FIRAT ÜNİVERSİTESİ
SOSYAL BİLİMLER DERGİSİ
Journal of Social Sciences
p-ISSN:1300-9702 e-ISSN: 2149-3243

Turkish Dialect Implementation of the Stroop Task

Stroop Testinin Türk Lehçelerine Uygulanması

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Araştırma Makalesi/Research Article

Makale Bilgisi
Geliş/Received:
08.01.2025
Kabul/Accepted:
04.08.2025

DOI:
10.18069/firatsbed.1616096

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stroop task, dialects, Kazakh, Turkmen.

ABSTRACT

This study examined the effect of language on cognitive control and attention processes in speakers of different Turkish dialects using the Stroop task. Unlike other studies investigating the Stroop task in the language domain, this study was applied only to Kazakh and Turkmen participants learning Turkish. The aim of the study was to show how the Stroop effect works in different dialects of Turkish. In the Stroop task, participants were presented with colored words printed in congruent or incongruent colors. The results revealed that Turkmen and Kazakh participants responded slower in the incongruent condition, but had faster response times in the congruent condition. Moreover, accuracy rates differed between the two groups. Turkmen participants achieved higher correct response rates overall. These findings suggest that the strategies of reducing cognitive load and adding control cues were differentially effective in the two dialect groups. The higher correct response rates of Turkmen students were due to the fact that Turkish and Turkmen are in the same dialect group.

Keywords
stroop görevi, dialect, Kazakça, Türkmence.

ÖZ

Bu çalışma, Stroop görevini kullanarak farklı Türk lehçelerini konuşan bireylerde dilin bilişsel kontrol ve dikkat süreçleri üzerindeki etkisini incelemiştir. Stroop görevini dil alanında araştıran diğer çalışmalardan farklı olarak çalışma sadece Türkçe öğrenen Kazak ve Türkmen katılımcılara uygulanmıştır. Çalışmanın amacı, Stroop etkisinin Türkçenin farklı lehçelerinde nasıl işlediğini göstermektir. Stroop görevinde katılımcılara uyumlu veya uyumsuz renklerde basılmış renkli kelimeler sunulmuştur. Sonuçlar, Türkmen ve Kazak katılımcıların uyumsuz durumda daha yavaş tepki verdiklerini ancak uyumlu durumda daha hızlı tepki sürelerine sahip olduklarını ortaya koymuştur. Ayrıca, doğruluk oranları iki grup arasında farklılık göstermiştir. Türkmen katılımcılar genel olarak daha yüksek doğru yanıt oranlarına ulaşmıştır. Bu bulgular, bilişsel yükü azaltma ve kontrol ipuçları ekleme stratejilerinin, her iki lehçe grubunda farklı şekilde etkili olduğunu göstermektedir. Türkmen öğrencilerinin daha yüksek doğru yanıt oranlarının, Türkiye Türkçesi ile Türkmencenin aynı lehçe grubunda yer almasından kaynaklanmıştır.

Atıf/Citation: Uzun, C. ve Yeşildal Eraydın, Y. (2025). Turkish Dialect İmplementation of the Stroop Task. *Fırat University Journal of Social Sciences*. 35, 3, 1223-1236.
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1. Introduction

Various techniques are used in language teaching and acquisition (Atlı, 2012). The Stroop task is one of them. The Stroop task is a classic psychological test used to measure an individual's attention and cognitive processing abilities. This test assesses how an individual processes conflicting information when processing a stimulus, thus testing cognitive flexibility and selective attention abilities (Song, Hakoda, 2015). In the Stroop task, participants are usually presented with words written in coloured ink. participants are asked to say the meaning of the word, not the color of the writing. For example, if the word 'green' is written in red, the correct answer is 'green'. This is a challenging task that requires attention and inhibitory control because the participant must ignore the semantic meaning of the word and focus only on the colour of the ink. The Stroop task is particularly used in the assessment of attention disorders, mental flexibility and various neuropsychological conditions. It is also widely used in research on ageing, dementia and other cognitive disorders.

