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The research data are available from the corresponding author upon reasonable request.

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# Digital nudges for online food selection: the interaction of emotional eating and psychological traits in university students

## *Estímulos digitais para a seleção de alimentos em linha: a interação entre a alimentação emocional e as características psicológicas em estudantes universitários*

Zehra Margot Çelik<sup>1</sup> , Hatice Merve Bayram<sup>2</sup> , Gizem Topalçı<sup>3</sup> 

<sup>1</sup> Marmara University, Faculty of Health Sciences, Department of Nutrition and Dietetics. Istanbul, Türkiye. Correspondence to: ZM ÇELİK. E-mail: <zcelik@marmara.edu.tr>.

<sup>2</sup> Istanbul Gelisim University, Faculty of Health Sciences, Department of Nutrition and Dietetics. Istanbul, Türkiye.

<sup>3</sup> Üsküdar University, Institute of Social Sciences, Clinical Psychology Master's Program. Istanbul, Türkiye.

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### ABSTRACT

#### Objective

This study aimed to examine the impact of digital nudge models and emotional eating behaviors on online food choices among university students.

#### Methods

This cross-sectional study was conducted on 356 students (87.1% female). Data were collected via an online questionnaire, including the Barratt Impulsivity Scale, Twenty-item Toronto Alexithymia Scale, and the Emotional Eater Questionnaire. Four digital nudge categories were used (default, highlighting, social influence, and warning) to assess their influence on food choice. Additionally, body weight and height were taken with the participants' declaration. Data were analyzed using IBM®SPSS® 24.0.

#### Results

The most frequently selected food category was hamburgers (n=282), with the warning nudge in the dessert category being the most effective (43.3%), followed by the social influence nudge (31.3%). There was no significant correlation between impulsivity, emotional eating, and digital nudge effectiveness ( $p>0.05$ ). However, gender differences were noted, with females responding more to social influence nudges. There was a moderate positive correlation between Emotional Eater Questionnaire and body mass index and Twenty-item Toronto Alexithymia Scale ( $r=0.315$ ,  $p<0.001$ ,  $r=0.347$ ,  $p<0.001$ , respectively). Furthermore, the Barratt Impulsivity Scale showed a weak positive correlation with Twenty-item Toronto Alexithymia Scale ( $r=0.127$ ,  $p<0.05$ ).

#### Conclusion

Digital nudges influenced food choices; however, psychological factors such as impulsivity and emotional eating did not significantly affect their effectiveness. Future research could explore the role of psychological traits in digital nudging for healthier food choices.

**Keywords:** Alexithymia. Digital nudge. Eating behaviors. Emotional eating. Food choice. Impulsivity.



## RESUMO

### Objetivo

Este estudo teve como objetivo analisar o impacto dos padrões digitais de nudge e dos comportamentos alimentares emocionais nas escolhas alimentares online entre estudantes universitários.

### Métodos

Este estudo transversal foi realizado com 356 estudantes (87,1 % do sexo feminino). Os dados foram recolhidos através de um questionário em linha, incluindo a Escala de Impulsividade de Barratt, a Escala de Alexitimia de Toronto de vinte itens e o Questionário de Comedores Emocionais. Foram utilizadas quatro categorias de estímulos digitais (padrão, destaque, influência social e aviso) para avaliar a sua influência na escolha dos alimentos. Além disso, foram registados o peso e a altura dos participantes. Os dados foram analisados com o IBM®SPSS® 24.0.

### Resultados

A categoria de alimentos mais frequentemente selecionada foi a dos hambúrgueres ( $n=282$ ), sendo o empurrão de aviso na categoria das sobremesas o mais eficaz (43,3%), seguido do empurrão de influência social (31,3%). Não se verificou uma correlação significativa entre a impulsividade, a alimentação emocional e a eficácia do incentivo digital ( $p>0,05$ ). No entanto, foram observadas diferenças entre os géneros, com as mulheres a responderem mais aos estímulos de influência social. Verificou-se uma correlação positiva moderada entre o Questionário de Comedores Emocionais e o índice de massa corporal e a Escala de Alexitimia de Toronto de vinte itens ( $r=0,315$ ,  $p<0,001$ ,  $r=0,347$ ,  $p<0,001$ , respetivamente). Além disso, a Escala de Impulsividade de Barratt mostrou uma correlação positiva fraca com a Escala de Alexitimia de Toronto de vinte itens ( $r=0,127$ ,  $p<0,05$ ).

