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ORIGINAL ARTICLE

Does the Stroop effect decrease with imagery?

Stroop etkisi imgeleme ile azalır mı?

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ABSTRACT

Background/Aims: The present study examines the impact of imagery on the Stroop effect, which is a measure of interference effects on attention.
Methods: The Stroop task requires participants to identify the color of a word while disregarding its meaning. The study group consisted of 40 participants undergoing 14 weeks of imagery sessions, each lasting 90 minutes. The data were analyzed using the Statistical Package for Social Sciences, version 25.0 software. Statistical tests, including the Mann-Whitney U Test and the Wilcoxon Signed Rank Test, were also employed to compare the pre-test and post-test results.
Results: The results indicate that imagery has a beneficial impact on reducing the Stroop effect.
Conclusion: The findings suggest that imagery has a positive effect on reducing the Stroop effect. The results indicate a notable impact on the Stroop effect, assessing the influence of imagery on attention and cognitive interference. Nevertheless, further research is recommended to validate these results.

Keywords: Attention, imagery, Stroop effect, Stroop test

ÖZ

Arka Plan/Amaçlar: Bu çalışma, imgelemenin dikkat üzerindeki girişim etkilerinin bir ölçüsü olan Stroop etkisi üzerindeki etkisini incelemektedir.
Metodoloji: Stroop görevi, katılımcıların bir kelimenin anlamını göz ardı ederken rengini tanımlamalarını gerektirir. Çalışma grubu, her biri 90 dakika süren 14 haftalık imgeleme seanslarına tabi tutulan 40 katılımcıdan oluşmuştur. Veriler SPSS 25 yazılımı kullanılarak analiz edilmiş ve ön test ve son test sonuçlarını karşılaştırmak için Mann-Whitney U Testi ve Wilcoxon İşaretli Sıra Testi gibi istatistiksel testler kullanılmıştır.
Bulgular: Sonuçlar, imgelemenin Stroop etkisini azaltmada faydalı bir etkiye sahip olduğunu göstermektedir.
Sonuç: Bulgular, imgelemenin Stroop etkisini azaltmada olumlu bir etkiye sahip olduğunu göstermektedir. Sonuçlar, imgelemenin dikkat ve bilişsel müdahale üzerindeki etkisini değerlendiren Stroop etkisi üzerinde kayda değer bir etkiye işaret etmektedir. Bununla birlikte, bu sonuçları doğrulamak için daha fazla araştırma yapılması önerilmektedir.

Anahtar Kelimeler: Dikkat, imgeleme, Stroop Etkisi, Stroop Testi

Introduction

The Stroop paradigm is a widely used test to assess attentional bias (1). Although similar to the traditional Stroop task, the emotional Stroop paradigm uses words with emotional content (2). When a person tries to name the color of an incongruently spelled color word, the response time (RT) is prolonged due to the distraction of emotional words (3). This can be explained by the person's attention being diverted towards disorder-related or personal issues. The Stroop effect is generally weaker compared to the effects in the traditional Stroop task. This test is a tool used to elicit and examine attentional biases in individuals with mental disorders (4).

A fundamental feature of the human cognitive system is the ability to attend to and utilize goal-directed stimuli while ignoring environmental distractions (5). The Stroop task provides a means of assessing selective attention (6). This task requires participants to name the displayed color of words presented while ignoring the meaning of the words (7). In the field of psychology, the