Since the 1960s, the Stroop task has become an important tool in cognitive psychology to study the mechanisms underlying processes such as word production, word recognition, attention and executive control (Starreveld et al., 2017). The task requires participants to quickly identify the colour of words written in coloured ink, while these words often contain distracting and conflicting information. The Stroop task is a particularly valuable tool for studies of attentional processes and executive function. It provides information about how people direct their attention, what information they prioritise and how they choose between conflicting information.

As technology has developed, the Stroop task has been adapted to technology in a number of ways. Computerised Stroop tasks have made it possible to measure participants' reaction times and accuracy rates more accurately. In addition, new technologies such as mobile applications and virtual reality (VR) have made Stroop tasks more interactive and accessible.

The Stroop task can be administered in three different states: neutral, congruent and incongruent.

a. Congruent state: Situations where the meaning of the word and the colour of the ink are the same. For example, the word is green and the ink is green.

b. Incongruent case: Situations where the meaning of the word and the ink colour are different. For example, the word is red and it is written in blue.

c. Neutral case: The word has no colour name and can be written in any colour. For example, the word is house and is written in blue.

The Stroop task is often used in incongruent situations. Participants try to name the colour of the word, ignoring the meaning of the word. Participants tend to automatically process the meaning of the word, which delays the time it takes to correctly respond to the colour of the word. This leads to longer reaction times and an increased likelihood of making errors. In congruent situations, participants generally respond faster than in incongruent situations, and participants make fewer errors when responding to the colour of the word. Participants' performance in neutral conditions is usually between their performance in congruent and incongruent conditions. This means that participants' response times in neutral conditions are faster than in incongruent conditions and slower than in congruent conditions. They are less likely to make errors in incongruent situations and more likely to make errors in congruent situations (Berger et al., 2019, 1-2).

In this study, the Stroop task was applied to speakers of different Turkish dialects. Speakers of different Turkish dialects have different cognitive processes and this difference was measured using the Stroop task. Specifically, the study was designed to examine how the Stroop task works with colour words across Turkish dialects (Turkish, Turkmen and Kazakh). The aim of the study is to determine how the Stroop effect occurs between different dialects of Turkish and whether these effects differ. The study examined the effects of different dialects on the Stroop effect by administering the Stroop task to Kazakh and Turkmen participants learning Turkish. Turkmen was chosen because it belongs to the same dialect group as Turkish (Southwest group) and is a dialect close to Turkish in terms of phonology and morphology (Buran et al., 2014). Kazakh belongs to the Northwestern group of Turkish dialects. It was chosen because it is different from Turkish in terms of phonology and morphology (Buran & Alkaya, 2014). Dialects that are close to Turkish in terms of phonetics and grammar, and dialects that are different in these aspects were compared using the Stroop test. In this way, the differences between the thinking and attention skills of people speaking different dialects were revealed.

2. Literature Review

It has been found that the Stroop task offers a wide range of research in different disciplines and contexts. Five main research areas stand out in the studies on the Stroop task:

I. Studies Investigating the Classical Stroop Task Effect**: These studies focused on examining the effects on attention and cognitive control caused by the mismatch between word meaning and ink color in the Stroop task. These classic paradigms provided a starting point for understanding the basic mechanisms of the Stroop effect.

II. Studies Investigating Mood States**: The Stroop task has been used to assess individuals' emotional states and to understand the impact of emotional content on cognitive processing. These studies specifically examined the effects of psychological states such as stress, anxiety and depression on Stroop performance.

III. Studies Investigating the Impact of Cognitive Performance and Executive Function**: The Stroop task has been used as an effective tool to measure the performance of individuals' executive functions such as attention, memory, decision making and problem solving. These studies have made important contributions to understanding cognitive control processes and mental flexibility.

IV. Stroop Task Research in Healthcare**: The Stroop task has been widely used in the health field to investigate effects on neurological disorders, attention deficit hyperactivity disorder (ADHD), Alzheimer's disease, and other neurological conditions. These studies show how Stroop performance can be used as a tool in clinical assessments.

V. Stroop Task Research in Language Learning**: The Stroop task has been applied to understand how attention and cognitive control mechanisms operate in language learning processes. These studies have investigated how the Stroop effect affects learning performance and cognitive load, especially in second-language learning.

