

CULTURAL DIFFERENCES AND THEIR EFFECT ON COGNITIVE FUNCTION
TASKS

by

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Abstract

In an attempt to further research on Bilingualism, this study examined the relationships between acculturation, time perception, and a cognitive task called the Color-Word Stroop Task. The results were reached by utilizing detailed demographics, psychological acculturation scale, language experience and proficiency questionnaire, The Color-Word Stroop Task, and a time perception questionnaire. The results concluded that for the sample utilized, there was no relationship between acculturation, time perception, and the Color-Word Stroop Task. The possible limitations, and modifications are discussed further.

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Cultural Differences And Their Effect On Cognitive Function

The United States of America is a nation that is home to many individuals from different parts of the world. It is estimated that about one third of the American population is a part of a minority group, and this is predicted to grow to half by the year 2050 (Rivera Mindt et al., 2008). Of these minority groups, more than 18 % report being bilingual; speaking a language other than English at home (Rivera Mindt et al., 2008). This continued increase in the bilingual population in the U.S. has led to increasing interest in determining whether our present educational practices are benefitting all U.S. residents. There is evidence across research of differences between bilinguals and monolinguals in their cognitive abilities, and some have interpreted these differences to mean that bilingualism confers certain advantages in cognitive processes that monolingualism does not. These statistics have opened the door for questions as to how the bilingual mind works.

Bilingualism is typically described as the use of two languages in terms of understanding and speaking (Grosjean, 1982). The appropriate production of one language while suppressing the other is believed to rely on important cognitive mechanisms that bilinguals utilize. The first mechanism is when one language is used more frequently than the other language, resulting in weaker links between the languages' cognitive representation in the mind. In order to prevent weaker links, an effort should be made to practice both languages equally. This places emphasis on the use of both languages. When trying to maintain fluency in both languages, the use of both equally is important. The second mechanism is inhibition, which is the ability to suppress one language to produce the other; this occurs through interface. Interface can be described as the interaction between two aspects, in this case both languages. In other words, the mind has to decide which language to use either to speak or process information internally. Learning two

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languages can be a disadvantage because it can delay the proficiency in both at an early age.

Bilingual children would most likely begin speaking at a later age than the average monolingual child would. Another disadvantage is vocabulary size (Rivera et al, 2008). The area of the brain in which vocabulary size is stored can be compared to a closet, if a closet in general can only hold ten pairs of shoes, then the splitting of this space for two people now only allows five pairs per person. Language works in a similar way; if the mind has a certain amount of space for language, then with two languages, that space has to be shared between the two.

A common task utilized to measure inhibition is the Color-Word Stroop Task (Stroop, 1935), in which participants are required to suppress an immediate response to produce a correct response. This task is used liberally across studies investigating bilingual cognition, as it is believed that bilinguals undergo a similar cognitive process when producing a 'correct' language in a given situation.

The Color-Word Stroop Task

The Color-Word Stroop Task (Stroop, 1935) measures executive functions that are similar to the cognitive processes that bilingual individuals use. It is typically presented using colors with a couple of trials. In the first trial of words are presented spelling different colors in black ink. The second trial consists of a series of "X's" that are presented in different color ink. In the third trial, which is important, are the words for the colors presented in different color ink than the word itself is conveying. For example, the color pink would be presented in green color ink, and the participant would have to state that the color of the ink used instead on the word itself. The third trial is important because this is when participants demonstrate the most inhibition. Inhibition in this case is a voluntary or involuntary restraint on the direct expression of an instinct. There are some Color-Word Stroop Tasks that might require a fourth trial in which

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the color of the word it is reading is the stimuli that needs to be identified instead of the ink color. Reaction time and the differences between automatic processing and conscious visual control, in other words inhibition control, are measured in this task. In Stroop's research he noticed that other experimenters were using a similar approach but were exposing the participants to the experiment itself in the practice rounds. Since participants were exposed to the material in the practice run, their data may not have been useful. The Color-Word Stroop Task was created to eliminate this bias and has been used frequently by other researchers.