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Stroop effect refers to the observed delay in reaction time between stimuli (8). that are congruent and those that are incongruent (9). The Stroop effect has been employed in the construction of psychological tests, most notably the Stroop test (10). A fundamental example of this phenomenon can be observed when there is a discrepancy between the designation of a color (e.g. "blue," "green," or "red") and the color in which it is presented (such as the word "red" printed in blue ink instead of red ink). When respondents are asked to identify the color of a word, they tend to require a longer RT and are more prone to error when the color of the ink does not correspond to the name of the color (11). The Stroop task provides evidence for the automaticity of reading (12). The fastest responses are observed in congruent trials, where the meaning of the presented word is congruent with its displayed color (e.g. "RED" shown in red), followed by neutral trials, where the meaning of the given words is unrelated to the colors (e.g., "LOT" shown in red) (13). The slowest RTs are observed on incongruent trials, wherein the color displayed and the meaning of the words are incongruent (e.g. red shown in blue). The efficacy of the task can be evaluated by calculating the differences in RTs between the aforementioned imagery-applied flood conditions (7). The Stroop effect is sufficiently pronounced to capture attention, and a considerable number of individuals report experiencing cognitive dissonance during an incongruent trial (14). The Stroop effect persists despite prolonged training and is resistant to conscious strategies employed in imagery (1). The methods that result in reduced Stroop effects all entail the manipulation of the stimulus context (e.g., the coloring of a single letter instead of all letters or the reduction of the response-stimulus interval) to provide external support for imagery mechanisms. Consequently, these methods are unlikely to be the result of deliberate, top-down imagery. Financial incentives, provided to enhance motivation and performance, are unlikely to influence reaction times, except perhaps to accelerate them across all trial types, or to reduce the Stroop effect to a minimal extent (15).

Cognitive processes are typically classified as automatic. Automatic processes are either involuntary at birth or become so through extensive practice. It is proposed that some processes are innate and automatic, whereas others become automatic through practice. To illustrate, reading words is a pseudo-automatic process for proficient readers. Consequently, the Stroop effect is regarded as the "gold standard" of automatized performance (16). The act of reading words is regarded as an automatic process. Although explicit instructions are provided for competent readers to focus on the color in which words are printed, the tendency to access the meaning of the word remains.

Imagery is a state of consciousness that involves focused attention (selective attention/selective inattention hypothesis) (17), reduced environmental awareness, and an enhanced capacity to respond to suggestions (18). While it is widely acknowledged that imagery can influence cognitive processes, the precise extent to which imaginative suggestions contribute to this phenomenon remains a topic of contention (19). There is a plethora of theories about the nature of imagery. Imagery is regarded as an altered state of mind, characterized by a distinct level of awareness that differs from the typical state of consciousness (20). Imagery may also be conceptualized as a placebo effect (21), a redefinition of the therapeutic interaction (22), or a form of imaginary role-playing (23). It is posited that during the process of imagery, an individual's focus and concentration are enhanced, and their responsiveness to suggestion is optimized (24). Imagery commences with a hypnotic induction, which encompasses a series of preliminary instructions and suggestions. The application of imagery for therapeutic purposes is referred to as "hypnotherapy." The extant research evidence indicates that hypnotizing a person can facilitate the formation of false memories and that the use of imagery does not enhance the accuracy of memory recall (25).

The majority of imagery theories concur that responding to a hypnotic suggestion entails top-down cognitive imagery processes and that the sensation of involuntariness, which is the hallmark of the hypnotic phenomenon is exclusively attributable to impaired or relinquished metacognition (26). The most straightforward imagery theory is cold imagery, which makes few assumptions and regards reduced metacognition as the fundamental process underlying the hypnotic response. In particular, this theory suggests that hypnotic responding is achieved through the use of deliberate imagery. Subjects deliberately engage in perceptual or cognitive strategies to create the imagery applied to the imagery described in the suggestion, while simultaneously altering the monitoring of their intentions and convincing themselves that they are not acting intentionally

(27). The theory is based on higher-order theories of thought consciousness, which posit that a mental state becomes conscious as a result of being referred to by a higher state (28). Under the tenets of cold imagery, responding to a suggestion entails the deployment of a strategy to generate the imagery delineated in the suggestion, without the subject being aware of the strategic nature of their actions. This assumption leads to the conclusion that the only distinction between a hypnotic and a non-hypnotic response is the form of the accompanying second-order state. It can thus be inferred that if the Stroop interference effect can be reduced by responding to the suggestion of blindness, it should also be possible to do so through a voluntary non-hypnotic strategy that employs the same approach as that used in response to the suggestion. Identifying such a strategy is pivotal to imagery theory and straightforward, metacognitive explanations of imagery. This is because the absence of a clear explanation involving intentional actions invites more complex theories to address the issue of blindness suggestion (29).

