

Stroop Effect Differences In Bilinguals And Monolinguals

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Abstract

Experimental research was conducted on University students to determine the differences in the Stroop effect between bilinguals and monolinguals. A sample of 40 bilinguals (English-French) and 40 monolinguals (20 = English, 20 = French) with an age range of 20 to 30 years was approached and selected by language proficiency level. The Golden Stroop test and its parallel French version, Stroop GEFEX, were used, and the reaction was recorded. One-way ANOVA indicated that monolinguals, both English and French, performed better than bilinguals on the colour-word component of the Stroop test. No significant difference in bilinguals and monolinguals was observed on other components of the Stroop test. Neuroimaging data indicates higher activation of the left posterior parietal lobe, the right inferior frontal gyri, and the ACC in monolinguals than bilinguals.

Stroop Effect Differences In Bilinguals And Monolinguals

The central nervous system (CNS) is best known for its excellent capacity to accept change with the passage of time and because of experience. This change shows learning, which is a remarkable concept that is said to be a widely measurable behaviour, and it is open to training and adaptation. The same point of view was presented by Bialystok, Craik, and Freedman (2007), who were in favour of the remarkable advantage of speaking, writing, and understanding two languages, which protects individuals from having dementia in old age.

A cohort study was conducted, and a sample of 185 patients was selected from a memory clinic in Taranto. Those patients were bilinguals as well as monolinguals; the sample was matched on other demographic, cognitive, and social factors. Findings revealed that the onset of dementia occurs four years later in bilinguals as compared to monolinguals. Similarly, another study, which viewed conflict resolution in monolinguals and bilinguals elderly, indicates that the latter is better at conflict resolution than the former (Bialystok, Craik, Klein, & Viswanathan, 2004). The significant implication of these findings on bilinguals is the management of two languages, which puts a constraint on bilinguals and leaves long-term benefits that move away from the sphere of language. However, these findings cannot be generalized to children and youngsters (Bialystok, Martin, & Viswanathan, 2005; Martin-Rhee & Bialystok, 2008) as they have only been studied in elderly populations.

Early empirical studies show that bilinguals are better at those tasks that entail the repression of irrelevant information that once was relevant than monolinguals. This finding was revealed in functions like dimensional change card slot (DCCS) (Bialystok, 1999) and also in those that have a significant amount of input that is irrelevant and needs to be ignored, for example, identifying grammatical errors and, at the same time ignoring inconsistent and irrelevant semantic content. These bilingual benefits might be considered to be predicted if the inhibitory control mechanisms were involved in all the tasks, including conflict resolution. So, in such a scenario, the need for bilinguals to control the irrelevant annotation or lemmas would enhance the central control mechanism, though it is possible that an inhibitory mechanism specific to language might engage in those particular tasks, allowing the improvement in its accuracy. So, in the case of identifying grammatical errors, it was found that such type of processing includes language-specific mechanisms. In DCCS, most often it is less often, the presentation of shapes like circles and ovals, and colours like blue and red most often activate the well-developed inhibitory control mechanism for the language. Bilinguals have the higher capability to sort out one dimension and then jump to the other one that might be related to the coding of physical properties of the presented stimuli related to language while operating the well-developed inhibitory processes of a language control system.

Bialystok, Craik, and Luk (2008) recently found that monolinguals showed a greater Stroop effect than bilinguals. This drastic difference in the two groups might be because bilinguals are better able to eliminate and remove the impact of irrelevant words. More prominently, to determine that bilingualism converses a general inhibitory control benefit would need the use of tasks that are not so apparently driven to language as the Stroop task. The task-switching paradigm is one of the most widely and newly used models to explore the differences between bilinguals and monolinguals (Prior & MacWhinney, 2010). The present study is designed to determine whether monolinguals differ from bilinguals regarding the Stroop effect. Literature has provided evidence that monolinguals perform better on the Stroop test than bilinguals.

Method

Participants

A total sample of 80 was selected with a distribution of 40 bilinguals (English/French), whereas 40 monolinguals (20 = English & 20 = French) from the University of Sydney were selected. The age of the sample ranged from 20 to 30 years. All three groups were similar in their age as Bonferroni's post hoc comparison indicates that there is no significant age difference in English monolinguals ($M = 25.89$, $S.D = 8.25$), French monolinguals ($M = 24.45$, $S.D = 8.27$), and Bilinguals ($M = 25.39$, $S.D = 6.77$). None of the participants had psychological or neurological issues. All were tested individually and were given an incentive of 5\$ for their participation. Those individuals who could speak other than English and French were excluded from the study.

