

Affective Processing in L1 Turkish Speakers: Evidence from Emotional Stroop Task

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ABSTRACT: In Turkish, different variations of the emotional Stroop task have been mostly utilized in psychology and psychiatry research. So far, psycholinguistic studies on how L1 Turkish speakers process emotionally valenced (positive, negative) and neutral words have been scant. Thus, the study aimed to investigate how emotionally valenced and neutral Turkish words are processed by 60 adult monolingual Turkish speakers. During the experiment, participants were asked to report the color of the word on the screen as quickly and accurately as possible while ignoring its meaning by pressing the 'Q' key for green or blue words and the 'P' key for yellow or red words. The findings revealed when Turkish words carefully matched on variables other than valence were used as the stimuli in the emotional Stroop task, valence did not affect the speed and accuracy of responses. That is, valence alone does not have a significant impact on the emotional Stroop task performance. Besides, a stepwise linear regression analysis did not support the view that variables such as arousal, dominance, number of letters, frequency, and concreteness are the predictors of reaction time.

Keywords: affective processing, valence, emotional Stroop task, L1 Turkish.

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D1 Trke Konuřucularında Duygusal İřleme: Duygusal Stroop Deneyinin Bulguları

Z: Trke’de duygusal Stroop deneyinin deęiřik varyasyonları aęırlıklı olarak psikiyatri ve psikoloji alanlarında kullanılmıřtır. D1 Trke konuřucularının duygusal olarak deęerlenmiř (pozitif, negatif) szcklerle ntr szckleri nasıl iřlemedięini inceleyen psikodilbilim alıřmaları yok denecek kadar azdır. Bu sebeple, alıřmanın amacı, Trke szcklerin 60 yetiřkin D1 Trke konuřucusu tarafından duygusal olarak nasıl iřlendięini arařtırmak ve aynı zamanda szcklerin sahip olduęu duygusal deęerlięin bu szcklerin iřlenmesini etkileyip etkilemedięini ortaya ıkarmaktır. Deney sırasında katılımcılardan, bilgisayar ekranında grdkleri szcęn anlamını gz ardı ederek, olabildięince hızlı ve doęru bir Őekilde szck yeřil veya mavi ile yazılmıřsa klavyedeki ‘Q’ tuřuna, sarı veya kırmızı ile yazılmıřsa ‘P’ tuřuna basmaları istenmiřtir. alıřmadan elde edilen bulgular, duygusal deęerlik haricinde farklı deęiřkenler bakımından eřleřtirilmiř pozitif, negatif ve ntr Trke szckler bir duygusal Stroop deneyinde kullanıldıęında, D1 Trke konuřucularının bu szcklere verdikleri cevapların hızını ve doęruluęunu etkilemedięini gstermektedir. Bu durum, duygusal deęerlięin tek bařına duygusal Stroop deneyindeki performansa nemli bir etkisinin olmadıęı anlamına gelmektedir. Ayrıca, kademeli doęrusal regresyon analizi, uyarılma, baskınlık, harf sayısı, kullanım sıklıęı ve somutluk deęiřkenlerinin tepki sresinin yordayıcıları olduęu fikrini desteklememiřtir.

Anahtar szckler: duygusal iřleme, duygusal deęerlik, duygusal Stroop deneyi, D1 Trke.

1 Introduction

In his seminal study, Stroop (1935) conducted three experiments to investigate the effect of a compound stimulus in which there was a mismatch between the word and the ink color (e.g., the word ‘red’ written in green ink) on word reading and color naming as well as the role of practice. The findings demonstrated that although no significant interference was observed in reading words with incongruent ink color, naming ink colors of incongruent words took longer compared to a baseline condition (MacLeod, 1991). The Stroop effect, or Stroop interference, refers to this contrast in color-naming times (Parris et al., 2022). Compared to word reading, which is highly automatic and requires only one response, color naming triggers multiple competing responses, resulting in slower performance in color naming when compared to word reading (MacLeod, 1991). Since its publication, Stroop’s (1935) work has provided an opportunity to inquire into how irrelevant stimuli can disrupt ongoing activity by exploring

the specific features of the stimulus that lead to interference (McKenna & Sharma, 1995). As participants are expected to concentrate on one aspect of the stimulus while disregarding another, interference occurs when they fail to ignore the word dimension (Parris et al., 2022).

Adapted from the original task mentioned above, the emotional Stroop task (EST) has emerged as an admissible research tool for scrutinizing the impact of affective words on allocating attention in the last decades. During the experiment, participants are exposed to neutral and emotionally valenced (positive, negative) stimuli, and their task is to report the color of the printed words (Eilola et al., 2007). Unlike the original task, the interference observed in the EST is primarily attributed to the affective properties of the presented stimuli in contrast to any semantic or perceptual incongruence between the words (e.g., the word “red” in blue ink) (Sutton et al., 2007). Emotional stimuli tend to prolong reaction times (RTs) in contrast to neutral stimuli during emotional trials, which is termed the “emotional Stroop effect” (McKenna & Sharma, 1995, p. 1596). That is, emotional words result in interference by capturing attention, causing the participants to slow down while naming the color of those words compared to neutral words. Similar to the original Stroop task, the EST involves two processes: inhibiting the automatic tendency to read the word and decode its semantic content and activating the intentional focus on naming its color (Larsen et al., 2006). Therefore, the EST can be utilized to explore the conflict between automatic and controlled cognitive processes while solving a task (Imbir et al., 2021).

Even though both the classical Stroop task and EST include naming the ink color of words, they differ in terms of the role of color manipulation. That is, in the classical Stroop task, the stimuli are color words and divided into two categories, i.e., congruent and incongruent, based on whether there is a match between the word and the ink color (Ben-Haim et al., 2016). The color presented across trials varies, ending in some trials being congruent (e.g., the word RED displayed in red ink) and others being incongruent (e.g., the word RED displayed in blue ink). Hence, interference in this task is calculated via the subtraction of congruent RTs from incongruent RTs (Larsen et al., 2006). However, in the EST, congruency is not considered as the stimuli involve emotionally valenced and neutral words. Thus, this task measures how color-naming performance is influenced by the affective content of words (e.g., the positive word ‘vacation’ vs. the negative word ‘death’) (Ben-Haim et al., 2016). In other words, colors serve as the task-relevant dimension to evaluate the participant’s attentional focus and to assess the extent to which emotional words disrupt their attention.

Defined as the degree of pleasantness or unpleasantness pertaining to the emotional response elicited by external stimuli, valence might be the most influential affective component of stimuli playing a significant role in interference control in the EST (Imbir et al., 2021). The prominent finding in the

EST studies, especially in earlier studies, is that negatively charged stimuli (e.g., fear) produce a greater slowdown in RTs compared to neutral words (e.g., leaf; Williams et al., 1996). However, such disruptive effects were not observed for positive stimuli in studies with non-clinical populations (McKenna & Sharma, 1995). This result is generally explained by the threat-related associations of negative stimuli, which interfere with the efficient processing of stimulus features relevant to the task, including color (Ben-David et al., 2012). The automatic vigilance hypothesis suggests that negative stimuli receive preferential attention from individuals since negative events such as threats often demand urgent action as opposed to positive ones (Pratto & John, 1991).