Bressler and Rossman (30) were other pioneers of the imagery method, and their work contributed to the widespread use of the method in psychological treatments by defining how it should be used. It is typically employed as a supplementary approach. In a study conducted by Campbell-Gillies (31), positive mental imagery was employed in conjunction with music for individuals diagnosed with breast cancer. The findings indicated that participants exhibited a reduction in stress, anxiety, and depressive symptoms during their chemotherapy treatment, which spanned six sessions. In this study, we tried to determine whether imagery can reduce Stroop interference. The Stroop effect can be significantly reduced or eliminated in certain contexts (12). Research has shown that responses obtained during imagery can occur after imagery (22, 32, 33). If the Stroop effect can be modulated simply without initiating imagery, it may have broader effects than previously believed. To date, no experimental study on the Stroop effect of imagery has been conducted in Turkey. Accordingly, the present study sought to ascertain whether the use of imagery affects adversely the Stroop effect.

The hypotheses of the present study are organized as follows;

H1: The use of imagery has a significant effect on the Stroop effect.

H2: There is no significant effect on the Stroop effect between the experimental group using imagery and the control group not using imagery.

Materials and Method

This study was designed in a quasi-experimental design to examine the effect of imagery on the Stroop effect. Experimental and control groups were formed from homogeneous groups (34). The main purpose is to test the cause-and-effect relationships between the independent variable and the dependent variable (35).

Participants

The study group of this research was formed in the 2022-2023 academic year in Beyoglu, in the province of Istanbul. Forty participants were admitted to a private health center in the district; therefore, a total of 40 participants were included in the study, 20 in the imagery group and 20 in the non-imagery group. Three participants in each group were included in the study as a backup in case of data loss. In quasi-experimental studies, the sample size can be as low as 15 subjects (36). The research was conducted in the psychology room of a private health center. The research was conducted by obtaining the necessary permissions from the health center. In addition, the study group was informed about the purpose of the research and the process by using the Voluntary Consent Form and permission was obtained for the study group to participate in the research voluntarily. The study group was conducted at different times so that the experimental and control groups were not affected by each other's performances.

Fig 1

Ethics

Written informed consent was signed by all participants before data collection. The study was approved by the Ethics Committee of Istanbul Gelisim University with the number (2023-08-57) and was conducted under the 1961 Declaration of Helsinki and its later amendments.

Inclusion and Exclusion Criteria

Individuals who met any of the following criteria were excluded from participation in the study: (a) individuals with disabilities who required special accommodations, (b) individuals with a lifetime history of organic mental disorder, psychotic disorder, bipolar disorder, or substance abuse, and (c) individuals with severe axis II psychopathology, as defined by the