Material

The stimuli of the Golden Stroop Color and Word Test (Golden, 1978; Mitrushina et al., 1999) were used to assess the Stroop Effect in bilinguals and monolinguals. Instead of recording the number of responses, the time taken by participants to complete all the stimuli was recorded. Errors made by all the participants were also recorded. The parallel French version of the Golden Stroop Test used Stroop GREFEX (Roy et al., 2016), and again, the time taken by the participants was recorded.

Procedure

Informed consent was presented to all participants in a manner consistent with the APA guidelines. Both bilinguals were asked to rate themselves on how well they read, speak, write, and understand. English and French on a Likert Scale with 1 = Not at all, 2 = beginner, 2=somewhat, 3=pre advanced, and 5 = advanced. Only those participants who scored pre-advanced and advanced in all four linguistic abilities (speaking, reading, writing, and understanding) were included in the study. Three groups, Bilinguals, English monolinguals and French monolinguals, were presented with the Stroop test. The order of components of Stroop test administration for each group was similar (colour-word, naming colours, and reading of words; whereas for bilinguals, last was the colour-word between language conditions).

Results

Data was analyzed using the Statistical Package for Social Sciences (SPSS), and a one-way analysis of variance (ANOVA) was applied to analyze the difference in the Stroop test of the three groups.

Comparison of English-French bilinguals with both English monolinguals and French monolinguals in the three components of the Stroop test showed significant differences among the three groups. Post-hoc comparison indicated that English monolinguals and French monolinguals performed better than the English-French bilinguals in colour – the word component ($p > .05$), as shown in Table 1. Findings indicate that there is no significant difference between bilinguals and monolinguals in the other two components of the Stroop test.

Discussion

Results have indicated that the overall performance of bilinguals on the Stroop test was slower than that of monolinguals. Significant differences were found only in the task-switching component, colour – word. Present findings are supported by the work of Dyer (1971), who found that bilinguals differ from monolinguals in interference. A vast amount of literature is available on language-switching tasks in bilinguals (Abutaleb & Green, 2008). Garbin et al. (2010) have presented their findings on

task switching in bilinguals and monolinguals. The neuroimaging data indicated that monolinguals showed a significant switch cost compared to bilinguals, who did not show any switch costs. Neuroimaging data showed that the left posterior parietal lobe, the right inferior frontal gyri, and the ACC showed a higher level of activation in monolinguals on switch relative trials.

On the other hand, this switch-modulated activation was limited to the left inferior frontal gyri (Abutalebi & Green, 2007). When multiple language usage increases, then only the left inferior frontal gyri and left putamen are activated selectively in bilinguals, and so sometimes, it eliminates or weakens the task switch costs (Garbin et al., 2010). Findings are further supported by neuroimaging studies that indicated the inhibitory mechanisms needed in comprehension and production are not similar for bilinguals, and in actuality, there is no language switch. There are control networks that maximise comprehension and production processes, as well as separate word production and auditory word recognition. So, it would appear that the bilinguals have adaptive cognitive control in terms of language switching (Green & Abutalebi, 2013).

These findings are supported by past research that focused on the differences between bilinguals and monolinguals. Findings have been explained in relevance to the cognitive and neural functions. The present study has its limitations in that students from the same institute were located, which might have affected their language ability. Moreover, there was a narrow age range. Instead, a wide range of ages could be taken to have more general findings. In the future, the combined effect of neuroimaging and the Stroop test should be implemented while recording the time it takes to complete the task to provide a better explanation.

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Table 1

Comparison of French-English bilinguals, English and French monolinguals in the three conditions of the Stroop Test

	English-French Bilinguals (n = 40)		English Monolinguals (n = 20)		French Monolinguals (n = 20)		<i>F</i>	<i>p</i>
Variables	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>	<i>M</i>	<i>SD</i>		
French Stroop								
Reading time (sec)	45.88	10.11	–	–	44.72	5.33	.070	.07
Naming time (sec)	57.75	16.13	–	–	62.55	12.17	.520	.09
Color-word time (sec)	111.84	30.17			92.90	27.43	4.180	.036*
English Stroop								
Reading time (sec)	46.19	14.34	42.67	8.56	–	–	.991	.12
Naming time (sec)	71.06	17.94	69.98	12.55	–	–	.912	.22

Color-word time (sec)	113.23	32.22	99.38	30.17	-	-	4.46	.021*
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