Remarkably, the overwhelming majority of EST studies have overlooked positive stimuli (e.g., vacation) (e.g., Okada et al., 2019), and the ones that included such words often failed to produce significant RT differences compared to neutral words (e.g., Eilola et al., 2007; Eilola & Havelka, 2011). However, some scholars propose that positively valenced words may generate a facilitating effect as opposed to the interference caused by negative stimuli, with the idea that due to their threatening characteristics, negative stimuli may narrow the attentional focus to primarily assess the emotional valence of the stimulus (Lazarus, 1991). As a result, the automatic vigilance that disrupts task performance might not occur with positive stimuli as they lack a threatening component. Drawing on Fredrickson's (2001) broaden-and-build theory, Liu et al. (2018) hypothesized that in the EST, positive emotions may facilitate the redirection of attention from the task-irrelevant emotional content to the relevant feature, i.e., color, both within a single trial and across successive trials. Their findings supported the view that positive emotions can be recognized at an early stage, and this immediate detection can promote the transition from emotional content to the task-relevant feature, i.e., the ink color, rather than causing disruption.

Originally, the interference effect was believed to occur within individual trials, whereby the affective content of the stimuli rapidly and involuntarily captured attention (Williams et al., 1996). This widely acknowledged belief that affective words automatically capture attention proposes that the response to color is slowed down by a negative word within a single trial. These interference effects are characterized as happening fast and taking place in real-time on a single trial (McKenna & Sharma, 2004). Specifically, earlier research considered the emotional Stroop effect as the impact affective stimuli exert on the immediate upcoming response, which is now called the "fast" effect, as responses in the current trial are influenced by the word valence (Frings et al., 2010).

More contemporary research, on the other hand, has reported the presence of a "slow" effect, suggesting that the emotional word presentation might impact the processing of subsequent trials (e.g., McKenna & Sharma, 2004). Findings from a body of research provided evidence for the carry-over effects of valence

in different versions of Stroop task (e.g., Kunde & Mauer, 2008; McKenna & Sharma, 2004; Waters et al., 2005). For instance, McKenna and Sharma (2004) conducted four experiments via the EST to examine both “fast” and “slow” emotional interference effects. Remarkably, the researchers found robust evidence for the “slow” effect in all experiments. However, the data did not support the presence of a “fast” effect. Based on their findings, the authors proposed that “fast” effects might be solely observed in a clinical population by utilizing a threat-related stimuli list. Regarding the “slow” effect, several accounts were offered: (i) a temporal delay account positing that negative stimuli require time to build activation before disrupting performance, (ii) a disengagement account, proposing sustained attentional capture by negative stimuli at the semantic level, (iii) a task-preparation interference account, where emotional stimuli disrupt cognitive control for upcoming trials.

Interestingly, some scholars have identified both “fast” and “slow” effects in their studies, suggesting the impact of valence in both current and consequent trials (e.g., Frings et al., 2010; Liu et al., 2018). For example, in an EST in German, Frings et al. (2010) classified each trial based on whether the target stimulus was negative or neutral, and whether the previous trial was negative or neutral. The researchers documented both a “fast” effect and a “slow” effect. That is, the subjects demonstrated slower reactions to negative trials than neutral (the “fast” effect). Besides, they showed slower responses to neutral trials in case the preceding trial was negative instead of neutral (the “slow” effect). In conclusion, the researchers posit that such effects might stem from a shared mechanism initiated in the current trial and persist until the subsequent one. On the other hand, Liu et al. (2018) identified the facilitating effect of positive stimuli in both current and following trials. Particularly, in Experiment 1, participants responded faster to positive stimuli following neutral words (a fast facilitation effect) and to neutral stimuli following positive words (a slow facilitation effect), compared to responses to neutral stimuli following neutral words. The authors concluded that in line with the broaden-and-build theory (Fredrickson, 2001), positive emotions promote attentional flexibility, which facilitates redirecting attention from one stimulus to another.

It should be noted that there are also studies that do not support these results. For example, a recent study by Crossfield and Damian (2021) examined the effect of valence on lexical processing via a lexical decision task (LDT) and an EST with a mouse-tracking technique and a key-press emotional Stroop task using the same stimuli including carefully matched emotionally charged and neutral words. The findings unveiled a significant advantage in processing positive stimuli compared to neutral and negative words in LDT as indicated by shorter duration, faster response latencies, and higher accuracy rates in the processing of these words. However, no such significant valence effects were

observed in the ESTs. Therefore, there is still a need for future studies to illustrate the role of emotionally valenced words in both current and consequent trials.

When it comes to language emotionality in L1 Turkish speakers, to the researchers' knowledge, this group has been largely neglected in the literature. Only one study included emotionally valenced (positive, negative) and neutral Turkish words as the stimuli, albeit with a different methodology and research focus (Mergen & Kuruođlu, 2021). In their study with 48 Turkish-English bilinguals and 53 Turkish monolinguals, Mergen and Kuruođlu (2021) examined how lexical processing is organized in these groups' brains and compared their performance in Turkish words regarding speed and accuracy through LDT in a visual hemifield paradigm, i.e., an experimental method in which stimuli are briefly presented to either the left or right visual field to investigate lateralized processing in the brain, based on the contralateral organization of the visual system. The stimuli included 30 real words and 30 non-words in both Turkish and English. The findings revealed that bilinguals demonstrated a balanced performance in their two languages. There was no significant difference in response latencies to words presented in the right or left visual field, suggesting a symmetrical organization. In the monolingual group, however, the processing of the words presented in the right visual field was faster compared to those presented in the left visual field. The comparison of groups regarding their processing speed indicated that monolinguals were faster than bilinguals, regardless of the field of presentation. Nevertheless, there was no significant difference between groups in terms of accuracy.

In Turkish psychiatry and psychology research, however, a particular version of the EST called the Word-Face Stroop task has been employed with healthy adults or adolescents and psychiatric patients along with the classical Stroop task (Bařgöze, 2008, 2015; Dođanay, 2023) and an EST with anger and fear related words (Aruntař, 2013). The Word-Face Stroop task measures conflicts between emotional words and emotional facial expressions by creating emotionally congruent and incongruent situations (Bařgöze, 2008). In this task, congruent conditions pair emotionally valenced words with matching facial expressions, whereas incongruent conditions reverse these pairings. So far, in this context, only one published article (Bařgöze et al., 2015) has been identified examining RTs from healthy subjects and unmedicated patients diagnosed with major depression disorder through a valence-based Word-Face Stroop task.

All in all, this study aims to offer several contributions to the field. First, it sheds light on how L1 Turkish speakers process emotionally valenced and neutral stimuli presented in an EST. As this group has received minimal attention in psycholinguistic literature thus far, the current research serves as a pioneering investigation, providing initial evidence in this area and paving the way for future research. Besides, the Turkish stimuli list generated for the purpose of the present research is quite comprehensive regarding both the number of words and the

scope of matched variables. Finally, this study advances the discourse on fast and slow effects reported in EST research by addressing the discrepancies identified in the existing literature.

2 Literature Review

In the fields of psychology and psycholinguistics, the emotional Stroop effect has been widely scrutinized with monolingual English speakers (e.g., Crossfield & Damian, 2021; Dresler et al., 2009). In one of these studies, Dresler et al. (2009) scrutinized RT data derived from 50 healthy subjects via the EST to understand whether emotional interference is produced by word valence or word arousal, which refers to the measure of a stimulus's capacity to elicit a calming or stimulating response (Kuperman et al., 2014). The researchers also delved into the effect of trait and state anxiety and their interaction on emotional interference in healthy individuals. The findings unraveled that emotional interference is determined by word arousal rather than valence. In other words, there was no difference between negative and positive stimuli matched on arousal ratings in terms of RTs. Nevertheless, both types of stimuli elicited longer RTs compared to neutral words. Besides, the recall and recognition tasks showed that emotionally charged words were better recalled and recognized compared to neutral stimuli regardless of their valence. Finally, subjects with high state anxiety demonstrated elevated emotional interference and trait anxiety did not affect emotional interference. Anxiety prompts automatic attention to emotional or threat-related stimuli, consuming cognitive resources. Unlike trait anxiety, state anxiety is a temporary, action-oriented state that more strongly affects cognitive performance. The lack of effect from trait anxiety may be due to coping strategies developed by high-anxiety individuals, especially when motivated to perform well in a task, and because trait anxiety reflects a general tendency, not a constant anxious state.