### Conclusão

Os estímulos digitais influenciaram as escolhas alimentares; no entanto, fatores psicológicos como a impulsividade e a alimentação emocional não afetaram significativamente a sua eficácia. Investigações futuras poderão explorar o papel dos traços psicológicos no estímulo digital para escolhas alimentares mais saudáveis.

**Palavras-chave:** Alexitimia. Incentivo digital. Comportamentos alimentares. Alimentação emocional. Escolha de alimentos. Impulsividade.

## INTRODUCTION

Impulsivity can be defined as a set of rapid and unplanned movements made without the opportunity to logically filter the results of conscious action [1]. Individuals with impulsive tendencies exhibit a set of characteristics, including risk-taking, carelessness, impatience, excitement, pleasure-seeking, inability to calculate the possibility of harm, and extroversion [2]. Impulsivity is associated with a range of conditions, including personality disorders, impulse control disorders, alcohol abuse, obesity, attention deficit hyperactivity disorder and bipolar disorder [3]. Furthermore, impulsive behaviors have been linked to negative eating behaviors [4]. Existing literature suggests that individuals with obesity are more prone to impulsive behaviors in comparison to their normal-weight counterparts [5,6]. Furthermore, a correlation has been identified between impulsivity and the pleasure derived from consuming palatable foods in the absence of hunger or satiety [7].

Nudging is a strategy designed to influence individuals' behavior in a predictable way without imposing restrictions or significantly altering their economic incentives [8]. The nudging technique can be used to influence health-related choices, as demonstrated in a study where vending machine wraps featuring brand logos, colors, or beverage images were used as priming nudges to guide beverage selection [9]. With the increasing prevalence of online food ordering, the concept of digital nudging has emerged as a powerful tool to shape consumer decisions in digital environments. Digital nudging involves altering the user interface or design to guide choices, as demonstrated in domains such as health, e-commerce, and transportation [10,11]. Even though research into digital nudges in the context of online dining options has been conducted across a range of fields, there

is a notable dearth of studies in this area [12]. Extant research has predominantly concentrated on the identification of the most significant digital stimuli, namely the default nudge and social influences [13-15].

The current study is grounded in Self-Regulation Theory, which posits that individuals with poor self-regulation are more likely to engage in impulsive behaviors, including unhealthy food choices [16]. Dual-Process Theory provides a framework for understanding how digital nudges influence decision-making by distinguishing between two cognitive systems: System 1 (automatic, intuitive processing) and System 2 (deliberate, rational processing). Decision-making models should account for both rational and behavioral assumptions, as individuals frequently rely on heuristics and cognitive biases when making choices [17]. Digital nudges primarily target System 1 by subtly guiding users toward healthier choices without requiring conscious deliberation. However, individuals with high impulsivity or alexithymia may be less responsive to such nudges because their decision-making processes are dominated by automatic, emotion-driven choices. Furthermore, Affect Regulation Theory suggests that individuals prone to emotional eating use food as a coping mechanism to regulate negative emotions [18]. This may reduce the effectiveness of digital nudges since emotionally driven food choices are motivated by immediate affective needs rather than external cues like warnings or social influence. Given these theoretical perspectives, this study seeks to investigate whether impulsivity, alexithymia, and emotional eating moderate the effectiveness of digital nudges in shaping online food selection behaviors.

The phenomenon of eating behavior is a complex process, with intrinsic, environmental and social effects [19]. Understanding the factors that shape food choices is crucial for public health as it reveals the complex and personal process by which individuals balance health with other priorities in their diets [20]. An understanding of the decision-making processes employed by consumers in the context of a complex food environment can facilitate the development of insights into the factors that influence their food purchasing choices. This is referred to as the optimization of choice architecture, which constitutes the second fundamental principle of nudging [21]. One method of achieving this is by making the act of nudging itself more visible by displaying calorie information on billboards and restaurant menus, which can then guide consumers towards lower calorie choices [22]. Although prior studies have examined digital nudging in various consumer contexts [14,15], the interaction between digital nudges and psychological traits related to eating behaviors remains insufficiently addressed. Therefore, this study aims to explore the relationship between psychological traits and the effectiveness of digital nudges in online food selection. Specifically, it investigates whether individuals with higher emotional eating scores are less responsive to digital nudges that encourage healthy choices. Additionally, the study examines whether impulsivity and alexithymia moderate the impact of digital nudges, potentially reducing their effectiveness in guiding food choices. Furthermore, it assesses whether social influence nudges are more effective among individuals with lower self-control, as they may rely more on external cues in decision-making. Lastly, the study evaluates whether warning nudges are more influential in altering food choices compared to other nudge types, particularly for individuals with high levels of self-regulation.