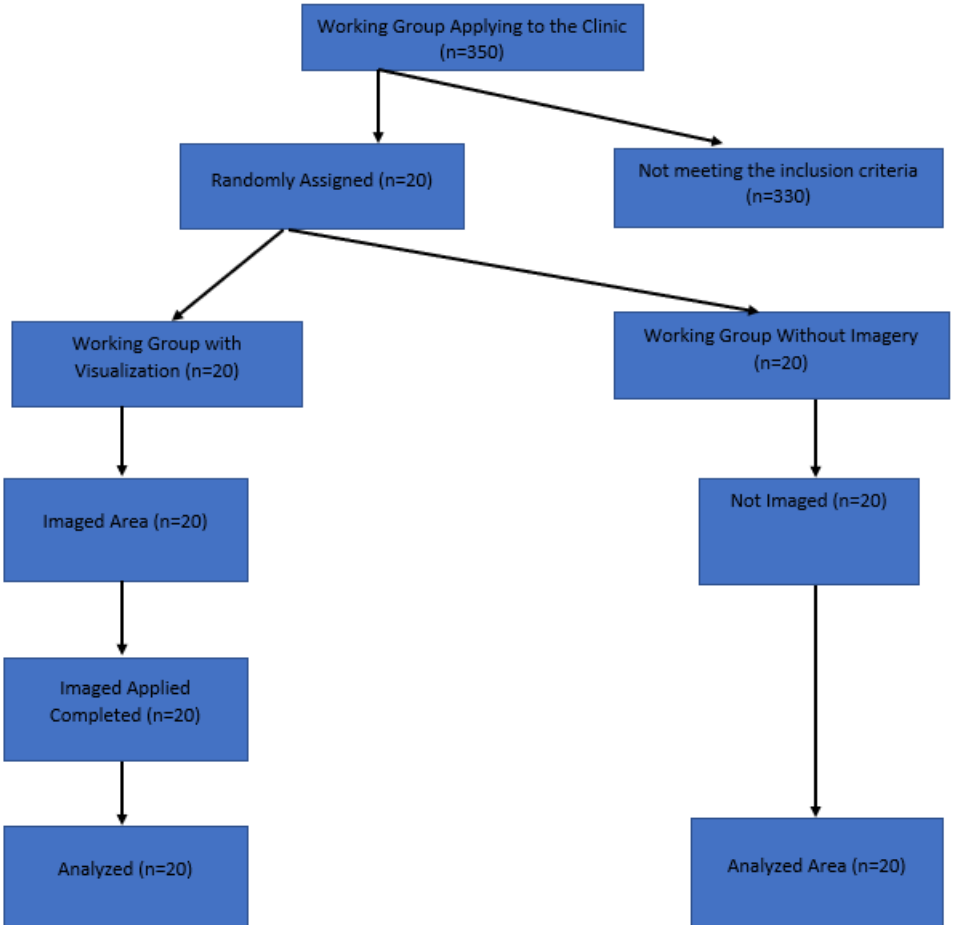

Figure 1. Flow Chart of the Study Group

Diagnostic and Statistical Manual of Mental Disorders, 5th Edition, Text Revision (DSM-IV-TR), including cluster personality disorders, antisocial personality disorder, non-voluntary individuals, and borderline personality disorder.

Data Collection Tools and Techniques

The Personal Information Form (PIF)

In the study, eight questions were prepared in the Personal Information Form developed to determine the sociodemographic information of the study group. The form included demographic information such as gender, age, income, education level, and whether the study group had a psychiatric diagnosis.

The Stroop Test

There are many single Stroop Tests in the literature (37). In the Stroop Test, it is asked to say color names printed using a color different from the color. There is a Turkish form called BILNOT Battery (38). The original Stroop Test consists of the Victoria Form. In this form, the Stroop Test TBAG (Scientific and Technical Research Council of Turkey) Form consists of four white cards with a size of 14.0 x 21.5 cm and each card has 6 lines of 4 items arranged on it. These cards are the "stimulus" items of the test and the reactions that the subject should give to these stimuli, i.e. the "tasks" that the subject should fulfill, constitute the sections of the test. The basic scores of the test are scored separately for these sections (38).

The TBAG Form of the Stroop Test includes the colors blue, green, red, and yellow, and the names of these colors used in the Victoria Form as follows: Card 1 has color names printed in black on a white background, showing a feature of the original Stroop Test; the card has color names printed in different colors, but the color used to print each word is different from the color that the word expresses, i.e. the word "red" is printed in "yellow" and is the main stimulus, and the most critical part of all Stroop tests. The control of reading speed and color utterance is done for control purposes. Even so, card 3 is printed in different colors,

0.4 cm in diameter, and is taken from the Victoria Form; in the original Stroop Test, these stimuli are presented as squares. Card 4 contains neutral words printed in different colors (the words "as much, weak, if, medium") and is available in the Victoria Form (38).