These five main research areas demonstrate the flexibility and functionality of the Stroop task in different contexts, making it a valuable tool in both theoretical and applied studies. In the studies examining the effect of the classic Stroop task, situations such as the semantic relationship between the colour stimulus and the words and the reaction time to the colour stimulus were investigated (MacLeod, 1991, Coltheart et al., 1999, Scarpina & Tagini, 2017).

Emotional states have been investigated using the Stroop task effect. It has been observed that the emotional Stroop task has been used in subjects such as the mechanism of the emotional Stroop task, the effect of emotional words on memory, the effect of emotional words on colour naming, the effect of emotional words on memory (Drobes et al., 2006, Frings et al., 2010, Gootjes et al., 2011, Fan et al., 2016, Kar et al., 2018, Filippi et al., 2017, Berger et al., 2019).

Studies investigating the effect of cognitive performance and executive function using the Stroop task effect have been identified (Bush et al., 1998), MacLeod & Macdonald, 2000, Leung et al., 2000, Norris et al., 2002, Raz et al., 2007, Song & Hakoda, 2015, Levinson et al. 2018, Nicosia & Balota, 2020, Periáñez et al. 2021).

Studies investigating the Stroop task in the area of health have been found in ageing, anxiety disorders, alcohol consumption, etc. (Houx et al., 1993, Becker et al. (2001), Dell'Acqua et al., 2007, Moritz et al., 2008, Azizian et al., 2010, Schoene et al., 2014, Spanakis et al., 2019).

Studies investigating the Stroop task in language learning were identified. As the topic of our study is language and the Stroop task, the studies on this topic were examined in detail. It was found that the Stroop task in language learning has been studied in different ways: There are studies investigating colour naming processes in bilinguals, measuring cognitive processes in bilinguals with the Stroop task, investigating the role of bilingualism in cognitive processes such as attention, memory and thinking, revealing the interaction of some languages with the Stroop task, investigating language processing under any intervention with the Stroop task, and measuring how language learning processes affect cognitive processes with the newly developed Stroop task.

Fang et al (1981) applied a Stroop colour naming task to bilingual Chinese-English, Spanish-English and Japanese-English speakers. Smith and Kirsner (1982) investigated whether Chinese reading and colour naming processes are similar to English reading and colour naming processes using a Stroop task. Mägiste (1984) investigated developmental changes in the language skills of bilingual German and Swedish secondary school students using the Stroop task. Chen and Ho (1986) used the Stroop task to test the language skills and cognitive control of bilingual Chinese and English students of different ages. Ingraham et al (1988) presented normative