The Color-Word Stroop Task and Bilinguals

One of the areas of study in which the Color- Stroop Task has been utilized has been to examine the cognition of bilinguals in different languages. There are several studies that have found differences between bilinguals and monolinguals in their performances on the task. Rosseli et. al (2002) conducted an experiment that utilized the Color-Word Stroop Task to examine if there is a difference in inhibition between monolinguals in English and bilinguals in English and Spanish. There were essentially three groups in total, Spanish monolinguals, English monolinguals, and Spanish English bilinguals. Along with the Color-Word Stroop Task the participants had to participate in a self-report questionnaire that collected information like age, the age the second language was acquired, and how fluent they are in in both languages. Bilinguals were asked to fill out two versions of this questionnaire, one in English and one in Spanish. Bilinguals had the same scores on both the English and Spanish Color-Word Stroop Tasks. When compared to their monolingual counterparts bilinguals were slower to respond in the same tasks. Bilinguals did worse than monolinguals in the color naming condition in both languages. The results indicated that there is no bilingual advantage; in fact, these results may indicate that bilinguals may suffer disadvantages in the Color-Word Stroop Task.

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While there are many similar studies that utilized the Color-Word Stroop Task in Spanish-English bilingual samples, it has also been utilized in other language bilingual studies.

Abdelgafar and Moawad (2015) conducted a series of studies to evaluate possible differences in cognition between Arabic and English bilingual children and Arabic monolingual children. There were 25 monolingual children between the ages of seven and ten and there were 25 bilingual children between the ages of seven and ten. The researchers in this study conducted eight tests in total including the Color-Word Stroop Task. All participants' parents and caregivers were asked to answer a questionnaire about the children's exposure to native language and second language, and some demographic information. The results for the Color-Word Stroop Task indicated there were no significant differences between monolinguals and bilinguals. There were no advantages or disadvantages amongst Arabic and English bilinguals and Arabic monolinguals. In this particular language group there were no significant results based on this part of the study alone.

Gathercole et. al (2010) studied Welsh and English bilinguals, and English monolinguals. There were two age groups, primary and teenage, within the bilingual and monolingual groups resulting in four groups in total. There were no significant differences in correct responses with the bilingual group at any age group but there was a significant difference between bilinguals and monolinguals in the younger group. The bilinguals in the younger group appeared to have a bilingual advantage. This supports the idea that there is a bilingual advantage. Children who had dominance over both languages, and utilized both did best on the Color-Word Stroop Task.

Chen and Ho (1986) conducted a Color-Word Stroop Task on participants of different grade levels. There were 120 Chinese and English bilinguals from grade levels 2,4,8,10 and college. There were 24 participants in each grade level group. A modified version of the Color-Word Stroop Task was used for this study where stimuli was presented in one language but

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required to respond in the other. For example the word could have been presented in Chinese and the participant could have been required to state the ink color in English. The results demonstrated that responding in Chinese was slightly more difficult than responding in English to Chinese stimuli for participants after a certain age, and participants who were younger had a more difficult time responding to stimuli presented in English.

The results amongst all the Color-Word Stroop Tasks mentioned were not consistent with one another. There were four different languages that were studied along with English and it appeared that almost every language had its own results. The Chinese bilinguals approached the Color-Word Stroop Task in a different way than the rest, which could create a conflict in comparing results amongst the different Color-Word Stroop Tasks. The Welsh and English bilingual Color-Word Stroop Task demonstrated a significant finding in the primary age children group; they had a better grasp on both languages according to this article. The Arabic and English Color-Word Stroop Task demonstrated no significant results. In order for the Color-Word Stroop Tasks to be compared to one another there should be a universal measure in which all Color-Word Stroop Tasks should abide by.