## METHODS

### Study design and participants

This cross-sectional study recruited university students from various academic disciplines through an online survey platform. The sample size was calculated as 320 using the Epi Info program,

with a frequency of occurrence of 50%, a bias level of 5%, a pattern effect of 1, and a 99% confidence interval. An online questionnaire was sent to 1,000 students between January and May 2024 as part of the study, and 450 completed questionnaires were received. Of these, 356 students with complete data were included in the study. Participants were required to be at least 18 years old and have prior experience ordering food online. Those with dietary restrictions that significantly limit food choices (e.g., severe food allergies) were excluded from the study to maintain the generalizability of results.

University students were selected as the target population for this study due to their high engagement in digital food consumption and susceptibility to impulsive decision-making influenced by digital interfaces [14]. Given their frequent reliance on online food delivery services and exposure to digital marketing strategies, university students serve as an ideal group for assessing the impact of digital nudges on food selection behaviors.

All procedures followed the tenets of the Declaration of Helsinki. The study was approved (Approval number: 2023/142) by the Marmara University Non-Interventional Clinical Research Ethics Committee on 28.12.2023. All subjects provided written and verbally informed consent.

## Measures

A 13-item questionnaire was developed by researchers to assess students' sociodemographic characteristics, general health status, digital behavior, and dietary habits. This included questions on age, gender, academic major, chronic conditions, screen time, and frequency of online food ordering. The questionnaire also asked participants to self-report their weight and height, which were used to calculate Body Mass Index (BMI).

This questionnaire was created based on relevant literature and expert opinion but was not subjected to a separate validation process, as it served an exploratory and descriptive purpose within this study [9,13,14]. While it was not subjected to a formal psychometric validation process – such as exploratory or confirmatory factor analysis – it served as a contextual, exploratory tool to characterize the study sample. The aim was not to measure latent constructs but to provide descriptive variables for subgroup analyses and correlation testing. Therefore, validation procedures were not deemed necessary for this specific exploratory use.

### *Barratt Impulsiveness Scale (BIS-11-SF)*

Barratt Impulsivity Scale Short Form (BIS-11-SF) is a short version adapted from the 30-item 'Barratt Impulsivity Scale' developed by Patton, Stanford, and Barratt in 1995 and validity and reliability study conducted by Spinella in 2007. It is a self-report scale that is answered with a 4-point Likert scale (rarely/never, sometimes, frequently, and almost always/always) and evaluates the appearance of impulsivity [23,24]. The scale consists of three sub-factors: Inability to Plan, Motor Impulsivity and Attentional Impulsivity. While the items of the scale are scored from 1 to 4, scoring is carried out in the opposite way for items marked in reverse. Turkish adaptation was conducted by Tamam et al. [25]. In the evaluation of the Barratt Impulsivity Scale Short Form, when the total score increases, impulsive behavior also increases.

### *Twenty-item Toronto Alexithymia Scale (TAS-20)*

Twenty-item Toronto Alexithymia Scale (TAS-20) is a scale developed by Bagby et al. [26] consisting of 20 items and 3 sub-dimensions (Difficulty Recognizing Emotions, Difficulty Expressing

Emotions and Expressive Thinking. The Turkish adaptation of the scale was carried out by Güleç et al. [27] in 2009. The scale is designed to examine the presence of alexithymic features and is a 5-point Likert type. Items 4, 5, 10, 18 and 19 are reverse scored. The higher the score obtained from the scale, the higher the level of alexithymia.

#### *Turkish Version of the Emotional Eater Questionnaire (EEQ-TR)*

The Emotional Eating Scale was developed by Garaulet et al. [28] to assess emotional eating. The Turkish adaptation of the scale was conducted by Arslantaş et al. [29]. The scale, which evaluates the effect of emotions on eating behavior, consists of 10 questions and 3 sub-dimensions (inability to prevent food cravings, food types, and guilt). The scale is scored as Never (0), Sometimes (1), Usually (2) and Always (3). An increase in the score obtained from the scale indicates an increase in emotional eating behavior.