data on the Stroop task applied to the Hebrew language. Tzelgov et al. (1990) used a Hebrew-Arabic bilingual Stroop task in two separate experiments. Lee et al. (1992) administered Stroop colour naming tasks to native Chinese, Malay and Tamil participants in their first and second languages, English. Lee and Chan (2000) investigated whether Chinese and English orthographies differentiate the Stroop effect. Roelofs and Hagoort (2002) assessed language use control with a Stroop task. Roelofs (2003) explained the use of a model called WEAVER++, which models language production, with Stroop effects. Sumiya and Healy (2004) used a Stroop task to investigate the interaction between Japanese and English speakers. Sutton et al. (2007) used a Stroop task to investigate how words with emotional content affect attention in bilingual Spanish and English speakers. Goldfarb and Tzelgov (2007) investigated the causes of the so-called WLSSE phenomenon. Sumiya and Healy (2008) administered a Stroop colour-word task consisting of stimuli in English and Japanese to bilinguals.
Costa et al. (2008) administered a Stroop task to fluent speakers of Spanish and Catalan in order to understand the process of lexical competition between different languages during language production. Coderre et al. (2008) analysed the Japanese writing systems kana and kanji using the Stroop effect. Kelly et al. (2010) measured the relationship between gesture and language using the Stroop test. Van Heuven et al. (2011) applied a Stroop task to participants who knew similar and different languages. Braet et al. (2011) measured the reading ability of second language learners using the Stroop task. Bayard et al. (2011) used the Stroop to measure participants' French proficiency. Tse and Altarriba (2012) examined the effects of bilinguals' first language (L1) and second language (L2) proficiency on their selective attention performance on a Stroop task. Naylor et al. (2012) studied the Stroop task in bilinguals. Singh and Mishra (2013) administered a modified Stroop task to bilingual participants to monitor their second language proficiency. Marian et al. (2013) applied a Stroop task to multilingual participants to understand inhibitory control in multilingual individuals. Brauer (2013) used the Stroop effect to investigate how language similarity and language proficiency work in bilinguals. Coderre et al. (2013) examined executive control skills and word retrieval speed in the Stroop performance of bilingual English and Chinese participants. Dudschig et al. (2014) used the Stroop task to suggest that there is converging evidence that the process of understanding our first language (L1) reactivates experiential sensorimotor traces in the brain. Heidlmayr et al. (2014) used the Stroop task to investigate the role of bilingualism in cognitive processes such as attention, memory and thinking. Suarez et al. (2014) investigated how second language ability (English) suppresses first language grammatical ability (Spanish) using a Stroop task. Geukes et al. (2015) established a relationship between colour words in German and newly learned words, and investigated how these words performed in the Stroop task. Aparicio et al. (2017) investigated the effect of language control expertise on two cognitive control processes using a Stroop task. Wang et al. (2016) investigated the sensitivity of English and Chinese as a second language speakers to the Stroop effect. Sabourin and Vīnerte (2020) developed a new Stroop task method to understand potential differences in language processing and cognitive control in bilingual groups of adolescents and adults. Chen and Zou (2021) conducted an experiment to understand how language is affected by interference based on the basic principles of the traditional Stroop effect. Hu et al (2021) aimed to investigate the effect of the Stroop effect on language.
The main purpose of this study is to investigate in detail how the Stroop effect works in different dialects of Turkish and to comprehensively reveal the effects of attention and cognitive control mechanisms on language diversity in this process. The study aimed to evaluate the effects of different dialects on cognitive processes by applying the Stroop task to participants who are learning Turkish and whose native language is Kazakh and Turkmen. In this context, this study, which examines the Stroop effect between dialects of Turkish such as Kazakh and Turkmen, clearly differs from other studies in the field of linguistics that address the Stroop paradigm.
The originality of the study lies in the fact that it offers an approach to understanding how language diversity shapes cognitive control processes and attention mechanisms. Revealing the effect of linguistic structures in different dialects of Turkish on responses to the Stroop task can provide important clues about language processing processes. At the same time, this study provides an innovative contribution to language teaching and cognitive language research by offering a new perspective on the need to take dialect differences into account in language learning and processing processes. Understanding the potential differences in language variety on the Stroop effect not only provides a theoretical perspective but can also shed light on the development of practical language learning strategies.

3. Method

The learning paradigm was adapted from the statistical learning procedure described by Breitenstein and Knecht (2002) and was designed to explore participants' learning mechanisms in more depth. In the learning phase, color words were written in Turkish and presented to the participants visually via a computer screen. Each color word was displayed on a different color background to provide a striking and contrasting appearance. Participants viewed each word for only 200 milliseconds, followed by a 50 millisecond break. After this short period, a new color word appeared on the screen.

During the learning phase, each color word was presented in two different categories: 25 color words whose ink and background colors matched, and 25 color words whose ink and background colors did not match. These categories were designed to assess the impact of color perception and word processing on cognitive processes. The trials were presented in a randomized order for each participant, adding variety to the learning process. When participants were unable to respond within the allotted time, instant feedback was provided by displaying "too slow" on the screen.

The learning phases were conducted in sessions, each consisting of 500 trials and lasting approximately 25 minutes. This long and attention-demanding process was planned to measure the participants' learning performance in more detail.

The same Stroop tasks were administered during the first and second day. However, the task was varied by using 5 different color sets on each day. Each trial was displayed on the screen for 200 milliseconds and participants were asked to select only the ink color, regardless of the meaning of the word. Participants were given a set amount of time to complete this task and all their responses were displayed on the screen as feedback. The feedback was labeled as "correct," "incorrect," or "very slow" so that participants had the chance to evaluate their performance instantaneously. These structured learning and testing processes aimed to create an effective working environment for participants' cognitive control and color perception.

3.1. The Participants

A total sample group of 20 native speakers of Kazakh and Turkmen was formed; each group consisted of 10 people. The participants were selected from individuals who had been in Turkish for between 3 and 6 months and had continued their Turkish language learning process during this period. The participants' level of Turkish grammar was determined as **intermediate level**, which they could easily understand in daily communication. This enabled the effective implementation of the Stroop task by providing the basic Turkish proficiency required for the study.

