging given the variability of language use within the community. Commerce, immigration, and the mobility of people between two countries necessitate the use of two languages for people on both sides of the border. Thus, Spanish-English bilinguals in a border community may have greater opportunities to use both languages in multiple settings. Therefore, proficiency for picture-naming or for taking dictation in either language may not accurately reflect the extent to which a bilingual person uses or is immersed in a language. For example, the student body at the University of Texas at El Paso (UTEP) is comprised of more than 20,000 students, and 74% of these students are of Hispanic descent. Additionally, 9% of UTEP’s students are Mexican nationals (2007-2008). Some Hispanic students may be recent immigrants who are more proficient in Spanish than in English. Other students are first or second (or more) generation U.S. citizens who are more proficient in English than in Spanish. Mexican nationals, who complete