In a recent study, Crossfield and Damian (2021) employed both an LDT and an EST with two different methods, i.e., mouse-tracking and keypress, utilizing the same set of stimuli to explore how valence impacts lexical processing. Unlike other studies in the literature, the items in the stimuli list were matched across three valence categories in terms of 26 lexical, sub-lexical, and conceptual variables. The results yielded a facilitation effect of positively valenced words in LDT. Nevertheless, valence did not influence the performance in both ESTs. As suggested by other studies in the literature (e.g., Estes & Adelman, 2008; Larsen et al., 2006), the null effect of valence in the ESTs might be due to the control over confounding variables. Another explanation is that valence effects can be task-specific. That is, valence impacts lexical decision tasks more than naming tasks (Kuperman et al., 2014; Larsen et al., 2008), likely because lexical decisions involve deeper semantic processing (Yap & Seow, 2014).

Studies with other language speakers, on the other hand, have been scarce (e.g., Ben-David et al., 2012; Frings et al., 2010; Imbir et al., 2021). For instance, in their EST study in German, Frings et al. (2010) categorized each trial based on whether the target stimulus was negative or neutral, and whether the previous trial was negative or neutral. Both a “fast” effect and a “slow” effect were reported, suggesting that participants slowed down in negative trials compared to neutral trials as well as in neutral trials when they were preceded by negative trials instead of neutral. The authors concluded that a shared mechanism that started in the present trial and remained until the ensuing trial might be responsible for the observed effects.

Earlier studies generally observed greater interference in color identification during emotional trials compared to the neutral trials (see Williams et al., 1996 for a review). A wide range of psychopathologies have been studied through the EST, including clinical anxiety (e.g., Mathews et al., 1995), high-trait anxiety (e.g., Fox, 1993), posttraumatic stress disorder (e.g., Kaspi et al., 1995), panic disorder (e.g., McNally et al., 1992), obsessive-compulsive disorder (e.g., Lavy et al., 1994), social phobia (e.g., Mattia et al., 1993), depression (e.g., Segal et al., 1995), and specific phobias such as spiders and snakes (e.g., Martin et al., 1992, Mathews & Sebastian, 1993). Typically, negatively valenced stimuli produced prolonged RTs as opposed to neutral and positive words (MacKay et al., 2004), which is generally explained by the threatening implications of negative stimuli diverging attention from the task-relevant component of the target word (e.g., color) (Ben-David et al., 2012). In healthy participants, however, such effects were not always detected and were frequently found to be less evident (e.g., Algom et al., 2004).

Among non-clinical populations, negative emotions confer significant evolutionary advantages. Under threat, they constrict the focus of attention and elicit specific behavioral tendencies, thereby facilitating rapid and effective responses that markedly enhance survival prospects (Lazarus, 1991). As positive emotions offer minimal survival benefits in such contexts (Fredrickson, 1998), positive stimuli have been largely ignored in the EST literature (e.g., MacKay et al., 2004). Moreover, those that included positively valenced words often failed to observe any differences in RTs between neutral and positive conditions (e.g., Eilola & Havelka, 2011; McKenna & Sharma, 1995). Eilola and Havelka (2011) explained that the difference between processing negative and positive word stimuli may stem from distinct neural mechanisms linked to emotional valence. According to Craig's (2005) homeostatic neurobiological model, positive emotions are associated with the left forebrain and parasympathetic activity, promoting energy conservation, while negative emotions engage the right forebrain and sympathetic activity, related to energy expenditure. This neural asymmetry underlies the differential processing of positive and negative emotional content.

Despite the null findings in the literature regarding positive stimuli, in contrast to the interference effect of negative words, some scholars have put forward that positively valenced words might generate shorter RTs in both current and successive trials compared to neutral words, providing evidence on the facilitating role of positive emotions on attentional orientation (e.g., Liu et al., 2018). Particularly, Liu et al. (2018) observed the facilitation of positively valenced stimuli in both immediate and subsequent trials. That is, participants in Experiment 1 reacted to the positive stimuli faster when followed by neutral words (“fast” effect) and to neutral words when followed by positive words (“slow” effect) in comparison to neutral words following neutral stimuli. The researchers posit that this observation stems from the idea that positive emotions can be recognized early on and promote attentional flexibility.

Subsequent research has indicated a second, slower interference effect that occurs between trials, referred to as “emotional lingering” (McKenna, 1986; McKenna & Sharma, 2004). Recent studies have documented both “fast” and “slow” effects (e.g., Frings et al., 2010). The “fast” effect indicates the immediate influence of valence on the present trial “N”, whereas the “slow” effect pertains to potential residual repercussions of valence from the preceding trial “N-1”. As highlighted earlier, the existing body of research presents inconsistent results. For instance, McKenna and Sharma (2004) only identified evidence for the “slow” effect, while Frings et al. (2010) reported both “fast” and “slow” effects. Nevertheless, following the same approach, Crossfield and Damian (2021) did not replicate the expected findings in their key-press EST, possibly owing to their stringent control over the stimuli used in the experiment.

In the Turkish context, the emotional Stroop task or its variants have been utilized in psychology and psychiatry studies with clinical groups and healthy individuals as controls (Aruntaş, 2013; Başgöze, 2015; Doğanay, 2023). For example, Aruntaş (2013) utilized both a classical and Word-Face Stroop task with adolescents aged between 12 and 14 and young adults as controls to investigate cognitive and emotional conflict. In both groups of participants and across both the classical and Word-face Stroop tasks, a significant congruency effect was observed, with faster RTs and a higher number of correct responses for congruent trials compared to incongruent trials. Nonetheless, no significant differences were found between adolescents and young adults in terms of performance, i.e., RTs and accuracy scores.

In another study, Başgöze (2015) compared 20 unmedicated depressed patients and 20 healthy individuals using a valence-specific Turkish fMRI-compatible Word-Face Stroop task. Specifically, the participants initially completed a pen-and-paper classical Stroop task. Later, they participated in the Word-Face Stroop task in a magnetic resonance scanner. The findings of the valence-specific Word-Face Stroop task demonstrated that both groups exhibited a positive-negative asymmetry effect, characterized by slower responses to

negative stimuli. However, patients responded more quickly and accurately to negative stimuli compared to the healthy group. Consistent with these results, distinct patterns of brain activation were observed between the groups. Patients, in contrast to the healthy group, displayed increased activation in cognitive control regions, such as the right Dorsolateral Prefrontal Cortex and Superior Frontal Gyrus, in response to negative stimuli. Additionally, patients exhibited greater activation in areas critical for attention regulation and reorientation, such as the Frontal Eye Field and Middle Frontal Gyrus, when processing incongruent stimuli. These neural activations, combined with the behavioral data, suggest that patients have an attentional bias toward negative stimuli. Specifically, rather than having any particular emotional or cognitive deficiencies, patients possess a negatively skewed attentional mechanism.

Finally, in a recent study, Dođanay (2023) conducted two types of emotional Stroop tasks, i.e., one version with emotionally valenced words and another with emotional face pictures, with 69 healthy young adults aged between 18-29 to examine differences between anger, fear, and neutral emotions. The results indicate that anger-related words caused more errors than neutral words, and congruent fear facial images resulted in more errors than congruent neutral facial images. Significant differences in RTs were observed between congruent and incongruent anger facial images compared to their neutral counterparts. However, no significant differences were found between anger and fear stimuli in either EST. The researcher concluded that as both anger and fear are considered threat-related stimuli, participants' decision-making might have been affected by the presence of such stimuli, leading them not to be able to distinguish between anger and fear-related words.