The participants, whose mother tongues were Kazakh and Turkmen, ranged in age from 19 to 28 years old, and equal numbers of women and men (5 women and 5 men) were selected for each group. This distribution ensured a balanced sample in terms of both age and gender and supported a more general validity of the results. In addition, participants were carefully selected from among individuals without color vision impairment. This selection criterion is critical as the Stroop task is based on visual color perception. Thus, any physiological limitations in color perception were prevented from affecting the study results. This careful selection process aimed to increase the reliability of the study and the validity of the results.

3.2. Experimental Design

The experiment was conducted on a computer running the Windows operating system and the stimuli were carefully designed to maximize participants' visual attention. The stimuli were presented on a 24-inch LCD monitor with a refresh rate of 120 Hz, positioned approximately 60 cm above eye level. The words were displayed on a gray background in a small **Times New Roman** font for high legibility, covering a viewing angle of approximately 3.5° horizontally and 1° vertically. This arrangement was specifically designed to both optimize the visibility of the words and increase the attention requirement. Participants' responses were recorded using a standard Windows keyboard and each keystroke was logged for data analysis.

Two separate experiments were conducted to achieve the objectives of the study and to examine the Stroop effect in different contexts. In the first experiment, Kazakh and Turkmen native speaker groups' responses to the Stroop task were measured and potential cognitive differences between these groups were analyzed. The

first experiment aimed to provide baseline data for understanding the interaction between language and cognitive control processes.

In the second experiment, the effects of factors such as learning intensity and control stimuli on the Stroop task were examined in detail. In this phase, participants were exposed to learning stimuli at different intensity levels, focusing on changes in cognitive control mechanisms. The second experiment aimed to explore in depth the role of learning processes and attentional control on the Stroop effect. This two-stage experimental approach provided a comprehensive data set to understand the effects of both language and learning intensity on cognitive processes.

3.2.1. Experiment 1: Administering the Stroop task to Kazakh and Turkmen participants

The first experiment was meticulously planned to assess how Kazakh and Turkmen participants processed Turkish color words using the Stroop paradigm. In this experiment, both groups of participants were taught Turkish color names and, following their learning process, we observed how they formed a cognitive association with these words. The Stroop effect was measured 24 hours after the completion of the learning phase to assess the participants' short-term cognitive processing capacity for the learned words.

The Stroop task included newly learned color words. During this task, participants were expected to ignore the written meaning of the word and identify only the ink color in which the word was written. This is a critical criterion for testing cognitive control and attentional mechanisms. Responses were recorded by pressing colored buttons that matched the ink color of the word. This method allowed for the measurement of visual and motor response processes.

Care was taken to ensure experimental balance between the two groups and participants were evenly assigned to the Stroop sessions. This approach made it possible to analyze the differences between the groups and to assess the overall validity of the Stroop effect in both groups.

In Experiment 1, data were collected over two days. On the first day, the Stroop task was administered after the participants were taught Turkish color names. On the second day, the retention of the information learned the previous day and its continuity on the Stroop effect were analyzed. This arrangement provided an important opportunity to understand the effects of the time difference between learning and testing on cognitive processing.

Table 1. shows the first and second Stroop task in Experiment 1.

one day	The five new colour words were red, green, purple, blue and yellow. Participants selected the option (button) that matched the colour of the new or Turkish word on the screen.
two day	Five new colour words were used: pink, orange, grey, brown and black. Similar to Stroop Task 1, participants selected the colour option (button) that matched the ink colour of the word on the screen.

3.2.2. Experiment 2: Stroop task with learning intensity and control stimuli

The main aim of the second experiment was to examine the details of the Stroop effect more thoroughly by adding neutral control stimuli to the Stroop blocks. This experiment aimed to investigate the potential effects of both reducing the learning intensity and adding control stimuli on the Stroop effect. In this context, participants were taught new words and their corresponding color terms through a statistical learning paradigm. Stroop effects were measured 24 hours after the completion of the learning phase, which was determined as a critical time interval for the assessment of learning retention and cognitive processing.