Limitations of The Color-Word Stroop Task

Scarpina and Federica (2017) conducted a study to demonstrate the capability of the many approaches utilized to score the Color-Word Stroop Task. The purpose of study was to highlight the importance of why a universal Color-Word Stroop Task should be developed. The researchers utilized different journal publications to obtain various versions of the Color-Word Stroop Task. The results of their research were reached by comparing results of various Color-Word Stroop Tasks that were published. It was discovered that there were various methods of scoring the Color-Word Stroop Task. Some were scored solely on speed performance,

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others took into account speed and accuracy as separate accounts, and some included speed and accuracy together. The researchers proposed that there should be a fixed time for all areas of the Color-Word Stroop task.

Another limitation was comparing the results among the participants. Some studies recruited adult participants while others recruited children. The cognitive process of an adult and child are quite different. A possible issue that presents itself in analyzing these results is that some studies utilize monolinguals in both English and the other language of study and other studies only had one group of monolinguals for one language, another study had no monolingual group at all. This creates an issue with creating a base line which to compare participants.

The Spanish English Color-Word Stroop Task exposed more questions in terms of culture. The Spanish English bilingual results had the most significant results in a negative way in terms of bilinguals. The bilinguals did not do well in the Color-Word Stroop Tasks they participated in. These results might raise the question of the perception of time in terms of culture. Does the way some cultures perceive time affect the Color-Word Stroop Task? The Color-Word Stroop Task in most cases is measuring reaction time. A common theme the Spanish culture has is that if one is given task one must do it right no matter the time it takes.

An Issue of Time Perception

Graham (1981) produced an article that explored the perception of time in different cultures. He presented the idea that there are three different ways of perceiving time: linear, circular traditional, and procedural traditional. People and/or cultures that perceive time as linear visualize time as one straight line sort of like a time line. In this case time is perceived as having a past, present and a future. For people and/or cultures that perceive time as circular, traditional time is visualized as a cyclical pattern where events occurred based on a pattern. There are

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cultures today that rely on this perception of time order to complete certain tasks like hunting or harvesting crops. Lastly, for people and/or cultures that perceive time as procedural traditional, there is a great emphasis on activities being carried out correctly as opposed to being on time. Time perception does not only appear to be something that is shaped by culture but it can also influence language as well. Language has demonstrated that it can affect or control the way in which a speaker views the world around them.

There was one study conducted with American and Brazilians that studied how time was perceived between both cultures. Clocks in public places in Brazil often times do not work. This would conflict with one's perception of time if one cannot keep track of it. The second finding introduced by this article is that being late is perceived as more relaxed, being late or early has a bigger time window. The third is Americans prize punctuality while Brazilians prize lateness. The logic behind this concept is not entirely clear in the article, but perhaps Brazilians prize lateness since it would indicate that one is preoccupied with something else that could be deemed more important (Levine, West, & Reis, 1980.) This could bring Graham's (1981) research into perspective because participants from the Spanish and English Color-Word Stroop task may have perceived time in the procedural traditional view.

The bilingual mind has demonstrated how difficult it is to understand, particularly the way information is processed alone, but the languages and the cultures the languages pertain to, do have an influence as to how the brain works. When evaluating the bilingual mind one should remember bilinguals are harboring two cultures and forming one that is a mix of the two. These two cultures must be taken into consideration when creating cognitive tasks to evaluate their brain function. The Color-Word Stroop Task is one of a series of cognitive function tasks that have been conducted in an attempt to understand the bilingual mind. The question becomes if

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culture were to be taken into consideration, would TheColor-WordStroop Task still be effective in evaluating the bilingual mind? TheColor-WordStroop Task does measure time, but if a culture values a task well done as opposed to a task done quickly. TheColor-WordStroop Task is supposed to be completed as quickly as possible, but working quickly can lead to errors. Therefore, someone with a less linear time perspective might be willing to sacrifice speed for accuracy. The question becomes would those results still be valid. More specifically from a cultural standpoint, does culture influence the perception of time and does the perception of time influence scores on The Color Word Stroop Task.

