The Influence of a Time Limit and Bilingualism on Scholastic Assessment Test Performance

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The purpose of the present study was to explore the influence of bilingualism and a time limit on Scholastic Assessment Test (SAT) performance. Participants were randomly divided into two groups: a time limit group and a no time limit group. Both groups completed an SAT math and critical reading practice test. One group completed the tests under the specified time limit as directed by the SAT developers; while the other group completed the tests without any specified time limits. Bilingualism was quantified by self reported estimates of how long the second language had been practiced, how often the second language had been used, and self estimate of skill level in that language. A time limit adversely influenced math but not critical reading performance. Bilingualism adversely influenced critical reading performance but not math performance. A time limit had a stronger deleterious effect on bilinguals than monolinguals math but not critical reading performance.

Approximately 20% of the US population speaks a language other than English with the rate increasing to 48% in New York City and 60% in Los Angeles (U.S. Census Bureau, 2010). Bilingualism in Europe is even more prevalent with approximately 56% of the population across all European Union countries being bilingual (European Commission, 2006). From 1980 to 2009, the number of school-age children (5-17 years old) in the United States speaking a language other than English at home increased from 4.7 to 11.2 million (National Center for Education Statistics, 2011).

With the increase of Latin American students in the United States education system, it is important to determine the role of bilingualism on academic achievement (Bialystok, 2011). While the advantages of bilingualism have been well documented (Bialystok, 2009; García-Vázquez, Vázquez, & López, 1997), disadvantages of bilingualism have

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equally been documented (Bialystok & Depape, 2009; Gollan, Bonanni, & Montoya, 2005). The purpose of the present study was to explore the relationship between bilingualism and *Scholastic Assessment Test* (SAT) performance. Taken by more than two million students every year, the SAT is required by many institutions as part of the college application process (The College Board, 2011).

Bilingualism defined. People may be considered bilingual in many ways: 1) people who speak, read, and write fluently in two languages; 2) people who speak, read, and write in one language, but can only speak the second language; and 3) speak, read, and write in one language, but understand to some extent a second language (Romaine, 1995). Valdés and Figueroa (1994) define simultaneous bilinguals as people who have acquired a first and second language at the same time. Sequential bilinguals are people who acquire their second language after the first language was acquired. Circumstantial bilinguals are those that must learn a second language due to living circumstances in order to survive, such as immigrants living in the United States. Elective bilinguals are people who choose to become bilingual, but do not need the second language in order to live, such as college students taking a foreign language course.

Research finds that individuals need at least five years of language experience to develop problem solving ability in the language (Cummins, 1981). Regular use of both languages is also necessary for bilingual development (Grosjean, 1992). Further, language ability can be influenced by the individual's perceived ability in speaking the second language. Bandura (1993) postulates that performance is optimized when the individual has a high degree of self confidence in their ability. For the purpose of the present study, bilingualism is defined as the regular use of a second language for at least five years, and a perceived skill level of advanced.

Advantages of Bilingualism. Researchers who advocate learning a foreign language suggest bilingualism enhances cognitive ability (Bialystok, Craik, & Freedman, 2007). Studies have shown that children, adults, and older adults who are lifelong bilinguals and speak both languages on a daily basis show higher levels of executive control compared to monolinguals (Bialystok & Depape, 2009). Speaking more than one language may even delay the onset of dementia (Bialystok et al., 2007). Learning two languages seems to enhance mental flexibility and superior concept formation (Garcia-Vázquez et al., 1997). The mechanisms for these underlying phenomena are yet to be determined, but the management of multiple language systems seems to yield cognitive benefits (Bialystok & Depape, 2009).

A meta-analysis conducted by Adesope, Lavin, Thompson, and Ungerleider (2010) revealed that bilingualism is dependent on several

cognitive activities such as attentional control, working memory, metalinguistic awareness, and abstract and symbolic representation skills. Evidence has suggested that the regular use of two languages requires attentional control of the target language. Bialystok and Martin (2004) found that adults who have been bilingual since childhood are better at managing attention while performing tasks that involve cognitive control.

Researchers have also found that bilinguals possess superior metalinguistic awareness (Bialystok, Majumder, & Martin, 2003; Campbell & Sais, 1995; Galambos & Hakuta, 1988), metacognitive awareness (Kemp, 2007), abstract or symbolic reasoning, creative and divergent thinking (Ricciardelli, 1992), and problem solving (Bialystok, 1999). The bilingual's sense of metalinguistic awareness affects performance in noncritical reading tests. Presumably, bilingualism fosters a precocious use of critical reading mediation in the processing of information. Bilinguals are better able to use language as a tool to monitor cognitive functioning by increasing their capacity to memorize information and control more effectively the different steps in problem solving.