Neutral words were added to the Stroop task to further analyze attentional control and cognitive processes. These neutral words were used to test whether the Stroop task produced an interference or facilitation effect. The neutral stimuli served as a means to assess the participant's effect on the task of recognizing the ink color and responding quickly, as well as the level of attentional dissociation from the word meaning.

Both subgroups, i.e. Kazakh and Turkmen participants, were subjected to the same conditions throughout the experiment and their allocation to the Stroop sessions was counterbalanced. This minimized potential differences between the groups, resulting in more reliable and generalizable results.

During the Stroop tasks, participants were asked to respond by pressing a colored button that matched the ink color of the word displayed on the screen. This method allowed motor response speed and cognitive control

mechanisms to be assessed together. With the addition of neutral words, we observed how the Stroop effect changed in the context of interference or facilitation and analyzed the effects of these two factors on Stroop performance in detail. This experiment aimed to provide valuable insights into how the Stroop effect changes under different conditions.

Table 2. shows the first and second Stroop task in Experiment 2.

One Day	In Experiment 2, neutral words were added to the Stroop task in which red, green, purple, blue and yellow colours were used. Participants selected the colour option (button) that matched the ink colour of the words on the screen.
Two Day	In Experiment 2, neutral words were added to the Stroop task in which pink, orange, grey, brown and black colours were used on the second day. Participants selected the colour option (button) that matched the ink colour of the words on the screen.

3.2.3. Learning Phase

In order to evaluate the learning performance, the number of correct words of the Turkmen and Kazakh participants was determined. The number of colour words presented on the first and second day, Experiment 1 and Experiment 2, and the words used in the experiments are shown in the table below.

Table 3. shows the number of colour words presented on the first and second day in Experiments 1 and 2 and the words used in the experiments.

Day one colours			Second day colours		
	number of compatible stimuli	number of incongruent stimuli		number of compatible stimuli	number of incongruent stimuli
red	25	25	pink	25	25
green	25	25	orange	25	25
purple	25	25	grey	25	25
blue	25	25	brown	25	25
yellow	25	25	black	25	25

Number of Words Presented: Refers to the total number of color words taught and presented to participants each day and for each experiment.
Words Used: Includes sample color words used in the experiments and presented to the participants.
Number of Correct Words (Average): Indicates the average number of words answered correctly for each group.

4. Result

The results of Experiments 1 and 2 were analyzed in detail in terms of response times and performance levels. In both experiments, important data on participants' learning processes, attentional control mechanisms and cognitive processing speed were obtained. These results revealed comparative differences between the groups as well as the effects of Stroop tasks on participant performance after the learning phase. Detailed evaluation of the results was useful in understanding how response times varied across days and the effects of learning retention on performance. The findings of both experiments provide a better understanding of the interplay between cognitive processes and language learning and provide valuable insights into how the Stroop effect may differ with learning intensity and control stimuli.

4.1.Experiment

4.1.1. Response Time Analysis

Stroop mean reaction times of the first and second day were calculated. On both days and in both languages, responses to incongruent trials were slower than to congruent trials.

Table 4. shows the reaction times of the participants according to the results of Experiment 1.

participant type	compliant average response time	non-compliant mean reaction time
Turkmen	2.7	3.4
Kazakh	1.9	4

Participants' responses to incongruent stimuli were faster than to congruent stimuli. The Stroop effect is present in both languages, and for Turkmen participants, responses to incongruent words are slower than to congruent words. This suggests that Turkmen participants have longer reaction times in incongruent conditions and are more cognitively demanding. Kazakh participants had much more difficulty in incongruent conditions and their reaction times increased considerably. However, some participants' responses to incongruent stimuli were slower than to congruent stimuli. This suggests that individual differences may exist.

4.1.2. Performance Analysis

The table below shows the performance analysis of Turkmen and Kazakh participants according to the results of Experiment 1:

Table 5. Table 5, shows the performance results of the participants according to the results of Experiment 1.