The four stimulus cards and related tasks in the TBAG Form of the Stroop Test include all of the cards and tasks leading to the three factors obtained for the Stroop Effect in Jensen's (39) study. In the study (39), where completion time scores were used, Factor 1, color naming, required a card with colored circles (card 3 in the present study) and a card with color names written in white on a black background (card 1 in the present study); Factor 2, interference effect, required a card with color names (card 2 in the present study) and a card with colored circles (the card 3); and finally, Factor 3, speed, required a card with color names written in white (card 1 in the present study). Three types of scores were calculated from each of the four cards in the Stroop Test TBAG Form. These were the time elapsed from the time the subject was given the "Go" command until the last item of the card was read/spoken, the number of errors, and the number of corrected responses. The duration and error scores were also found in previous Stroop tests. The number of correction scores was used for the first time in the Stroop Test TBAG Form.

There are two critical sections in the Stroop test. This section is Section 5, where the 2nd card colors are said. The other sections are control sections in which the basic levels of reading and color naming are determined. Card 1, with color names printed in black, shows the basic level of reading speed; Card 3, with colored shapes, and Card 4, with neutral words printed in color, show the basic level of color naming speed (38).

Practising Imagery

The study group received 14 weekly sessions of 90 minutes each. The imagery method involves the use of imagination for therapeutic purposes to reduce stress in people. Mental images are stimulated by a therapist to visualize the images in the mind (40). The imagery method works by using the special connection between the nervous system and the visual cortex and has similar features to the imagery method. The client is made to focus on whatever the symptom is. Thus, the unconscious mind uses that imagery to allow the mind to replace negative things with more positive thoughts. In the research, imagery was used for the symptoms of the participants and it was replaced with a more positive situation with the power of the mind (41). Sessions with each participant were conducted at different times. No participant was negatively affected by the imagery method. Some participants wanted the sessions to be used for different problems. These participants were referred to a different specialist.

The flow chart of the application is shown below.

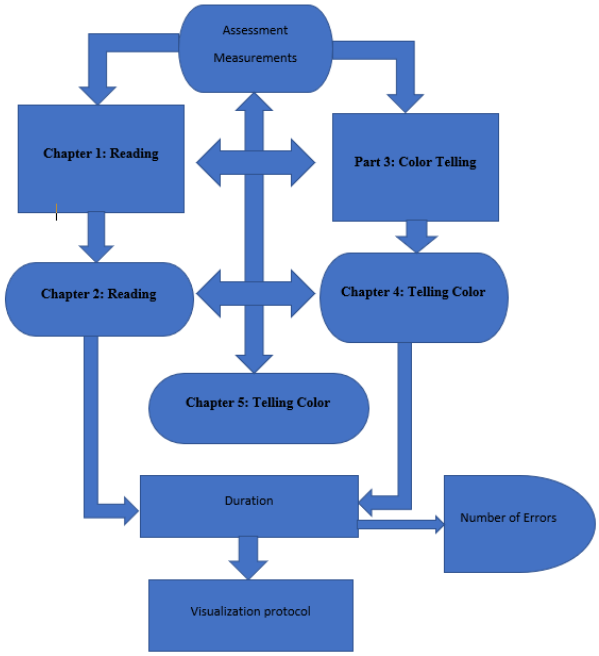

Figure 2. Imagery and the Stroop Flowchart

Data Analysis

In the data analysis phase of the study, to decide which tests were appropriate, the values obtained from the pre-test applications were examined whether they met the parametric or nonparametric basic assumptions, and it was concluded that the data were not a homogeneous and normally distributed group. In line with the data obtained from the homogeneity and normality tests, it was decided that nonparametric tests could be used in the study, aiming to examine the effect of imagery on the Stroop effect. In the study, there are two groups: Experimental and control groups. In terms of measurements, there are intra-group, inter-individual, and intra-individual measurements. The Mann-Whitney U Test was used to determine the difference between the pre-test and post-test of the groups, and the Wilcoxon Signed Rank Test was used to evaluate the pre-test and post-test differences between the groups. The data were analyzed on the computer using SPSS 25.