### **Experimental design and procedure**

A between-subjects experimental design was implemented, in which participants were randomly assigned to one of four digital nudge conditions: default, highlighting, social influence, and warning nudges. Participants viewed a simulated online food ordering interface displaying food choices with the respective nudge manipulation. They were then asked to select their preferred food items. After making their selections, they completed the psychological assessments and provided demographic information.

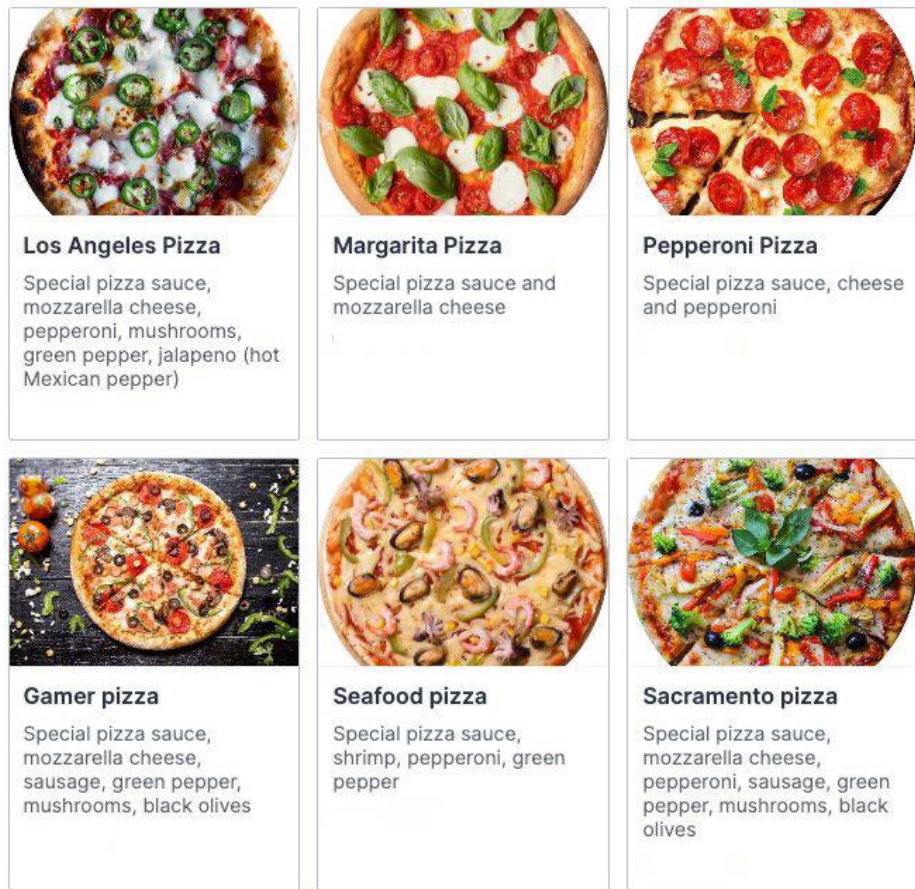
In this study, four categories of food (hamburgers, pizza, kebab –Turkish cuisine, and chocolate desserts) were selected from the main food categories available on online food websites based on the most preferred food types identified in previous studies conducted in Türkiye [30,31]. The extant literature suggests that the use of six items is an effective method for avoiding the effects of choice overload [32]. Consequently, the six most popular dishes within the categories were selected and images of each dish were obtained from royalty-free websites. Furthermore, supplementary data were gathered in alignment with the content displayed on the websites and presented in the questionnaire. The digital nudge models were examined under four subheadings: default, highlighting, social influence, and warning.

**Default:** This is one of the most prominent digital nudges found in the literature [10]. The nudge consists of the pre-selection of a choice of topics. This pre-selection is not necessarily the first item on a list [33]. For this reason, in the survey, when the participants opened the page with the options, the “Lahmacun” dish was already selected in the kebab-Turkish cuisine category.

**Highlighting:** This nudge emphasizes the visual salience of options to increase attention directed at participants [34,35]. Usually, this is done by changing the size and color of the text or increasing the contrast of the options. To determine the highlighting nudge, colored background behind the “Gamer Pizza” option in the pizza category was used while the other options had white backgrounds (Figure 1).

**Social influence:** In situations of uncertainty, people tend to follow the leadership of other like-minded people [34]. Some of the psychological phenomena described in the literature include people following the crowd, following opinion leaders, or conforming to social norms [34-36]. Based on one of these phenomena, a social nudge was created for the “Cheeseburger” option in the hamburger category to measure social influence. Only Cheeseburger had a statement as “90% of other people liked this”.