	Turkmen participants		**Kazakh participants**	
	true	false	true	false
mean	33.5	14.5	26.1	21.9
standard deviation	11.8	11.6	12.1	12.2
minimum	10	3	6	1
maxsimum	45	38	47	42

Turkmen respondents, who gave 33.5 correct answers on average, gave 7.4 more correct answers than Kazakh respondents. The distribution of correct answers of Kazakh participants is in a wider range than that of Turkmen participants. Turkmen participants, with an average of 14.5 incorrect answers, have a lower rate of incorrect answers than Kazakh participants (21.9). The distribution of incorrect answers of Kazakh participants is in a wider range than that of Turkmen participants. Turkmen participants generally performed better, with a higher proportion of correct answers and a lower proportion of incorrect answers.

4.2. Experiment 2

4.2.1. Response Time Analysis

Stroop mean reaction times of the first and second day were calculated. On both days and across participants in both groups, responses to incongruent trials were slower than to congruent trials.

Table 6. shows the reaction times of the participants according to the results of Experiment 2.

participant type	**compliant average response time**	**non-compliant mean reaction time**
Turkmen	3.2	4.2
Kazakh	3.5	4.5

According to the reaction time analysis, the Kazakh participants' reactions to new words were slower than those of the Turkmen participants. The participants' responses to congruent stimuli were faster than to incongruent stimuli. In conclusion, the Stroop effect is present in both languages, and Turkmen and Kazakh participants' responses to incongruent words are slower than to congruent words.

The fact that incongruent response times were longer than congruent response times in both groups shows the classic interference effect of the Stroop task. However, the fact that both the congruent and incongruent response times of the Turkmen group were shorter than those of the Kazakh group suggests that the reduction in study intensity and the addition of control stimuli shortened the participants' response times and they responded faster in the task.

4.2.2. Performance Analysis

The performance of Turkmen and Kazakh participants in the second experiment is as follows:

Table 7. shows the performance results of the participants according to the results of Experiment 2.

	Turkmen participants		**Kazakh participants**	
	true	false	true	false
mean	30.8	16	26.5	21.5
standard deviation	7.6	7.12	9.4	9.4
minimum	23	5	15	3
maxsimum	43	25	45	33

The fact that the mean correct answer of the Turkmen group was higher than the Kazakh group shows that the participants in the Turkmen group were more successful in the Stroop task. Reducing the learning intensity and adding control stimuli increased the rate of correct answers.

These analyses support the conclusion that the strategies of reducing learning intensity and adding control stimuli improve performance on the Stroop task and reduce the interference effect.

5.Discussion

In Experiment 1, the reaction times of Turkmen and Kazakh participants to the Stroop task were analyzed under compatible and incompatible conditions. The findings show that there are remarkable cognitive differences between the two groups. Turkmen participants responded faster in compatible conditions and demonstrated fluency in cognitive processing processes. However, it was observed that their reaction times were significantly prolonged in incompatible conditions. This indicates that incompatible conditions increase cognitive load and challenge the participants' attention control mechanisms. Turkmen participants were observed to generally exhibit consistent performance in compatible and incompatible conditions and to have higher correct response rates. This shows that Turkmen participants are more effective in cognitive control processes and can process the Stroop effect faster.

On the other hand, Kazakh participants showed longer reaction times in incompatible conditions. This reveals that they have difficulty reaching correct conclusions, especially in incompatible conditions. This prolongation in reaction times indicates that the effect of cognitive load is more pronounced on Kazakh participants. In addition, the fact that correct response rates are lower than Turkmen participants suggests that linguistic differences in this group may negatively affect cognitive control mechanisms. The variability observed in the reaction times of the Kazakh participants suggests that individual differences in the learning process are more pronounced.

In general, the results of Experiment 1 showed that the Turkmen participants performed with higher accuracy rates and shorter reaction times on the Stroop tasks. This consistency indicates that the linguistic similarities between Turkmen and Turkish increased the participants' cognitive processing speed and accuracy. The Kazakh participants, on the other hand, had more irregularities in their reaction times and accuracy rates. This provides evidence that the linguistic differences between Kazakh and Turkish make cognitive control processes more difficult.

In Experiment 2, strategies such as reducing the learning intensity and adding control stimuli were included in the Stroop task. Although slower reaction times were observed in the incompatible conditions for the Turkmen participants, the correct response rates were higher. These findings indicate that the control stimuli and the strategies of reducing the learning intensity worked effectively on the Turkmen participants. The fact that the Turkmen participants performed consistently even in the incompatible conditions suggests that linguistic similarities increased the effectiveness of the learning strategies.