Disadvantages of Bilingualism. There is evidence that bilingualism can be detrimental to cognitive functioning (Bialystok & Depape, 2009; Gollan et al., 2005). Bilinguals maintain a smaller vocabulary in each language than do monolinguals (Bialystok, 2009). Bilinguals have lower scores than monolinguals on the *Peabody Picture Vocabulary Test* (Bialystok & Depape, 2009). Compared to monolinguals, bilinguals name fewer objects using standardized measures of picture naming such as the *Boston Naming Test* (Gollan et al., 2005). Ivanova and Costa (2008) found bilinguals named pictures slower than monolinguals, both when the bilinguals named the picture in their dominant language and their weaker second language. Bilinguals show more tip-of-the-tongue states when retrieving names of picture objects or low-frequency words when given the definitions. Bilinguals tend to have difficulty in producing a well-known word or a person's name when feeling the recall is imminent (Gollan et al., 2005). Bilinguals also experience more interference in lexical decisions (Ransdell & Fischler, 1987).

Rodriguez-Fornells, Lugt, Rotte, Britti, Heinze, and Münte, (2005) found that bilinguals have difficulty in creating effective mechanisms to prevent interference from their native language when using their second language. Interference of phonological information from the non-target language in German-Spanish bilinguals was inferred from event-related brain potentials and functional magnetic resonance imaging. These findings suggest that bilingualism causes an increased processing load on the language production system.

Time Limits and Bilingualism. Research has found that bilinguals tend to struggle when pressed for time (Blumenthal, Britt, Cohen, McCubbin, Maxfield, & Michael, et al., 2006; Gollan, Montoya, Fennema-Notestine & Morris, 2005; Kaushanskaya & Marian, 2007). Ganushchak and Schiller (2009) asked German-Dutch bilinguals to perform a phoneme-monitoring task in Dutch with and without time pressure. The obtained error-related negativity (ERN) showed an atypical increase in amplitude under time pressure. The time pressure participants had more interference from their native language leading to a greater response conflict. The results suggest that error-related negativity is sensitive to psycholinguistic manipulations. It would appear that the functioning of the critical reading self-monitoring system during speaking is comparable to other performance monitoring, such as action monitoring. This explanation is due to the result that participants under time pressure had more interference from their native language, thus leading to a greater response conflict and enhancing the amplitude of the error-related negativity (Ganushchak & Schiller, 2009).

Bilinguals require more time to respond during a variety of picture naming tasks (Gollan et al., 2005; Kaushanskaya & Marian, 2007). Time pressure has also been identified as a stressor that affects the job performance of bilingual language professionals (Blumenthal et al., 2006). Bilinguals also tend to produce more tip-of-the-tongue and fewer correct responses in timed critical reading fluency tests even when tested in their primary language (Gollan et al., 2005). Researchers found performance on the *Wonderlic Personnel Test* to be hindered when students completed the test in their second language and under a time limit (Mullane & McKelvie, 2001). Francis, Tokowicz, and Kroll (2013), found a negative association between bilingual proficiency and response time (RT) on a vocal task. That is, more proficient bilinguals had shorter RTs than did less proficient bilinguals when translating words from their preferred language to their second language. Gollan and colleagues (2005) believed that since bilinguals perform differently in various test environments, separate normative data should be developed for bilinguals to prevent diagnostic error.

Scholastic Assessment Test (SAT). The *Scholastic Assessment Test* (SAT) is a globally recognized college admission test. Taken by more than two million students every year, it is required by many institutions as part of the college application process (The College Board, 2011). The SAT takes three hours and 45 minutes to complete. The test consists of 10 separately timed sections: three sections testing critical reading (70 minutes total), three sections testing mathematics (70 minutes), three sections testing writing (60 minutes), and one variable (un-scored) section test of either critical reading, mathematics, or writing (25

minutes). Possible scores on each part of the SAT range from 200 to 800. In any given year, the standard score is set at 500 with a standard deviation of approximately 100.

There have typically been racial/ethnic differences in test performance. In 2010, the mean critical reading score for Whites was 528, while Asian/Pacific Islanders had a mean score of 454. Hispanics had a mean score of 452, and Blacks had a mean score of 429. The mean mathematics score for Asian/Pacific Islanders was 591 while Whites had a mean score of 536, Hispanics had a mean score of 462 and Blacks had a mean score of 428 (U.S. Department of Education, 2011).