While the literature lacks widely published studies on this topic, in one available research article, Bařgöze et al. (2015) employed a valence-based Word-Face Stroop task in which the subjects were expected to decide whether the stimuli in the background were positive, negative, or neutral. Specifically, by generating emotionally congruent (e.g., positive word-positive picture) and incongruent (e.g., positive word-negative picture) conditions, this task evaluates conflicts between affective stimuli and facial expressions (Bařgöze, 2008). Healthy individuals were found to be quicker and more accurate compared to unmedicated individuals diagnosed with major depression disorder (MDD) due to shorter RTs and more accurate responses in congruent and positive trials. In processing emotionally incongruent facial expressions, healthy subjects slowed down in contrast to MDD patients. Finally, for negative words, healthy participants committed more errors when reacting to incongruent cases in which negative words were presented with neutral or positive facial expressions (e.g., happy face and negative word *zarar* 'harm'). However, MDD individuals made the least number of errors in the same category. The authors concluded that the results are in line with the analytical rumination hypothesis of depression

according to which patients exhibit reduced speed and accuracy in laboratory tasks due to the cognitive load imposed by persistent rumination. However, when tasks are related to their ruminative focus, repeated engagement may enhance their vigilance and proficiency.

Despite using a stimuli list including emotionally valenced (positive, negative) and neutral Turkish words, Mergen and Kuruoğlu (2021) adopted a different methodology and focused on how lexical processing is organized in the brain hemispheres of 48 Turkish-English bilinguals and 53 Turkish controls as well as their speed and accuracy in processing Turkish words through an LDT in a visual hemifield paradigm. The analysis yielded a balanced performance in bilinguals' two languages. Besides, RTs to words displayed in right or left visual fields did not differ significantly, implying a symmetrical organization. On the other hand, the monolingual group demonstrated a faster processing of the words displayed in the right visual field in contrast to the ones shown in the left visual field. Irrespective of the field of presentation, bilinguals were slower than monolinguals in terms of processing speed. This difference between groups can be explained by increased cognitive processing demands in bilinguals due to the challenge of selecting words from a lexicon that is nearly twice as large as that of monolinguals. However, no significant difference was observed between groups regarding accuracy scores. The researchers posit that this discrepancy between accuracy scores and RTs results might stem from participants' prioritizing speed over accuracy, hence failing to concentrate on word meaning.

As can be deduced from the literature outlined above, there is a serious gap in Turkish psycholinguistic literature regarding how L1 Turkish speakers process emotionally charged and neutral stimuli in an EST. Variations in populations tested and the experimental designs employed make it challenging to generalize findings across available studies. Besides, when it comes to understanding affective processing in a non-clinical group, psychological and psychiatric research often provide limited insights. Hence, the present study tries to address a significant gap in the existing literature by employing EST with an extensive stimuli list.

2.1 The Present Study

As summarized in the literature review previously, how Turkish monolinguals process emotionally charged and neutral stimuli has been overlooked by scholars. Furthermore, the debate over "fast" and "slow" interference effects in EST has not been resolved yet. In addition, the existing research available in the literature omitted positively valenced stimuli, the inclusion of which could potentially enhance facilitation due to their valence. Therefore, the current study examined how the valence of a Turkish word (positive, negative, neutral) affects

the lexical processing in Turkish monolinguals' mental lexicon. Hence, the subsequent research question guided the inquiry into understanding the issue:
RQ1. How are emotionally valenced and neutral Turkish words processed by Turkish monolingual speakers?

As evidence on the processing of affective stimuli has been considerably lacking in Turkish psycholinguistic literature, the predictions pertaining to how L1 Turkish speakers process emotionally charged and neutral Turkish stimuli will be based on the available studies with English monolinguals. Accordingly, if valence plays a significant role, then it is predicted that the participants will demonstrate slower RTs in negative trials (e.g., McKenna & Sharma, 1995) or shorter RTs in positive trials (e.g., Liu et al., 2018) in comparison to neutral ones. However, another possibility is that valence may not generate any significant effects on the participants' performance in the EST, resulting in similar RTs in different valence conditions (e.g., Crossfield & Damian, 2021).

3 Method

3.1 Participants

Ethics committee approval for all procedures applied in the study was obtained from the Scientific Research and Publication Ethics Committee of Bahçeşehir University, dated 05.08.2024, and numbered E-85646034-604.01-86197. Participants were informed about the study, and consent forms were obtained from all of them. 60 L1 Turkish speakers took part in this study. 32 of the participants were women, while 28 of them were men. The mean age was 37.60 with a range from 19 to 56. Two participants held a secondary school degree, 11 had a high school degree, three had an associate's degree, 42 held a bachelor's degree, and two had a master's degree. All participants were native speakers of Turkish. They had normal (or corrected-to-normal) vision without the presence of color blindness as well as learning disorders. None of the participants had prior medical experiences that could potentially influence affective word processing.

3.2 The Stimuli

A prominent issue in the language emotionality research in Turkey is the lack of comprehensive stimuli lists. In some studies, the number of words in valence conditions was quite limited (e.g., 10 words in Mergen & Kuruođlu, 2017, 2021 and 16 words in Aruntař, 2013), whereas in other studies, valence categories were matched only in terms of arousal ratings (e.g., Bařgöze et al., 2015) or the number of letters and arousal scores (e.g., Aruntař, 2013; Dođanay, 2023). Hence, it was imperative to generate a stimuli list for the purpose of the current

research to eliminate the possibility of other variables confounding with valence as optimally as possible.

The words in the stimuli list were selected among 198 nouns from Başgöze (2008). In her master's thesis, employing the Manikin of Emotional Rating Technique (MERT) in combination with a 1–9 Likert scale, Başgöze (2008) collected valence, arousal, and dominance ratings for 198 Turkish words. The word set consisted of translations of a subset of items from the Affective Norms for English Words (ANEW) as well as words selected from a Turkish database (Tekcan & Göz, 2005). The words were carefully chosen according to frequency ($M = 81.7$, $SD = 85.8$, range: 15–444) and length (3–12 letters) and were limited to nouns. 45 native Turkish speakers completed the experiment individually. The words were rated for valence, arousal, and dominance using three MERT booklets containing identical words but different manikin scales. Among these 198 nouns, 87 words in three different valence categories, i.e., 29 positive, 29 negative, and 29 neutral words, were included in the current study by taking different factors into consideration as much as possible that are explained in detail in the following paragraph (see Appendix).

The valence, arousal, and dominance ratings of these words were acquired from the aforementioned study. The words were selected to fall within specific valence ranges (1–9): Negative words aggregated in the lower range ($M = 2.82$, $SD = 0.61$, range = 1.80–3.53), neutral words around the middle range ($M = 5.64$, $SD = 0.83$, range = 4.20–6.76), and the positive words toward the higher range ($M = 7.61$, $SD = 0.35$, range = 7.16–8.51). There is a significant difference between the valence conditions, $F(2, 84) = 428.674$, $p < .001$. Dominance ratings for the selected words also indicate a significant increase from negative ($M = 4.52$, $SD = 0.48$, range = 3.29–5.31) to neutral ($M = 5.67$, $SD = 0.65$, range = 4.33–6.80) to positive ($M = 6.89$, $SD = 0.41$, range = 5.60–7.40), $F(2, 84) = 149.519$, $p < .001$. The words were statistically matched in three valence categories based on the arousal ratings, $F(2, 84) = 2.841$, $p = .064$. Moreover, the frequency of the items was obtained from TS Corpus (Sezer & Sezer, 2013) and statistically matched triplet-wise, $F(2, 84) = 0.267$, $p = .766$. Similarly, the number of letters in words varied between 4 and 9 across three categories and statistically matched in all three categories, $F(2, 84) = 2.130$, $p = .125$.