## Pizzas



**Figure 1** – Highlight nudge.

Note: The items displayed to participants in the pizza category were presented in accordance with the highlight-nudge model. The five pizzas were presented with a plain white background, while the Gamer Pizza background was presented in a different manner. The images and ordering of the questionnaire used in the study were preserved and translated from the original Turkish language into English for presentation here.

Warning: The warning nudge does not encourage people to direct their decisions towards a specific item, but rather to change an initial choice [37]. For this reason, the dessert category was selected to evaluate the effectiveness of the warning impulse. The warning statement for the “Profiterole” option in this category was: “Please note that this dessert contains high calories”.

### Data analysis

Data were analyzed using IBM®SPSS® 24.0. Categorical data were expressed as the frequency (percentage), and differences were analyzed using Fisher’s exact test (when any expected cell count  $\leq 5$ ) or the chi-square test. The normality of data distribution was assessed using the Kolmogorov-Smirnov test. The ANOVA test was used to compare the mean values of data for groups that had normal distribution, while the Kruskal-Wallis test was used to compare the data from groups that did not fit the normal distribution. Spearman correlation was used for analyzing the relationship age, BMI, BIS-11-SF, TAS-20 and EEQ-TR scores. For all statistical tests, a  $p$ -value of  $<0.05$  was considered statistically significant.

## RESULTS

Table 1 shows the demographic characteristics of students. A total of 356 students (87.1% female) participated in the study. The mean age of the students was  $21.53 \pm 2.14$  years and BMI was  $22.02 \pm 3.70$  kg/m<sup>2</sup>. The distribution of academic majors showed that 39.6% of participants were enrolled in Nutrition and Dietetics, while 60.4% were from other disciplines. Most participants reported no chronic disease (76.1%), and the majority (37.1%) ordered food online 1-3 times per month. The psychological trait scores were as follows: the mean BIS-11-SF score was  $34.08 \pm 8.63$ , the mean TAS-20 score was  $53.08 \pm 9.75$ , and the mean EEQ-TR score was  $11.81 \pm 5.80$ .

**Table 1** – Demographical characteristics (n=356).

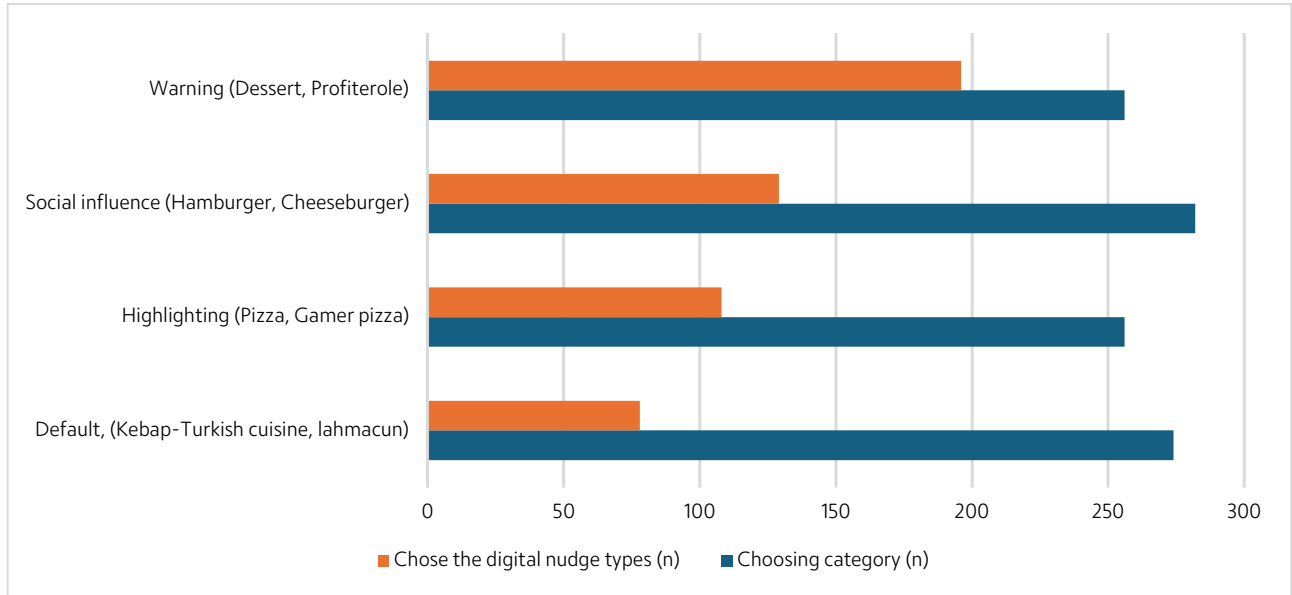
Parameters	n	%
Age (mean±SD)		21.53±2.14
Gender		
Male	46	12.9
Female	310	87.1
Department		
Nutrition and Dietetics	141	39.6
Others	215	60.4
Presence of a chronic disease		
Yes	85	23.9
No	271	76.1
Medication use		
Yes	60	16.9
No	296	83.1
Digital screen exposure time (min/day) (mean±SD)		336.73±125.29
Frequency of ordering food online		
Less than 1 per month	116	32.6
1-3 times a month	132	37.1
1 time per week	52	14.6
2-3 times a week	37	10.4
4-5 times a week	16	4.5
Everyday	3	0.8
Body weight (kg) (mean±SD)		60.76±13.07
Height (cm) (mean±SD)		165.67±7.73
BMI (kg/m <sup>2</sup> ) (mean±SD)		22.02±3.70
BIS-11-SF (mean±SD)		34.08±8.63
TAS-20 (mean±SD)		53.08±9.75
EEQ-TR (mean±SD)		11.81±5.80