The value of the SAT can be found in its ability to predict first year college success. Corrected for restriction in range and criterion unreliability, the relationship between freshman grade point average (GPA) and SAT Math/Critical reading performance is correlated (r = .57) (Pearson, 1993).

Time Limit and the SAT. Time allocations for the SAT are determined based on the findings that students answer 50 to 60 percent of the questions correctly and 80% finish nearly the entire test. In addition, almost all the students complete at least 75% of the questions (The College Board, 2011). The SAT along with many other standardized tests such as the *American College Test* (ACT), *Graduate Record Examination* (GRE), *Graduate Management Admission Test* (GMAT), and the *Law School Admissions Test* (LSAT), offer various accommodations to students. The most common accommodation requested by students, typically those with learning disabilities, is extended time (Camara, Copeland, & Rothschild, 1998). Current research suggests that extended time on the SAT does not change the construct of the test (Lindstrom & Gregg, 2007). This means that if more time was allocated on the test, the difficulty of the test would remain the same. However, Kellogg, Hopko, and Ashcraft (1999) found time limits caused students to underperform on standardized tests.

The Present Study. The purpose of the present study was to explore the influence of bilingualism and a time limit on SAT math and critical reading performance. The SAT math and critical reading tests were used due to their popularity and importance in the college application process. It is possible that time limits may adversely influence bilingual student performance. It is also possible that regardless of a time limit, bilingualism may enhance or worsen SAT performance.

Three hypotheses were tested. First, a time limit will adversely influence SAT math and critical reading test performance. Second, bilinguals will underperform monolinguals on SAT math and critical reading test performance. Finally, we hypothesize that a time limit will

have a stronger impact on bilinguals than monolinguals on SAT math and critical reading test performance.

METHOD

Participants were undergraduate students attending a private southern United States university enrolled in psychology courses. One hundred and eighteen participants (97 women, 21 men) with a mean age of 20.23 (*SD* = 2.022, range: 18-28) participated in the experiment. Four participants identified themselves as American Indian / Alaska Native, 57 as Black, 32 as Hispanic, and 25 as White.

The present study included a large display digital timer, SAT math and critical reading practice tests, and a self-reporting bilingualism and demographic questionnaire. The tests were paper-and-pencil based and taken from an SAT preparation book (Gruber, 2005). Participants were randomly divided into two groups; a time limit group and a no time limit group. The time limit was based on instructions provided by the SAT preparation book (Gruber, 2005). The math practice test included 20 questions with a 25 minute time limit. The critical reading test included 35 questions with a 25 minute time limit. The time limit group participants were informed of the time limit and a large digital timer was placed on a desk in the front of the classroom. The no time limit group was instructed to complete each test without a time limit. The math and critical reading tests were counterbalanced to mitigate order effects. After the completion of the tests, participants in both groups completed the Likert-type demographics questionnaire. To gauge bilingualism, the questionnaire included three items: how long they have known a second language with response options ranging from 0 (N/A) to 6 (entire life), daily use of second language ranging from 0 (N/A) to 9 (90-100% of time), and perceived skill level of second language ranging from 0 (N/A) to 5 (fluent, as well as first language). Results for each of the three items were totaled to generate a bilingualism score which ranged from 0 to 20. The questionnaire also included items pertaining to age, ethnicity, citizenship, family income, and parental education. The parental education values ranged from 1(*no formal education*) to 7 (*graduate degree*). The parental education variable and reported family income value were used to determine participant's socioeconomic status (SES). The tests and the questionnaire were distributed in a paper format and completed in a group setting in a standard classroom.

RESULTS

There were no gender, racial, or ethnic differences in performance on either the SAT math or critical reading tests. Further, socioeconomic status (SES) did not have an effect on math or critical reading test

performance. The sum of the three bilingual items was used to identify participants as bilingual or not bilingual. This measure of bilingualism was found to be reliable ($\alpha = .88$). There were 59 participants who spoke a second language for at least five years, on a daily basis, and perceived their second language ability to be at least advanced. Within the bilingual group, 27 (45.8%) identified English as their first language, 19 (32.2%) identified Spanish, 5 (8.5%) identified French / Creole, and 8 (13.6%) identified Other. Relating to second language, 25 (42.4%) identified English, 22 (37.3%) identified Spanish, 6 (10.2%) identified French / Creole and 6 (10.2%) identified Other. Within the bilingual group, there were no significant differences in performance on the math or critical reading tests regardless if English was their first or second language. Therefore, we did not differentiate the bilingual group for any of the following analyses.