Finally, a concreteness survey was conducted in Turkish through Google Forms in three versions on a 1–7 Likert scale (1=abstract, 7=concrete) to gather the concreteness ratings of the selected stimuli as the concreteness ratings for these items were not available in the literature. 48 Turkish monolingual participants (27 women, 21 men), who did not take part in the actual study, with a mean age of 30 completed the survey. The results revealed that the words were statistically matched in all three conditions, $F(2, 84) = 2.908$, $p = .060$. Thus, no changes were made in the stimuli list. Averages per condition with standard deviations in parentheses can be seen in Table 1.

Table 1: Characteristics of the Stimuli

	Conditions		
	Positive	Neutral	Negative
Valence	7.61 (0.35)	5.64 (0.83)	2.82 (0.61)
Dominance	6.89 (0.41)	5.67 (0.65)	4.52 (0.48)
Arousal	5.55 (0.77)	5.59 (1.01)	6.05 (0.84)
Number of letters	5.66 (1.14)	5.59 (1.12)	6.21 (1.47)
Frequency	23.50 (17.36)	20.37 (14.27)	21.51 (26.39)
Concreteness	3.76 (1.75)	4.89 (1.94)	4.43 (1.70)

Following the creation of the list, a pilot study was conducted with 31 monolingual Turkish speakers (18 women, 13 men) to assess the Turkish stimuli. The participants had a mean age of 40.80. Their educational background varied, with most having earned an undergraduate degree (24), followed by four with high school degrees, two with secondary school degrees, and one with an associate's degree. All participants were native speakers of Turkish. They had normal (or corrected-to-normal) vision without the presence of color blindness as well as learning disorders. The results indicated that the experiment ran smoothly, and the participants did not experience any difficulties with the completion of the task. Therefore, no changes were implemented to the stimuli list and the experiment.

3.3 Procedure

Initially, the participants were informed about the study and requested to read and sign the informed consent form. Later, each participant correctly identified seven plates from Ishihara's (1939) test of color blindness in order to verify that they could correctly distinguish colors. Next, a background questionnaire was given to collect participants' demographic information.

The experiment was administered via the E-Prime 3.0 software (Psychology Software Tools, Pittsburgh, PA). The present study adopted the same design and procedure as those employed in Experiment 3 in Crossfield and Damian's (2021) study. In their study, Crossfield and Damian (2021) utilized a stimuli list including a total of 87 words, with 29 in each valence category, obtained from valence, arousal, and dominance ratings among 13,000 English words in Warriner et al.'s (2013) study. The items fell at the lower end of the valence scale for negative words ($M = 2.09$, $SD = 0.27$, range 1.5–2.5), around the midpoint for neutral words ($M = 5.13$, $SD = 0.26$, range 4.5–5.5), and at the higher end of the valence scale for positive words ($M = 7.44$, $SD = 0.37$, range 7.0–8.5). There was a significant difference between the valence conditions, $F(2, 84) = 2225$, $p <$

.001. The dominance ratings significantly increased with valence, from negative words ($M = 3.50$, $SD = 0.58$, range = 2.6–5.0) to neutral words ($M = 5.14$, $SD = 0.72$, range = 3.6–6.2) and to positive words ($M = 6.14$, $SD = 0.74$, range = 5.0–7.9), with a significant difference across all conditions, $F(2, 84) = 110.9$, $p < .001$. The stimuli were statistically matched triplet-wise on 26 lexical and sub lexical variables except for valence and dominance ratings.

In Experiment 3, 44 participants (28 women, 16 men) with a mean age of 32.5 ($SD = 13.6$) completed a traditional key-press EST in an online platform for behavioral tasks called Gorilla to receive a monetary incentive. All participants were native English speakers with normal or corrected-to-normal vision and free of color blindness. During the experiment, participants were expected to report the word color as quickly and accurately as possible while ignoring the meaning by pressing the ‘P’ key for red or yellow words and the ‘Q’ key for blue or green responses. The words appeared in the center of the screen against a white background and remained on display until the response was completed by the participant. The next word followed immediately. Participants first completed 12 practice trials, and then the experiment continued with four blocks of 87 trials, with breaks provided between blocks. The total duration of the experimental session was about 20 minutes.

The motivation to employ the design and procedure of this study lies in the fact that it provides a detailed investigation of “fast” and “slow” emotional Stroop effects by using a 2×2 within-subjects factorial design. Along with the prior research in the field (e.g., Frings et al., 2010), their design included two factors: The emotional valence of the current trial (Trial “N”: negative vs. neutral) and the emotional valence of the immediately preceding trial (Trial “N – 1”: negative vs. neutral). However, to account for potential “fast” and “slow” effects of positive valence, additional analysis was carried out following the 2×2 within-subjects factorial design (Liu et al., 2018) including valence on the current trial (Trial “N”: positive vs. neutral) as the first factor and valence on the previous trial (Trial “N – 1”: positive vs. neutral) as the second.

In order to generate ink color copies of each lexical item, standard red, yellow, blue, and green in the Microsoft Word color palette was used. These colors are frequently utilized in the EST research (e.g., Crossfield & Damian, 2021; Dresler, 2009; Liu et al., 2018), potentially due to their perceptual discriminability and being robust to common color vision deficiencies as well as allowing consistency among studies in literature. All participants were tested individually in a quiet room. After Turkish instructions appeared on the computer screen, they were verbally repeated by the researcher who remained in the room throughout the experiment.

During the experiment, participants were asked to report the color of the word on the screen as quickly and accurately as possible while ignoring its meaning by pressing the ‘Q’ key for green or blue responses, and the ‘P’ key for yellow

or red words. Matching color stickers were placed on the relevant keys on the keyboard to facilitate the procedure. All words were presented in a black lowercase Arial font, size 28, and displayed in the center of the screen on a white background. Participants viewed the trials from a convenient distance (around 40 cm) on a 14.2-inches Huawei Matebook 14 HKD-W56 with a screen resolution of 2520×1680 .

The stimulus remained visible until a response was made, and the next word was presented immediately afterward. Following 12 practice trials, participants completed 4 experimental blocks of 87 trials each, with scheduled breaks provided at the end of each block. This resulted in a total of 348 experimental trials per participant. In each break, a reminder of the keypress response mappings was displayed along with instructions. The experimental session lasted around 15 minutes.

The presentation order of stimuli was randomized separately for each block and participant. Words were displayed once per block in varying ink colors across blocks, thus exposing participants to all color variations. The rationale behind such a design was to eliminate the possibility of associations between specific words and colors (Crossfield & Damian, 2021).

3.4 Data Analysis

Data analysis was performed in the R environment (R Core Team, 2020), using the *BayesFactor* package (Morey & Rouder, 2018). Statistical analyses were carried out with the *afex* package (Singmann et al., 2020) and the *emmeans* package (Lenth, 2025). Additional analyses were conducted utilizing *bayestestR* (Makowski et al., 2019), *olsrr* (Hebbali, 2020), and *Hmisc* (Harrell, 2020).

Following Crossfield and Damian's (2021) data clearance procedure, trials with incorrect responses were excluded from the RT analysis. In addition, RTs below 200 ms, above 2000 ms, or beyond ± 2.5 standard deviations from a participant's conditional mean were removed.