Note: BMI: Body Mass Index; BIS-11-SF: Barratt Impulsivity Scale Short Form; TAS-20: Twenty-item Toronto Alexithymia Scale; EEQ-TR: Turkish Version of the Emotional Eater Questionnaire.

Among the three main food categories presented, the hamburger category was selected by the majority of participants (n=282, 79.2%), indicating a strong preference for fast-food options among university students. Regarding the nudge types, the warning nudge in the dessert category was the most effective, influencing 43.3% (n=196) of participants to modify or reconsider their choices, followed by the social influence nudge in the hamburger category (31.3%, n=129). Figure 2 illustrates the distribution of food category and nudge selections.

Spearman correlation analyses were conducted to assess the relationships between BMI and psychological traits. As shown in Table 2, EEQ-TR scores were positively moderate correlated

with BMI and TAS-20 ( $r=0.315$ ,  $p<0.001$ ,  $r=0.347$ ,  $p<0.001$ , respectively). A weak but significant correlation was also observed between BIS-11-SF and TAS-20 scores ( $r=0.127$ ,  $p<0.05$ ), indicating that impulsivity was moderately associated with alexithymic tendencies.



**Figure 2** – Distribution of digital nudging type selections according to food categories.

**Table 2** – Correlation of age, BMI, BIS-11-SF, TAS-20 and EEQ-TR scores.

Parameters	1	2	3	4
1. Age	-			
2. BMI	0.027	-		
3. BIS-11-SF	0.029	-0.083	-	
4. TAS-20	-0.007	-0.070	0.127*	-
5. EEQ-TR	-0.081	0.315**	0.045	0.347**

Note: Spearman correlation was used. \* $p<0.05$ , \*\* $p<0.001$ . BIS-11-SF: Barratt Impulsivity Scale Short Form; BMI: Body Mass Index; EEQ-TR: Turkish Version of the Emotional Eater Questionnaire; TAS-20: Twenty-item Toronto Alexithymia Scale.

Table 3 shows the relationship between the choice of digital nudge types and some demographic characteristics, BIS-11-SF, TAS-20 and EEQ-TR scales. Among all nudge types, only the social influence nudge showed a statistically significant gender difference: females were more likely to choose social influence nudges compared to males ( $p=0.032$ ). No statistically significant differences were observed between the nudge groups in terms of BMI, department, or psychological trait scores (BIS-11-SF, TAS-20, EEQ-TR).

## DISCUSSION

This study is to our knowledge the first to investigate the moderating effects of impulsivity, alexithymia, and emotional eating on the effectiveness of digital nudges in online food selection. The preferred category of the participants was the hamburger category. The warning nudge was

**Table 3** – The relationship between the choice of digital nudge types and some demographic characteristics, BIS-11-SF, TAS-20 and EEQ-TR scales.