Table 8. General Evaluation Table of Stroop Task Performance of Turkmen and Kazakh Participants

Criteria	Turkmen Participants	Kazakh Participants
response time (compatible condition)	short	middle
response time (incompatible condition)	middle	low
correct answer rate (compatible condition)	high	middle
correct answer rate (incompatible condition)	high	low
response time consistency	consistent	variable
the effect of linguistic similarity	positive	weak
impact of learning strategies	effective	partially effective

Kazakh participants showed slower reaction times and lower correct response rates in incompatible conditions. However, although reaction times were faster than Turkmen participants in compatible conditions, the imbalance between correct and incorrect answers suggests that strategies of reducing learning intensity and adding control stimuli were not as effective as expected for Kazakh participants. This suggests that Kazakh participants' cognitive control mechanisms were more challenged by linguistic differences than Turkmen participants.

Linguistic similarities between Turkmen and Turkish allowed Turkmen participants to complete Stroop tasks faster and more effectively. Linguistic proximity accelerated word recognition processes and allowed them to have less difficulty in cognitive transitions between compatible/incompatible conditions. On the other hand, linguistic differences between Kazakh and Turkish led to longer reaction times and a greater tendency to make errors in Stroop tasks for Kazakh participants. This shows how linguistic and structural differences can be decisive in cognitive control processes.

The results of the experiments revealed significant differences in cognitive control and learning processes between Turkmen and Kazakh participants. Turkmen participants performed more consistently and effectively by taking advantage of linguistic similarities, while Kazakh participants had to struggle with the difficulties created by linguistic differences. These findings provide an important framework for understanding the effects of language and culture on cognitive tasks. Future studies could assess the generalizability of these findings by examining a larger group of participants and could further explore the role of different linguistic backgrounds on the Stroop effect.

6.Future Studies

Overall, these findings suggest that there are significant differences in the cognitive processes of Turkmen and Kazakh participants, and these differences are particularly evident in their responses to congruent and

incongruent situations. The results of the study highlight the potential benefits of adding control stimuli to the Stroop task and similar cognitive tasks, as well as effectively managing learning intensity. These findings provide important clues for developing strategic approaches to optimize cognitive control processes.

Future studies can evaluate the generalizability of the results obtained from a broader perspective by investigating the effects of these strategies on populations with different cultural and linguistic backgrounds. Furthermore, a detailed examination of the effects of different types of control stimuli and various levels of study intensity may allow for more effective and adaptable design of cognitive tasks.

Studies conducted on a larger and more culturally diverse group of participants may help us better understand the impact of cultural and linguistic factors on cognitive control processes. Such studies will provide an opportunity to go beyond Turkmen and Kazakh participants and evaluate

the effects of cultural and linguistic diversity on cognitive processes in a broader context by including groups speaking other dialects and languages.

Furthermore, testing different levels of cognitive load and investigating how these loads affect the effectiveness of strategies such as reducing learning intensity and adding control stimuli may provide a deeper understanding of cognitive control mechanisms. Future research may further investigate the cognitive and neurological mechanisms underlying dialectical differences, which may allow us to better understand the functioning of attentional and cognitive control processes across cultural and linguistic contexts. Such research will make significant contributions to both theoretical and applied fields, enabling the development of innovative approaches to the design of language learning and cognitive tasks.

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Etik, Beyan ve Açıklamalar

1. Etik Kurul izni ile ilgili;

☑. Bu çalışmanın yazar/yazarları Fırat Üniversitesi Sosyal ve Beşeri Bilimler Araştırmaları Etik Kurulu'nun tarih 17.07.2024 sayı 25773 ve karar 20 ile etik kurul izin belgesi almış olduklarını beyan etmektedir.

2. Bu çalışmanın yazar/yazarları, araştırma ve yayın etiği ilkelerine uyduklarını kabul etmektedir.

3. Bu çalışmanın yazar/yazarları kullanmış oldukları resim, şekil, fotoğraf ve benzeri belgelerin kullanımında tüm sorumlulukları kabul etmektedir.

4. Bu çalışmanın benzerlik raporu bulunmaktadır.