4 Results

No participants were removed from data analysis owing to excessive error rates ($>20\%$) or an unusually slow mean RT, i.e., 2 seconds. Trials with incorrect responses were excluded from the RT analysis (4.38%). RTs above 2000 ms or below 200 ms (0.09%), along with RTs above or below 2.5 standard deviations of a participant's conditional mean (2.86%), were also removed.

In repeated-measures ANOVAs conducted on the errors, there was no significant effect of Valence, $F(2, 118) = 0.38, p = .68$; $F(2, 84) = 0.29, p =$

.75, of Valence N- 1, $F1(2, 118) = 1.65, p = .20$; $F2(2, 168) = 2.30, p = .10$, nor a significant interaction, $F1(4, 236) = 1.01, p = .41$; $F2(4, 168) = 1.33, p = .26$.

In ANOVAs conducted on RTs, there was no significant effect of Valence, $F1(2, 118) = 0.14, p = .87$; $F2(2, 84) = 0.24, p = .79$, of Valence N - 1, $F1(2, 118) = 0.19, p = .83$; $F2(2, 168) = 0.31, p = .73$, nor a significant interaction, $F1(4, 236) = 1.37, p = .25$; $F2(4, 168) = 2.31, p = .06$.

“Fast” effects, which were represented by neutral and negative/positive trials where the previous trial was neutral, and “slow” effects, which were represented by neutral trials where the valence of the previous trial was either neutral or negative/positive, were examined. In Table 2, key comparisons for negative valence were highlighted in bold, while those for positive valence were italicized. Paired and independent samples t-tests investigating “fast” and “slow” effects of negative valence demonstrated that the “fast” effect (3 ms) was not significant, $t1(59) = 0.88, p = .38$; $t2(56) = 0.44, p = .66$, and neither was the “slow” effect (1 ms), $t1(59) = -1.01, p = .82$; $t2(28) = -0.90, p = .32$. Similarly, paired and independent samples t-tests examining “fast” and “slow” effects of positive valence indicated that the “fast” effect (2 ms) was not significant, $t1(59) = -0.45, p = .65$; $t2(56) = -0.81, p = .42$, and neither was the “slow” effect (2 ms), $t1(59) = 0.49, p = .62$; $t2(28) = 0.28, p = .78$.

Table 2: Response Times (in milliseconds) and Error Percentages (in parentheses)

Valence	Valence N-1		
	Negative	Neutral	Positive
Negative	494 (9.59)	492 (9.77)	500 (9.69)
Neutral	496 (10.00)	<i>495 (9.23)</i>	<i>493 (9.53)</i>
Positive	492 (9.01)	<i>497 (9.67)</i>	493 (9.54)

A stepwise linear regression was performed on RTs including arousal, dominance, number of letters, frequency, and concreteness in the analyses. Among these, only frequency met the entry criterion and was retained in the final model. The resulting model was not statistically significant, $F(1, 85) = 2.55, p = .114$, and explained a small proportion of the variance in RT, $R^2 = .029$, Adjusted $R^2 = .018$. The standardized regression coefficient for frequency was negative but not statistically significant, $\beta = -.17, t(85) = -1.60, p = .114$, 95% CI [-0.169, 0.018], indicating a trend toward slower responses for less frequent words. However, this effect did not reach significance. To supplement the frequentist findings, a Bayesian linear regression was conducted. The model-averaged inclusion Bayes factor for frequency was 0.682, providing anecdotal evidence

against including frequency in the model. The zero-order correlation between RT and frequency was $r(87) = -.17$.

5 Discussion

The findings derived from this study indicate that valence did not have a significant impact on the participants' performance in the EST. That is, when a stimuli list with Turkish items carefully matched on four different variables (arousal, number of letters, frequency, and concreteness) other than valence and dominance was used in an EST, valence did not play a role in the speed and accuracy of participants' responses. This finding resonates with Experiment 3 in Crossfield and Damian's (2021) study. The null finding in both studies suggests that in an EST, when stimuli are matched across valence conditions on different lexical and sub-lexical characteristics which might confound with valence, regardless of the language, valence does not significantly affect the performance of the participants in terms of speed and accuracy. Thus far, research on the emotional Stroop paradigm has produced inconsistent findings, which might be partly due to the inclusion of different words compared across the valence conditions. A comprehensive review of 32 published emotional Stroop studies by Larsen et al. (2006) illustrated that emotional words are typically lengthier, less commonly used, and have smaller orthographic neighborhoods than their neutral counterparts. The researchers reported that the predicted outcome of increased RTs on negative trials is supported by such lexical differences between negative and neutral words. Kahan and Hely (2008) also revealed that the interaction between frequency and valence influences RTs in color-naming tasks, implying that lexical features, rather than emotional components of the stimuli, may partially contribute to the reported emotional Stroop effect in some research. Therefore, as pointed out by other researchers (e.g., Estes & Adelman, 2008), in EST research, the magnitude of negative valence effects might be reduced by expanded control of variables that have an impact on lexical processing, illustrating the significance of including stimuli lists matched on other variables while examining the role of valence (Larsen et al., 2006).

The null finding in the current study contradicts other studies in the Turkish context (e.g., Aruntař, 2013; Bařgöze et al., 2015). However, it should be noted that the use of different versions of EST across studies, such as the Word-Face Stroop Task, poses a challenge to drawing generalized conclusions. Besides, as reviewed before, some of these studies included clinical participants with various conditions such as major depression (e.g., Bařgöze et al., 2015). Finally, as highlighted earlier, emotional Stroop effects in healthy populations were not always existent and were often found to be less robust (e.g., Algom et al., 2004).

Regression analyses conducted on the mean RTs of the words demonstrated no effect of arousal, dominance, number of letters, frequency, and concreteness

on participants' responses in the EST. Therefore, it is likely that other lexical and sub-lexical variables such as familiarity, or recently proposed conceptual features such as contextual diversity, sensory experience (Juhasz et al., 2011), and semantic diversity (Hoffman et al., 2013) play a more prominent role in predicting word processing speed. For instance, in the LDT of Crossfield and Damian (2021), participant responses were primarily influenced by traditional lexical factors like word frequency and familiarity, while conceptual factors such as contextual diversity and sensory experience had a lesser impact. In contrast, regression analyses of responses in the ESTs revealed that only the effect of conceptual factors, including arousal, semantic diversity, and concreteness, was found to be significant. In the literature, a substitute approach to selecting valenced and non-valenced words matched on all dimensions except valence is to perform multiple linear regression analyses on large datasets of words and their associated RTs, in order to assess whether valence contributes independently to response variability. To date, several studies have been conducted in English for this purpose (e.g., Estes & Adelman, 2008; Kuperman et al., 2014; Larsen et al., 2006). However, in Turkish, to the researchers' knowledge, no such attempt has been yet made. Thus, there has been a significant need in Turkish linguistic research for extensive corpora to provide ratings of Turkish words across various variables. Future studies might expand on the stimuli list prepared for the purpose of the study including ratings of different lexical, sub-lexical, and conceptual variables, and dwell on how these variables play a role in affective processing.

Although the inclusion of positive stimuli has been extensively overlooked in EST literature, the findings of the present study offer additional support to the available research evidence regarding the null effect of positive valence (e.g., Eilola & Havelka, 2011; McKenna & Sharma, 1995). This effect might stem from few survival-related advantages associated with positive emotions (Fredrickson, 1998). As for the investigation of "fast" and "slow" effects of positive valence, the current results are in contrast with literature (e.g., Liu et al., 2018). Such contrast might pertain to research design. For instance, in Liu et al. (2018), the researchers used 20 neutral and 20 positive two-character Chinese words as the stimuli, which were only matched in terms of arousal (low-arousing words). Therefore, it is possible that the observed effects might have been affected by factors not accounted for other than valence. Besides, linguistic and typological differences in the experimental languages, namely Chinese and Turkish, could potentially influence emotional processing.