Parameters	Digital Nudge Types											
	Default (Kebab-Turkish Cuisine, Lahmacun)			Highlighting (Pizza, Gamer pizza)			Social Influence (Hamburger, Cheeseburger)			Warning (Chocolate Dessert, Profiterole)		
	Choosing nudge types	Not choosing nudge types	<i>p</i> -value	Choosing nudge types	Not choosing nudge types	<i>p</i> -value	Choosing nudge types	Not choosing nudge types	<i>p</i> -value	Choosing nudge types	Not choosing nudge types	<i>p</i> -value
	n (%)			n (%)			n (%)			n (%)		
Gender			0.057			0.607			0.032			1.000
Male	5 (10.9)	41 (89.1)		12 (26.1)	34 (73.9)		10 (21.7)	36 (78.3)		38 (82.6)	8 (17.4)	
Female	73 (23.5)	237 (76.5)		96 (31.0)	214 (69.0)		119 (38.4)	191 (61.6)		258 (83.2)	52 (16.8)	
Department			0.297			0.126			0.143			0.885
Nutrition and Dietetics	35 (24.8)	43 (20.0)		36 (25.5)	72 (33.5)		58 (41.1)	71 (33.0)		37 (17.2)	23 (16.3)	
Others	106 (75.2)	172 (80.0)		105 (74.5)	143 (66.5)		83 (58.9)	144 (67.0)		178 (82.8)	118 (83.7)	
BIS-11-SF	34.34±9.14	34.01±8.49	0.798	33.98±8.89	34.13±8.53	0.885	34.52±8.39	33.83±8.76	0.395	34.17 ± 8.70	33.66 ± 8.28	0.713
TAS-20	51.41±9.71	52.27±9.77	0.255	51.75±10.67	52.22±9.34	0.546	53.41± 9.57	51.32±9.79	0.069	52.18 ± 9.73	51.58 ± 9.90	0.329
EEQ-TR	11.74±6.28	11.83±5.67	0.759	11.90±6.09	11.77±5.69	0.911	12.34±5.91	11.51±5.74	0.227	12.00 ± 6.04	10.88 ± 4.40	0.485
BMI (kg/m <sup>2</sup> )	22.14±3.44	21.98±3.77	0.454	22.16±3.89	21.95±3.61	0.770	21.52±3.54	22.30±3.76	0.067	22.11 ± 3.74	21.57 ± 3.46	0.329

Note: BIS-11-SF: Barratt Impulsivity Scale Short Form; BMI: Body Mass Index; EEQ-TR: Turkish Version of the Emotional Eater Questionnaire; TAS-20: Twenty-item Toronto Alexithymia Scale.

the preferred nudge with 43.3%, followed by social influence nudge with 31.3%. Furthermore, a statistical difference was found for genders only between those who chose social impact nudge type and those who did not. However, department BMI, emotional eating, alexithymia, and impulsivity did not statistically affect digital nudge selection.

Notably, individuals with higher emotional eating scores demonstrated lower responsiveness to digital nudges promoting healthy choices. This finding supports prior research indicating that emotional eaters tend to consume energy-dense foods as a coping mechanism, making them less receptive to nudges aimed at healthier selections [38]. Alexis et al. [39], further emphasize that emotional eating is associated with deficits in emotion regulation and inhibition, reinforcing the challenge of modifying such behaviors through external interventions. These results suggest that addressing the underlying mechanisms of emotional eating – such as difficulties in emotion regulation – may be essential for enhancing the effectiveness of nudging strategies.

Gender differences in nudge effectiveness were also observed with female participants responding more strongly to social influence nudges. This finding is consistent with studies suggesting that women are more sensitive to social norms and external cues when making food-related decisions [36]. In contrast, Jesse et al., suggest that men may respond more favorably to digital nudges, experiencing fewer decision-making difficulties [14]. Additional research indicates that women prioritize personal preferences and product quality in food selection, whereas men are more influenced by environmental and social factors [40-42]. Our study supports these findings, as gender was a significant factor only in the social influence nudge condition. Therefore, it is important to consider gender-specific trends when designing digital interventions.

Among the various nudge types examined, warning nudges in the dessert category had the strongest effect, followed by social influence nudges in the hamburger category. This is consistent with prior studies showing that consumers are significantly influenced by textual warnings and user-generated reviews in online food ordering environments [43]. Additionally, Jesse et al. [14], demonstrated that hybrid models combining default and social influence nudges exert the greatest impact, particularly when participants are warned about unhealthy options. Furthermore, our study found a positive correlation between emotional eating, impulsivity, and alexithymia. This aligns with research showing that alexithymic individuals – who struggle to identify and express emotions – are more prone to emotional eating [44,45]. Given that our sample was predominantly female and comprised health sciences students, this may have influenced the overall results, as this population tends to have greater nutritional awareness and healthier eating behaviors.