Methods

Participants

While our initial recruitment efforts focused solely on Spanish-English bilinguals, the restricted sample available on Purchase College campus required the broadening of the recruitment to include all bilinguals, regardless of language. The final sample consisted of 25 participants (84% female) who completed the study as part of their Introduction to Psychology course extra credit assignment, or students from other courses on campus. Participants ranged from 18 to 31 years in age ($M = 20.50$, $SD = 3.55$), and all were right handed, thus removing the potential handedness confound from our results. With regard to ethnicity/racial backgrounds, less than half (44%) reported being non-Hispanic White, more than two-thirds (68%) were born in the United States, and 68% grew up in an area that reflected their or their parents' cultural backgrounds. A complete frequency distribution of these demographics are provided in Table 1.

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With regard to language, 60% stated English as their first language, 12% stated Spanish as their first language, and 24% stated another non-English language as their first language.

Table 1 lists all first languages for this sample.

Materials

A demographics questionnaire was utilized to capture important demographics information such as age, gender, ethnic identity, cultural identity, and other variables.

The Psychological Acculturation Scale. The Psychological Acculturation Scale (PAS; Tropp, Erkut, Coll, Alarcon, & Vasquez-Garcia, 1999) assesses an individual's sense of attachment to and understanding of Anglo-American and Latino/Hispanic cultures. The PAS is a 10-item measure requiring participants to respond to questions on a 9-point Likert-type scale ranging from 1 = only Hispanic/Latino, to 9 = only Anglo/American. A mid-point score (4.5) suggests that the respondent is bicultural, that is, both Latino/a and American. Scores lower than 4.5 suggest a higher Latino/a orientation and scores higher than 4.5 suggest a greater Anglo-American identification.

The Language Experience and Proficiency Questionnaire. The Language Experience and Proficiency Questionnaire (LEAP-Q; Marian, Blumenfeld, & Kaushanskaya, 2007) was utilized to assess bilinguals' linguistic profiles and statuses. The LEAP-Q is a 16-open item questionnaire that consisted mostly of percentile rankings from 1 to 100 (e.g., Please list what percentage of the time you are currently and on average exposed to each language) and subscales. For the subscales, participants were asked to rate on a scale of 1 to 10 (0-none; 1-very low; 9-excellent; 4-perfect) their level of proficiency in speaking, understanding and reading in their language. The LEAP-Q is a reliable and valid questionnaire because it incorporates language proficiency and language history (e.g., Please list the number of years and months you

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spent in each language environment). A higher percentile ranking score in the percentage of time that the participant would speak in Spanish would help determine which participants self-reported as bilingual.

The Color-Word Stroop. The Color-Word Stroop described in the introduction section was utilized in this study to examine the amount of items each participant got correct and what amount of time it took them to complete the task. The Color-Word Stroop Task was integrated into the survey with a page with brief instructions on how to proceed with the Color-Word Stroop Task. There were a total of 40 Color-Word Stroop Task questions that were all timed.

Time Perception Questionnaire. Levine, West, & Reis (1980) utilized a questionnaire to gauge the perception of time within cultures. The researchers asked questions about how participants thought of time in specific situations. The researchers found significant results in their study, which is why it is incorporated in this study. The results gave insight as to how participants think of time.

Procedure

Participants were recruited through the Purchase College Psychology Participant Pool or through an announcement at a course they were taking. All of the materials were translated electronically to a survey generating website called Qualtrics. Participants were first asked to sign the consent form electronically. After the consent form was signed electronically the experiment began. Participants first answered the demographics section, followed by the Psychological Acculturation Scale, Language Experience and Proficiency Questionnaire, The Color-Word Stroop Task, The Perception of Time Questionnaire, and lastly a Debriefing Statement was presented at the end of the experiment. Participants were compensated with class participation credit or extra credit toward the course.