The current study demonstrates that valence does not have a significant effect on speed and accuracy of responses in an EST when Turkish stimuli are matched on four variables, i.e., arousal, number of letters, frequency, and concreteness. It may be valuable to apply different tasks, including naming tasks or other paradigms using the same set of stimuli, to explore whether the null effects

observed in this study are replicable, which would provide further insights into the broader applicability of the findings. Nonetheless, it remains possible that the current results are restricted to the particular task employed or participants tested.

6 Conclusion

This study attempted to investigate how monolingual Turkish speakers process emotionally valenced and neutral Turkish words. Utilizing 87 Turkish words matched on different lexical and sub-lexical variables except for valence and dominance ratings as stimuli in the EST, the findings demonstrated that valence did not influence the speed and accuracy of participants' responses. The present research serves as an initial contribution to the examination of affective and neutral word processing within a non-clinical sample of monolingual Turkish speakers. More research on this design with different populations will provide additional insights into the role of valence in lexical processing.

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Submission statement and verification: This study has not been previously published elsewhere. It is not under review in another journal. Publication of the study has been approved, either implicitly or explicitly, by all authors and the responsible authorities at the university/research center where the study was conducted. If the study is accepted for publication, it will not be published in the same form in another printed or electronic medium in Turkish or any other language without the written permission of the Journal of Linguistic Research.

Conflict of Interest Statement: The authors declare that there are no financial or academic conflicts of interest between themselves or with other institutions, organizations or individuals that may affect this study.

Data Use: The data from the emotional Stroop task and regression materials presented in this study can be accessed via the following link: <https://osf.io/tzhyp>

Ethical Approval/Participant Consent: Bahçeşehir University Ethics Committee approval dated 05.08.2024 and numbered E-85646034-604.01-86197 was obtained from the Ethics Committee. Participants were informed about the research, and informed consent was obtained from the participants.

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Appendix:

Neutral: baęlılık, alev, aslan, buhar, döviz, göęüs, perde, řaşkınlık, surat, řehir, yankı, yarışma, řöhret, ödeme, tören, řimşek, beslenme, posta, parti, ördek, merak, řehvet, lider, kismet, isyan, futbol, davul, güçlük, kader

Negative: ayrılık, leke, cehennem, gurbet, kira, intikam, öfke, kargaşa, kötülük, kumar, nefret, sakatlık, şehit, borç, savaş, silah, ameliyat, bekleme, yalnızlık, kurban, kırık, günah, gözyaşı, endişe, eksiklik, yaşlılık, bozukluk, batık, merhum
Positive: tatil, kuvvet, espri, enerji, hayal, gökyüzü, ziyafet, gelişme, hazine, şarkı, temizlik, sevda, yatak, arzu, bebek, beceri, alkış, cesaret, coşku, çaba, fikir, ilham, heyecan, zafer, dilek, yetenek, yolculuk, şeref, şans

References

- Algom, D., Chajut, E., & Lev, S. (2004). A rational look at the emotional Stroop phenomenon: A generic slowdown, not a Stroop effect. *Journal of Experimental Psychology: General*, 133, 323–338.
- Aruntaş, M. A. (2013). *Resolving emotional conflicts in healthy adolescent population* (Publication no. 343110) [Master's thesis, Middle East Technical University].
- Başgöze, Z. (2008). *Emotional conflict resolution in healthy and depressed populations* (Publication no. 233578) [Master's thesis, Middle East Technical University].
- Başgöze, Z. (2015). *The localization of emotional stroop activations in healthy and major depressive disorder populations using fMRI* (Publication no. 425841) [Doctoral dissertation, Middle East Technical University].
- Başgöze, Z., Gönül, A. S., Baskak, B., & Gökçay, D. (2015). Valence-based Word-Face Stroop task reveals differential emotional interference in patients with major depression. *Psychiatry Research*, 229(3), 960-967.
- Ben-David, B. M., Chajut, E., & Algom, D. (2012). The pale shades of emotion: A signal detection theory analysis of the emotional Stroop task. *Psychology*, 3, 537–541.
- Ben-Haim, M. S., Williams, P., Howard, Z., Mama, Y., Eidels, A., & Algom, D. (2016). The emotional Stroop task: assessing cognitive performance under exposure to emotional content. *Journal of visualized experiments: JoVE*, (112), 53720.
- Craig, A. D. (2005). Forebrain emotional asymmetry: a neuroanatomical basis?. *Trends in cognitive sciences*, 9(12), 566-571.
- Crossfield, E., & Damian, M. F. (2021). The role of valence in word processing: Evidence from lexical decision and emotional Stroop tasks. *Acta Psychologica*, 218, 103359.
- Doğanay, E. M. (2023). *The effects of fear vs. anger on emotional Stroop tasks in young adults* (Publication no. 834842) [Master's thesis, Çankaya University].
- Dresler, T., Mériaux, K., Heekeren, H. R., & van der Meer, E. (2009). Emotional Stroop task: effect of word arousal and subject anxiety on emotional interference. *Psychological Research PRPF*, 73, 364-371.
- Eilola, T. M., & Havelka, J. (2011). Behavioural and physiological responses to the emotional and taboo Stroop tasks in native and non-native speakers of English. *International Journal of Bilingualism*, 15, 353–369.

- Eilola, T. M., Havelka, J., & Sharma, D. (2007). Emotional activation in the first and second language. *Cognition and Emotion*, 21, 1064–1076.
- Estes, Z., & Adelman, J. S. (2008). Automatic vigilance for negative words is categorical and general. *Emotion*, 8(4), 453–457. <https://doi.org/10.1037/a0012887>
- Fox, E. (1993). Attentional bias in anxiety: Selective or not? *Behaviour Research and Therapy*, 31, 487-493.
- Fredrickson, B. L. (1998). What good are positive emotions?. *Review of general psychology*, 2(3), 300-319.
- Fredrickson, B. L. (2001). The role of positive emotions in positive psychology: The broaden-and-build theory of positive emotions. *American psychologist*, 56(3), 218.
- Frings, C., Englert, J., Wentura, D., & Bermeitinger, C. (2010). Decomposing the emotional Stroop. *Quarterly Journal of Experimental Psychology*, 63, 42–49.
- Harrell, F. E., Jr. (2020). *Hmisc: Harrell miscellaneous* (Version 4.4-0) [R package]. <https://CRAN.R-project.org/package=Hmisc>
- Hebbali, A. (2020). *olsrr: Tools for building OLS regression models* [R package]. <https://CRAN.R-project.org/package=olsrr>
- Hoffman, P., Lambon Ralph, M. A., & Rogers, T. T. (2013). Semantic diversity: A measure of semantic ambiguity based on variability in the contextual usage of words. *Behavior Research Methods*, 45(3), 718–730. <https://doi.org/10.3758/s13428-012-0278-x>
- Imbir, K. K., Duda-Goławska, J., Pastwa, M., Jankowska, M., & Żygierewicz, J. (2021). Event-related potential correlates of valence, arousal, and subjective significance in processing of an emotional Stroop task. *Frontiers in Human Neuroscience*, 15, 617861.
- Ishihara, S. (1939). *The series of plates designed as tests for colour blindness: Instruction manual*. Kanehara Shuppan Co.
- Juhasz, B. J., Yap, M. J., Dicke, J., Taylor, S. C., & Gullick, M. M. (2011). Tangible words are recognized faster: The grounding of meaning in sensory and perceptual systems. *Quarterly Journal of Experimental Psychology*, 64(9), 1683-1691. <https://doi.org/10.1080/17470218.2011.605150>
- Kahan, T. A., & Hely, C. D. (2008). The role of valence and frequency in the emotional Stroop task. *Psychonomic Bulletin & Review*, 15, 956–960.
- Kaspi, S. P., McNally, R. J., & Amir, N. (1995). Cognitive processing of emotional information in posttraumatic stress disorder. *Cognitive Therapy and Research*, 19, 319-330.
- Kunde, W., & Mauer, N. (2008). Sequential modulations of valence processing in the emotional Stroop task. *Experimental psychology*, 55(3), 151-156.
- Kuperman, V., Estes, Z., Brysbaert, M., & Warriner, A. B. (2014). Emotion and language: Valence and arousal affect word recognition. *Journal of Experimental Psychology: General*, 143, 1065–1081.