Exploratory analyses revealed a significant difference between class and critical reading performance, $F(3, 113) = 4.191$, $p = .007$. Post-hoc analysis using Least Squared Difference (LSD) revealed significant differences ($p < .05$) between freshman vs. junior, and freshman vs. senior on critical reading performance. Specifically, juniors ($M = 14.862$, $SD = 3.493$) and seniors ($M = 16.621$, $SD = 2.984$) performed significantly better on the critical reading test than the freshman ($M = 12.822$, $SD = 3.383$) students. Interestingly, there were no differences in performance between class and math test performance. Regardless of school status, sophomore, junior and seniors did no better on the math test than the freshman students. Table 1 provides details to math and reading performance based on bilingualism and time limit.

TABLE 1 Math and Reading Performance

		Math			Reading		
		Time Limit	No Time Limit	Total	Time Limit	No Time Limit	Total
Bilingual	*M* =	5.44	7.77	6.61	12.8	14.04	13.42
	SD =	2.98	3.48	3.40	2.83	4.05	3.47
Not Bilingual	*M* =	6.98	6.98	6.98	15.82	14.86	15.34
	SD =	2.62	3.01	2.75	3.78	3.39	3.62
Total	*M* =	6.21	7.37		14.31	14.49	
	SD =	2.87	3.27		3.60	3.73	

Note: Math score out of 20 possible points. Reading score out of 35 possible points

A multivariate analysis of variance (MANOVA) was conducted to explore the influence of bilingualism and a time limit on SAT performance. The dependent variables included math and critical reading

test performance. The independent variables included condition (time limit, no time limit) and bilingualism (bilingual, not bilingual). Class was included as a covariate due to its association with test performance.

Using Pillai's trace, there was not a significant effect of condition on test performance, $V = .036$, $F(2, 111) = 2.087$, $p = .129$. There was a significant effect of bilingualism on test performance, $V = .076$, $F(2, 111) = 4.584$, $p = .012$, $\eta^2 = .076$. Finally, there was a trend towards significance of condition and bilingualism on test performance $V = .051$, $F(2, 111) = 2.986$, $p = .055$.

There was a significant main effect of condition on math test performance $F(1,117) = 4.158$, $p = .044$, $\eta^2 = .036$. The no time limit group ($M = 7.374$, $SD = 3.268$) performed significantly better than the time pressure group ($M = 6.211$, $SD = 2.869$). Condition did not have an effect on critical reading test performance.

There was a significant main effect of bilingualism on critical reading test performance $F(1,117) = 9.251$, $p = .003$, $\eta^2 = .076$. The monolingual group ($M = 15.341$, $SD = 3.620$) performed significantly better than the bilingual group ($M = 13.422$, $SD = 3.466$). Bilingualism did not have an effect on math test performance.

There was a significant interaction effect between condition and bilingualism on math test performance $F(1,117) = 4.262$, $p = .041$, $\eta^2 = .037$. The no time limit bilingual group performed best ($M = 7.774$, $SD = 3.484$) followed by the no time limit monolingual group ($M = 6.975$, $SD = 3.008$), then the time limit monolingual group ($M = 6.983$, $SD = 2.622$) and finally the time limit bilingual group ($M = 5.440$, $SD = 2.980$). Although trending towards significance, there was no significant interaction effect between condition and bilingualism on critical reading test performance $F(1,117) = 3.076$, $p = .082$, $\eta^2 = .027$.

DISCUSSION

The present study explored the influence of bilingualism and a time limit on SAT performance. With respect to the first hypothesis, a time limit had a negative effect on math performance but not critical reading performance. The decreased math performance is consistent with past research (Kellogg et al., 1999). The conscious thought of the time limit can consume cognitive space, resulting in a reduction of available processing needed for problem solving (Evans, Handely, & Bacon, 2009). A reduction in cognitive space can slow a participants' problem solving activities resulting in an incomplete task. To determine if the variance in performance was due to incomplete tasks, we reviewed the completion rates of the time limit group. Results revealed no significant difference in test completion between the time limit and no time limit

groups. Similar to the no time limit group, nearly 80% of the time limit group completed the test in its entirety.