Results

Descriptive Statistics

Participants' scores on each of the following scales were computed: On the Color-Word Stroop, participants' mean number of correct responses ($M = 36.96$, $SD = 6.82$) indicate that most participants were able to produce the correct color ink while suppressing the automatic response of reading the word itself. With regard to reaction time, the mean time in seconds ($M = 1.50$, $SD = 0.76$) participants took to respond to each stimulus indicated their answers were not immediate, but rather took some time to be produced. The Psychological Acculturation Scale score ($M = 5.26$, $SD = 2.20$) indicates that for the most part participants indicated feeling they were acculturated equally between their two respective cultures. The Time Perception Questionnaire's scores were also computed: scores on the Romantic date scenario ($M = 3.24$, $SD = 0.30$) indicate participants would arrive on time for this event, in the scenario of Meeting with a Teacher, scores ($M = 3.02$, $SD = 0.24$) indicate that participants would arrive on time for this event, in the scenario of Meeting a Friend, scores ($M = 3.38$, $SD = 0.37$) indicates that participants would arrive on time for this event, in the scenario of going to Nephew's Birthday Party, scores ($M = 3.48$, $SD = 0.49$) indicate participants would arrive on time for this event, in the scenario of Meeting with a Government Official, scores ($M = 2.8$, $SD = 0.41$) indicate participants would arrive early for this event, lastly the average of all the questions per participant were computed ($M = 3.19$, $SD = 0.25$) which indicates that overall participants would arrive on time to events in general. A Pearson's correlation showed no significant correlation between The Color Word Stroop correct responses and The Color Word Stroop reaction time $r(23) = -0.01$, $p = 0.95$. There was no relationship between how quickly one completed the task

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and whether or not they answered correctly. Complete descriptive and inferential statistics is provided in Table 2 and Table 3.

Inferential Statistics

A series of Pearson's correlations were conducted to test our hypotheses that culture influences the perception of time and that the perception of time influence scores on The Color Word Stroop Task. Contrary to our hypothesis, A Pearson's correlation demonstrated no significant correlation between The Color Word Stroop correct responses and Psychological Acculturation Scale scores $r(23) = -0.17, p = 0.40$, Indicating no relationship between one's performance on the task and their level of acculturation. A Pearson's correlation showed no significant correlation between The Color word Stroop reaction time and Psychological Acculturation Scale score $r(23) = -0.10, p = 0.61$. A Pearson's correlation showed no significant correlation between The Color Word Stroop correct responses and the average scores on The Time Perception Questionnaire $r(23) = -0.02, p = 0.91$. These were the correlation analysis addressing the direct hypothesis. Complete descriptive and inferential statistics is provided in Table 2 and Table 3.

Discussion

The hypothesis driving this study was that culture influences the perception of time and the perception of time influences scores on The Color Word Stroop Task. There was no evidence in our data to support this hypothesis; there was no relationship between perceptions of time, and lateness, and performance on the Color-Word Stroop task. The findings contradict our prediction, that those who had laxer interpretations of lateness would perform worse on the Stroop when compared to those who had a stricter interpretation of lateness. We based our prediction on research that found that people from certain cultures might not place as high a value as

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Americans seem to place on time and the concept of timeliness. Specifically, Levine, West, & Reis (1980) found that when compared to Americans, Brazilian participants held time to be less important than Americans, and Brazilians appeared to prize lateness.

We also measured acculturation levels in our participants to control for the potential confound that Americanization would produce in our findings. There was no relationship between acculturation levels and Stroop performance in our participants, which precluded our ability to perform more sophisticated analyses. Thus, we determined that acculturation was not a factor in our sample.