From a theoretical perspective, these results highlight the complex interplay between psychological traits and digital nudging strategies. While impulsivity and alexithymia did not act as significant moderators, emotional eating emerged as a key factor, reinforcing the need for interventions that integrate emotion regulation strategies [46]. Practical applications of this research suggest that integrating mindfulness-based prompts or stress management tools into digital platforms could mitigate the effects of emotional eating and enhance the overall effectiveness of nudging strategies. These findings have practical implications for digital marketing, public health strategies, and online food platforms. For example, social influence nudges can be enhanced by integrating real-time user-generated ratings or peer reviews to increase credibility and persuasion. Similarly, warning nudges could be personalized using data from users' previous food choices – such as suggesting lower-calorie alternatives when a high-calorie item is selected. Such strategies could improve user engagement while promoting healthier decision-making in digital food environments.

Understanding these dynamics is crucial for analyzing how individuals make food choices, particularly in digital environments where nudges are employed. Nudges emphasizing healthier alternatives may be particularly effective for individuals with lower self-control, as they may be more prone to impulsive decision-making [47]. Moreover, individuals with high levels of alexithymia – who often experience difficulties in emotional processing – may struggle to engage with emotion-driven nudging strategies, potentially limiting the effectiveness of such interventions in promoting healthier food choices [48]. Interestingly, the findings suggest that low self-control could facilitate healthier choices when nudges are appropriately tailored [49]. Our findings indicate that impulsivity, as measured by the BIS-11 SF, did not significantly influence the effectiveness of digital nudges on online food choices. This suggests that regardless of an individual's level of impulsivity, digital nudges can still play a role in guiding food selection behaviors. These results imply that digital nudging strategies may be broadly applicable across different impulsiveness, and alexithymia levels, offering a promising approach for promoting healthier food choices in online environments.

Additionally, emotional eating can significantly influence dietary choices and overall health outcomes [50]. This behavior can often lead individuals to choose energy-dense and palatable foods, exacerbating problems such as obesity and related health conditions [51]. However, our findings revealed no significant relationship between the emotional eating tendencies, as measured by the EEQ-TR, and the effectiveness of different types of digital nudges on online food choices. This indicates that emotional eating tendencies, as measured by the questionnaire, do not appear to interact with or influence the impact of digital nudging strategies. This suggests that digital nudges may be effective across various eating behavior profiles, including those prone to emotional eating.

In practical terms, these findings suggest that digital nudges can be tailored to specific user profiles to maximize their impact. For instance, social influence nudges may be particularly effective for female users, while warning nudges could be designed to target individuals with higher levels of self-regulation. Moreover, understanding the role of emotional regulation in eating behavior may guide the development of more comprehensive and personalized digital interventions.

While this study provides valuable insights, certain limitations must be acknowledged. First, this study was cross-sectional, therefore, no direct cause and effect relationship can be established. Secondly, the study consisted of university students, which affects the generalizability of the study among other age groups. Thirdly, 39.6% of the participants were studying in the department of nutrition and dietetics. This may have reduced the effectiveness of the selection of digital nudge models due to their tendency to choose healthier foods due to nutritional education. Fourth, most of the participants were women. Considering that women are more likely to make healthy food choices, this may have reduced the selection of digital nudge models. Furthermore, it is important to acknowledge that the statistical power of some comparisons may be limited due to uneven distribution of nudge selection across categories. Future studies with larger and more balanced samples could further validate and deepen the interpretation of these results. However, the study also has strengths. To our knowledge, this is the first study to assess the relationship between impulse, alexithymia, emotional eating and digital nudge in online food selection. Moreover, the digital nudge types examined are some of the most analyzed in the literature.

## CONCLUSION

In conclusion, while digital nudges hold potential for guiding healthier food choices, their effectiveness appears contingent on individual psychological traits. Future research should explore

personalized nudging approaches tailored to emotional eaters, as well as gender-based variations in responsiveness. These insights could inform the development of more effective digital interventions for promoting healthier eating behaviors in online food environments.

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## CONTRIBUTORS

Conceptualization, Methodology, Data curation, Investigation, Software, Writing – original draft. Writing – review & editing: ZM ÇELİK, HM BAYRAM, and G TOPALCI.