Results

Table 1. Mann Whitney U Test and results of the analysis of the Stroop Test scores of the pretest imagery applied and imagery not applied groups

Table 1. Mann Whitney U Test and results of the analysis of the Stroop Test scores of the pretest imagery applied and imagery not applied groups

Variables	Groups	n	Mean Rank	Sum of Ranks	U	P
Section 1: Reading	**Imagery Applied**	20	20,80	416,00		
	Imagery Not Applied	20	20,20	404,00	194,000	,865
	Total	40				
Section 2: Reading	**Imagery Applied**	20	20,83	416,50		
	Imagery Not Applied	20	20,18	403,50	193,500	,854
	Total	40				
Section 3: Colour Telling	**Imagery Applied**	20	20,43	408,50		
	Imagery Not Applied	20	20,58	411,50	198,500	,965
	Total	40				
Section 4: Colour Telling	**Imagery Applied**	20	21,43	428,50		
	Imagery Not Applied	20	19,58	391,50	181,500	,608
	Total	40				
Section 5: Colour Telling	**Imagery Applied**	20	19,88	397,50		
	Imagery Not Applied	20	21,13	422,50	187,500	,724
	Total	40				
Duration	**Imagery Applied**	20	22,43	448,50		
	Imagery Not Applied	20	18,58	371,50	161,500	,271
	Total	40				
Number of Errors	**Imagery Applied**	20	20,75	415,00		
	Imagery Not Applied	20	20,25	405,00	195,000	,885
	Total	40				

As seen in Table 1, the pretest Stroop of the study group in the Imagery Applied and Non-Imagery Applied group; Part 1: Reading, Section 2: Reading, Part 3: Saying Color, Part 4: Saying Color, Section 5: Color Saying, Duration and Number of Errors, no statistically significant difference was found between the scores, supporting the hypothesis of the study (p.0.05). This can be accepted as an indication that there was no difference between the groups in terms of Stroop scores before the imagery study. This finding will show the change in the effect in the imagery group according to the starting point for each section

The results of the analysis show that the study group participating in the research was able to measure the Stroop effect of imagery in Chapter 1: Reading, Part 3: Color Singing, Part 4: There was no significant difference (p>.0.05) between the scores before and after Color Singing, Part 2: Reading, Section 5: Color Singing Duration and Number of Errors before and after scores show that there is a significant difference (p<.0.05). Significant effect in Stroop test 2: Reading, Chapter 5: Reading, Section 5: Color Saying Duration and Number of Errors, and these variables show a significant decrease. In this context, the hypothesis of the study was supported by finding a statistically significant difference in the Stroop scores of the study group in favor of the post-test. This finding indicates that the imagery study influenced reducing the Stroop effect.

Discussion

The general aim of this study is to investigate the effect of imagery on the Stroop effect. For this purpose, 20 participants in the imagery group and 20 participants without imagery were included in the study. In the

Table 2. Wilcoxon Matched Pairs Signed Test analysis results of pretest-posttest experimental and control groups of the Stroop Test Data