Limitations. One of the limitations of this study was the Psychological Acculturation Scale. The scale was established to measure the Hispanic culture and Anglo American Culture. There were participants in this study that were of different cultures that were not necessarily the Hispanic culture. This could be addressed by recruiting from a specific demographic only, which would have been to recruit bilingual participants that speak the same two languages as opposed to bilingual in general. Also modifying the acculturation scale according to the cultures being studied may have mitigated this limitation. For this particular study the Hispanic culture part of the questions should have been a more general term like “other culture specified previously”. Levine, West, and Reis (1980) produced the time perception questionnaire in this study by utilizing Brazilian and American participants, it would be interesting to see if the same findings could be found by adding The Color Word Stroop Task.

Studying college American students could be a limitation. College students are conditioned to place importance on time. Perhaps for future studies other types of participants could be recruited. It would be interesting to see how adults who are not attending college would perform in this study. It would also be interesting to see how children would do in this study.

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These two different demographic could produce different results. Participants who do not attend college could have a less linear perspective on time. Children are still developing their personalities and perspectives, so therefore their perspective on time might influence their Color-Word Stroop task performance.

The present study was an online study. Another possible limitation could be the participants' surroundings when participating in the study. The participants could have been distracted, or could have been affected by anything else taking place in their environment. Things like a conversation happening around them, television, or having to step away from the computer for any reason, and any other series of things. The study could have produced different results if the study were done in a lab setting. It would have also been beneficial to have monolinguals for both languages being studied. This would create a base line for both languages.

The Color Word Stroop may have had its own limitations also. Scarpina and Federica (2017) mentioned in their article that there is a need for a universal measure for the Color-Word Stroop Task. Color-Word Stroop tasks can measure time and accuracy separately like this study. Other versions of the task might have a formula to incorporate both components with one score. It would be beneficial for future research to develop a universal measure for the Color-Word Stroop Task. It would also be beneficial if software available to conduct the Color-Word Stroop Task were more advanced and user friendly. The software not being user friendly can create issues in analyzing data. It might also be beneficial to consider other cognitive tasks that could be better suited for measuring bilingual participants cognitive function that takes time into consideration. Aside from the limitations, this study can be interpreted as beginning tool for further research. There are many modifications that could be made to the methods of this study that could yield different and possibly even significant statistical results.

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Despite these limitations, this study contributes to the growing body of research conducted in this lab that has yet to replicate the bilingual advantages evident in other non-US based studies. The initial question of whether findings from those studies are generalizable to countries where bilingualism is viewed through a lens of immigration and outgroup belongingness grows increasingly important to investigate.

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Table 1

Specific Demographic information of Participants (n = 25)

Category	n	%
Race		
Asian	3	12.0 %
Black	4	16.0 %
Hispanic	7	28.0 %
Non-Hispanic White	11	44.0 %
Sex		
Female	21	84.0 %
Male	4	16.0 %
Primary Language		
Albanian	1	4%
English	15	60%
German	1	4%
Haitian creole	1	4%
Italian	1	4%
Korean	2	4%
Russian	1	4%
Spanish	3	12%
Second Language		
Arabic	1	4.3%
English	9	39.1%
French	2	8.7%
Italian	2	8.7%
Portuguese	1	4.3%
Spanish	7	30.4%
Telugu	1	4.3%
Education Level		
College	1	4%
High school graduate	7	28%
Less than high school	4	16%
Some College	11	44%
other	2	8%

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Table 2

Descriptive Statistics

Descriptive Statistics

	STROOP_Score	STROOP_RT	PACS_Score	TIME_Romantic	TIME_Teacher	TIME_Friend	TIME_Nephew	TIME_Official	TIME_composite
Valid	28	28	28	28	28	28	28	28	28
Missing	0	0	0	0	0	0	0	0	0
Mean	36.96	1.503	5.261	3.246	3.021	3.386	3.486	2.821	3.192
Std. Deviation	6.818	0.7641	2.203	0.3073	0.2394	0.3689	0.4942	0.4086	0.2480
Minimum	10.00	0.7347	1.900	2.600	2.600	2.600	2.400	2.000	2.680
Maximum	40.00	3.548	9.000	3.800	3.400	4.400	4.600	3.600	3.680