A second potential cause for the variance in math performance could be the time limit group using simpler and less effective problem solving strategies resulting in degraded performance. Beilock and DeCaro (2007) found participants under pressure used simpler problem solving strategies on multistep math problems, resulting in poorer performance. This behavior may also explain why the time limit did not influence critical reading task performance. Performance on critical reading tasks is typically based on vocabulary knowledge which does not require multistep problem solving strategies. Rather, it is based on the individual knowing the definition or "meaning" of the word. In this case, a time limit may not have as strong an impact on performance

Finally, the decreased performance could be due to the sample size being predominately female (82.2%). Research finds that the stereotype threat of "women being bad at math" can influence performance on math tasks (Spencer, Steele, & Quinn, 1999). Beilock (2008) found when women were aware of the stereotype threat, effort on complex math problems was diminished. This stereotype threat may be inhibiting performance on the more difficult problems in the time limit group due to a potential interaction of the stereotype threat and pressure felt by the time limit. Future research could explore the association between bilingualism, time limits and item difficulty on standardized testing performance.

With respect to the second hypothesis, bilingualism had a negative effect on critical reading test performance but not math performance. This result is consistent with past research demonstrating that bilinguals underperform on various reading tasks (Bialystok & Depape, 2009; Gollan et al., 2005). This underperformance may be due in part to the bilingual participants language proficiency. The threshold hypothesis emphasizes bilingual disadvantages being due to low language proficiency (Cummins, 1979). It posits that reading performance is particularly hampered when the bilingual individual has deficits in both languages. In other words, the bilingual individual speaks two languages, but is not highly proficient in either language.

With respect to the third hypothesis, a time limit had a stronger impact on bilingual's math performance than non-bilinguals math performance. Researchers find time limits adversely impact math performance (Kellogg et al., 1999). In multistep problems such as math, pressure appears to harm performance by overloading the working memory capacity system (Beilock & Carr, 2005). For example Beilock and DeCaro (2007) found an association between pressure and working memory capacity on test performance. Specifically, individuals high in

working memory capacity were able to effectively solve simple problems regardless of pressure being high or low. However, as the complexity of the problems increased, individuals high in working memory capacity made more errors under the high pressure condition.

Researchers also find that time pressure negatively impacts a bilingual's cognitive functioning (Gollan et al., 2005; Kaushanskaya & Marian, 2007). Specifically, bilingualism can burden the working memory system (van den Noort, Bosch, & Hugdahl, 2006). It is generally believed that working memory is a limited capacity system where resources are shared between processing and storage. Any increase in processing can degrade task performance (Baddeley & Hitch, 1974). Specific to math problem solving, reduced cognitive resources can make it difficult to form an appropriate problem representation, identify needed information, and check progress toward the solution (Walczyk & Griffith-Ross, 2006). Essentially, the reduced performance of the bilingual participants under a time limit may be due to an overload of the working memory capacity system. Future research could integrate the findings from the present study with the research conducted by Beilock and DeCaro (2007), and explore the influence of time limits and bilingualism on working memory capacity.

The finding that a time limit adversely affected bilinguals' SAT performance is significant. It provides evidence that some of the variance in SAT performance between monolinguals and bilinguals may be related to the testing environment. College acceptance committees may want to consider bilingual status when reviewing SAT scores of prospective students.

A strength of the research is its generality to the broader ethnic population which lies in the diversity of the present sample (17% White, 50% Black, 29% Hispanic and 4% American Indian/Alaskan Native). Some limitations of the research should be noted. There were a limited number of male participants (18%) and only undergraduate students from a private, Southern university were included in the research. In addition, we did not differentiate the bilingual group based on English being their first or second language.

In summary, the present study indicates that a time limit has a stronger deleterious effect on SAT math performance among bilinguals when compared to monolinguals. The importance of capturing a student's true abilities is integral to academic success. By better understanding what variables influence SAT performance, it may be possible to devise educational testing processes that mitigate variables that negatively impact test performance. From a practical standpoint, college acceptance committees may want to include a student's bilingual status when considering SAT scores.

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NOTES: Joseph Fagan passed away during the final stages of this research. Dr. Fagan became a full professor in 1978 at Case Western Reserve University and served as chair of the Department of Psychological Sciences from 1990 until 1995. He received the endowed Leffingwell Professor of Psychology title in 1990 and was named a fellow of the American Psychological Society. In 2009, Fagan received the Mensa Education and Research Foundation Award for Excellence in Research for his study of how an infant becomes an intelligent, achieving adult. We will miss his friendship, expertise, and positive influence.

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