Groups			N	Mean rank	Sum of ranks	z	p
Imagery Applied	Section 1: Reading	Negative ranks	11	5,74	165,50	1,507	932
		Positive ranks	8	5,50	155,50		
		Ties	1				
		Total	20				
	Section 2: Reading	Negative ranks	14	5,00	15,00	-2,926[c]	011
		Positive ranks	4	9,86	138,00		
		Ties	2				
		Total	20				
	Section 3: Colour Telling	Negative ranks	12	10,00	190,00	1,099	344
		Positive ranks	7	,00	,00		
		Ties	1[i]				
		Total	20				
	Section 4: Colour Telling	Negative ranks	12[j]	9,25	196,50	1,099	090
		Positive ranks	8	10,75	193,50		
		Ties	0[l]				
		Total	20				
	Section 5: Colour Telling	Negative ranks	16	8,50	25,50	2,001	001
		Positive ranks	4[n]	9,11	127,50		
		Ties	0				
		Total	20				
	Duration	Negative ranks	19	,00	,00	1,232	003
		Positive ranks	1	10,50	210,00		
		Ties	0				
		Total	20				
	Number of Errors	Negative ranks	17	2,79	54,50	1,566	034
		Positive ranks	3	4,70	73,50		
		Ties	0				
		Total	20				
Imagery Not Applied	Section 1: Reading	Negative ranks	11	11,38	182,00	2,11	877
		Positive ranks	9	12,67	188,00		
		Ties	0				
		Total	20				
	Section 2: Reading	Negative ranks	10	7,33	122,00	2,455	766
		Positive ranks	10	9,93	149,00		
		Ties	0				
		Total	20				
	Section 3: Colour Telling	Negative ranks	9	9,50	171,00	1,122	433
		Positive ranks	11	9,00	,00		
		Ties	0[i]				
		Total	20				
	Section 4: Colour Telling	Negative ranks	3[j]	6,67	20,00	1,999	122
		Positive ranks	15[k]	10,07	151,00		
		Ties	2[l]				
		Total	20				
	Section 5: Colour Telling	Negative ranks	8[m]	9,44	75,50	2,444	666
		Positive ranks	10[n]	9,55	95,50		
		Ties	2[o]				
		Total	20				
	Duration	Negative ranks	1[p]	4,50	4,50	1,339	322
		Positive ranks	18[q]	10,31	185,50		
		Ties	1[r]				
		Total	20				
	Number of Errors	Negative ranks	6[s]	5,75	34,50	1,555	090
		Positive ranks	4[t]	5,13	20,50		
		Ties	10[u]				
		Total	20				

study, the groups were compared with one another both before and after the application. The data obtained from the study indicated that imagery was an effective method for reducing the Stroop effect. In other words, the Stroop effect was found to be reduced by the use of imagery. In this context, it is evident that the use of imagery can effectively reduce and even eliminate the need for Stroop intervention (16). This indicates that cognitive processes that have become automatized through practice can be removed from automaticity and brought under conscious control. This finding shifts the focus of research on the effect of imagery on the Stroop effect from the field of altered consciousness to the field of cognitive neuroscience.

One of the few exceptions to the robustness of the Stroop effect is that it can be achieved by word blindness after hypnotic suggestion (18). The suggestion of word blindness, defined as the ability to see words as nonsense or meaningless characters during a Stroop task, was given to highly hypnotizable subjects. The results demonstrated a significant reduction in the Stroop effect compared to standard, unimagined subjects (42). The Stroop effect refers to the finding that, in comparison to a baseline condition, participants required a longer RT to indicate the font color in which a word was presented when the color of the word was incongruent with the font color. Raz, Shapiro, Fan, and Posner (43) demonstrated that the Stroop effect was markedly diminished when subjects were led to perceive words as meaningless. Moreover, electroencephalogram (EEG) data recorded during the Stroop task demonstrated a notable increase in frontal theta and frontal beta power among participants who were influenced by post-imagery suggestion (44). These findings indicate that post-imagery suggestions are effective methods for eliciting top-down processes (45). The EEG findings may be interpreted as evidence that this is due to the provision of additional cognitive control (46).