- Larsen, R. J., Mercer, K. A., & Balota, D. A. (2006). Lexical characteristics of words used in emotional Stroop experiments. *Emotion, 6*, 62–72.
- Larsen, R. J., Mercer, K. A., Balota, D. A., & Strube, M. J. (2008). Not all negative words slow down lexical decision and naming speed: Importance of word arousal. *Emotion, 8*, 445–452.
- Lavy, E. H., Oppen, P. van, & Hout, M. van den. (1994). Selective processing of emotional information in obsessive-compulsive disorder. *Behaviour Research and Therapy, 32*, 243-246.
- Lazarus, R. S. (1991). *Emotion and adaptation*. Oxford University Press.
- Lenth, R. V. (2025). *emmeans: Estimated marginal means, aka least-squares means* (Version 1.11.0-005) [R package]. <https://rvlenth.github.io/emmeans/>
- Liu, X., Yang, Y., Jiang, S., & Li, J. (2018). The facilitating effect of positive emotions during an emotional Stroop task. *Neuroreport, 29*, 883–888.
- MacKay, D. G., Shafto, M., Taylor, J. K., Marian, D. E., Abrams, L., & Dyer, J. R. (2004). Relations between emotion, memory, and attention: Evidence from taboo Stroop, lexical decision, and immediate memory tasks. *Memory and Cognition, 32*, 474–488.
- MacLeod, C. M. (1991). Half a century of research on the Stroop effect: An integrative review. *Psychological Bulletin, 109*, 163-203.
- Makowski, D., Ben-Shachar, M. S., & Lüdtke, D. (2019). bayestestR: Describing effects and their uncertainty, existence and significance within the Bayesian framework. *Journal of Open-Source Software, 4*(40), 1541. <https://doi.org/10.21105/joss.01541>
- Martin, M., Horder, P., & Jones, G. V. (1992). Integral bias in naming of phobia-related words. *Cognition and Emotion, 6*, 479-486.
- Mathews, A., Mogg, K., Kentish, J., & Eysenck, M. (1995). Effect of psychological treatment on cognitive bias in generalized anxiety disorder. *Behaviour research and therapy, 33*(3), 293-303.
- Mathews, A. M., & Sebastian, S. (1993). Suppression of emotional Stroop effects by fear arousal. *Cognition and Emotion, 7*, 517-530.
- Mattia, J. I., Heimberg, R. G., & Hope, D. A. (1993). The revised Stroop color-naming task in social phobics. *Behaviour Research and Therapy, 31*, 305-313.
- McKenna, F. P. (1986). Effects of unattended emotional stimuli on color-naming performance. *Current Psychological Research & Reviews, 5*, 3-9.
- McKenna, F. P., & Sharma, D. (1995). Intrusive cognitions: An investigation of the emotional Stroop task. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 21*, 1595–1607.
- McKenna, F. P., & Sharma, D. (2004). Reversing the emotional Stroop effect reveals that it is not what it seems: the role of fast and slow components. *Journal of Experimental Psychology: Learning, Memory, and Cognition, 30*(2), 382.

- McNally, R. J., Riemann, B. C., Louro, C. E., Lukach, B. M., & Kim, E. (1992). Cognitive processing of emotional information in panic disorder. *Behaviour Research and Therapy*, 30, 143-149.
- Mergen, F., & Kuruođlu, G. (2017). A comparison of Turkish-English bilinguals' processing of emotion words in their two languages. *Eurasian Journal of Applied Linguistics*, 3(2), 89-98.
- Mergen, F., & Kuruođlu, G. (2021). Lateralization of lexical processing in monolinguals and bilinguals. *International Journal of Bilingualism*, 25(6), 1497-1509.
- Morey, R. D., & Rouder, J. N. (2018). *BayesFactor: Computation of Bayes factors for common designs* (Version 0.9.12-4.2) [R package]. <https://CRAN.R-project.org/package=BayesFactor>
- Okada, K., He, G., & Gonzales, A. (2019). Monolinguals and bilinguals differ in performance on the Taboo Stroop task. *The Open Psychology Journal*, 12(1).
- Parris, B. A., Hasshim, N., Wadsley, M., Augustinova, M., & Ferrand, L. (2022). The loci of Stroop effects: A critical review of methods and evidence for levels of processing contributing to color-word Stroop effects and the implications for the loci of attentional selection. *Psychological Research*, 86(4), 1029–1053. <https://doi.org/10.1007/s00426-021-01554-x>
- Pratto, F., & John, O. P. (1991). Automatic vigilance: The attention-grabbing power of negative social information. *Journal of Personality and Social Psychology*, 61, 380–391.
- Psychology Software Tools, Inc. (2016). *E-Prime 3.0* [Computer software]. <https://support.pstnet.com/>
- R Core Team. (2020). *R: A language and environment for statistical computing* [Computer software]. R Foundation for Statistical Computing. <https://www.R-project.org/>
- Segal, Z. V., Truchon, C., Horowitz, L. M., Gemar, M., & Guirguis, M. (1995). A priming methodology for studying self-representation in major depressive disorder. *Journal of Abnormal Psychology*, 104, 205-213.
- Sezer, T., & Sezer, T. (2013, May). *TS Corpus: Herkes için Türkçe derlem*. In *Proceedings of the 27th National Linguistics Conference* (pp. 217–225).
- Singmann, H., Bolker, B., Westfall, J., & Aust, F. (2020). *afex: Analysis of factorial experiments* (Version 0.27.2) [R package]. <https://github.com/singmann/afex>
- Stroop, J. R. (1935). Studies of interference in serial verbal reactions. *Journal of experimental psychology*, 18(6), 643.
- Sutton, T. M., Altarriba, J., Gianico, J. L., & Basnight-Brown, D. M. (2007). The automatic access of emotion: Emotional Stroop effects in Spanish–English bilingual speakers. *Cognition and Emotion*, 21(5), 1077-1090.
- Tekcan, A. İ., & Göz, İ. (2005). *600 Türkçe kelimenin imgelem, somutluk, sıklık deđerleri ve çağırısım setleri*. Bođaziçi Üniversitesi Yayınları.

- Warriner, A. B., Kuperman, V., & Brysbaert, M. (2013). Norms of valence, arousal, and dominance for over 13,915 English lemmas. *Behaviour Research Methods, 45*, 1191–1207.
- Waters, A. J., Sayette, M. A., Franken, I. H., & Schwartz, J. E. (2005). Generalizability of carry-over effects in the emotional Stroop task. *Behaviour research and therapy, 43*(6), 715-732.
- Williams, J. M. G., Mathews, A., & MacLeod, C. (1996). The emotional Stroop task and psychopathology. *Psychological Bulletin, 120*, 3–24.
- Yap, M. J., & Seow, C. S. (2014). The influence of emotion on lexical processing: Insights from RT distributional analysis. *Psychonomic Bulletin & Review, 21*, 526–533.