Concerning the characteristics of individuals who are predisposed to imagery, Casiglia et al. (47) observed a reduction in the hemodynamic response and the Stroop effect during hypnotic suggestion. The hemodynamic response is defined as the cardiological response of the circulatory system to external stimuli perceived as stressors. The dominant response is more pronounced when the word is read in a context that is perceived as stressful. In contrast, the impact of word blindness on the facilitatory component of the Stroop effect (neutral RT minus congruent RT) appears to be more nuanced. (29). The question of whether it is possible to regain in individuals with imagery is rarely posed, yet it has been observed that this process can reduce or even eliminate the Stroop intervention in highly imagery-prone individuals. In conclusion, the Stroop effect is markedly diminished in individuals who engage in imagery.

Some studies have used hypnosis to influence the Stroop effect (48). Two main approaches are used in these studies. The first is to apply a period of hypnosis with post-hypnotic instruction. However, these strategies have been found to have little effect on Stroop interference. The other approach is to tell hypnotized participants that a language with meaningless words is used during hypnosis. This approach reduces the Stroop effect post-hypnotically, but the effect is still present. It should be noted that the post-hypnotic sessions are the second session and the order of testing is shuffled. It was observed that Stroop task performance increased after hypnosis and post-hypnotic anxiety levels decreased (49). It is thought that participants with decreased anxiety levels can use inhibition strategies more easily (50). In the experiments conducted under different conditions, no interaction of hypnosis on the Stroop task was found (48).

Post-hypnotic suggestions designed to impede access to word meaning demonstrated consistent and persistent effects on cognitive control processes engaged during the Stroop task (51). The impact of post-hypnotic suggestions was most pronounced in the significantly shorter reaction times observed on incongruent trials relative to the non-hypnotic condition. However, reaction times remained unaltered on neutral trials. This may be attributed to the elimination of interference between word meaning and color naming, either through the prevention of automatic word activation during reading or the enhancement of conflict resolution processes (29). The specific location of the effects of post-imagery suggestions on information processing remains a topic for future research.

Several studies on the Stroop effect have yielded insights into the neural processes underlying this phenomenon (24). The available evidence indicates that the Stroop effect is associated with forebrain regions (52). However, no consensus regarding the specific brain hemisphere is affected. However, given that attention function is a task of the forebrain (53), it can be postulated that imagery reduces the Stroop effect by affecting cognitive skills (54). In light of these

findings, it can be posited that the impact of imagery on Stroop is a natural phenomenon.

Conclusion

It is crucial to gain a comprehensive understanding of the underlying mechanisms that underpin the remarkable cognitive and behavioral effects of imagery. It has been demonstrated that the Stroop interference effect can be reduced through the use of imagery. This effect is acknowledged as a component of pre-executive functions (55). An illustrative example of the reduction of Stroop interference is the phenomenon of word blindness observed in post-hypnotic suggestion (i.e., a suggestion to perceive words as meaningless during the Stroop task). When this suggestion is provided to individuals with a proclivity for imagery, it has been demonstrated to reduce Stroop interference by half (29).

In this context, participants who were particularly responsive to imagery may have blurred their vision, perceiving only the color of the letter (56). The results indicated that the suggestion to interpret words as meaningless scribbles significantly reduced the Stroop effect in highly suggestible individuals. This effect was attributed to imagery. A potential limitation of the present study is that examining the brain mechanisms of individuals prone to imagery may elucidate top-down effects. Nevertheless, additional factors, such as the expectancy effect and placebo, may also contribute to a more comprehensive understanding of this process.

Consequently, the imagery method has been demonstrated to reduce the Stroop effect. Nevertheless, it is advised that this study be repeated, given the limited number of participants and the necessity for a different sample group. While there are international studies on the brain-based Stroop effect, it would be beneficial to conduct national brain-based studies to further support this research.

Ethical approval

The research has the Istanbul Gelisim University Ethics Committee Approval Decision NO: 2023-08-57 Date: 04.11.2022

All procedures performed in studies involving hu\man participants were in accordance with the ethical standards of the institutional and/or national research committee and with the 1964 Helsinki declaration and its later amendments or comparable ethical standards.

Conflict of interest

The author has no conflict of interest.

Informed consent

Consent was obtained from all participants included in the study.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

Funding information

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