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Research Note

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Effects of distractions such as audio, audiovisual, and hand-use on food intake and satiety ratings

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Conflict of Interest
There are no financial or other issues that might lead to conflict of interest.

ABSTRACT

Purpose: Various forms of distraction can have different effects on food intake. Distraction can draw attention away from the food being consumed and inhibit monitoring of food intake This study examined the effects of different levels of distraction on eating behaviors.
Methods: The study was conducted using a repeated-measures design. The participants (10 males, 13 females) were served test meals (curry rice, 800 g) with the same volume at lunch for 4 weeks. The eating behaviors were analyzed during 4 distraction sessions: first session (without distraction), second session (audio distraction, radio), third session (audiovisual distraction, television), and fourth session (audiovisual distraction and hand-use, smartphone). The satiety ratings were measured using a 100 mm visual analog scale.
Results: The participants consumed more food during the fourth session than during other sessions. In addition, the mealtime duration in the fourth session was longer than that in the other sessions (audiovisual distraction and hand-use, 13.74 minutes vs. without distraction, 10.36 minutes; audio distraction, 8.31 minutes; and audiovisual distraction, 9.61 minutes; $p < 0.05$). As the satiety ratings obtained before and after consumption of the test meals in each distraction session, participants felt significantly more satiated 30 minutes after consuming the test meal in the first session than they did in the other distraction sessions (without distraction, 84.23 mm vs. audio distraction, 76.07 mm; audiovisual distraction, 68.93 mm; and audiovisual distraction and hand-use, 74.70 mm; $p < 0.05$).
Conclusion: Different levels of distraction can have different effects on eating behaviors and when distractions become diverse and selectable, food intake may be affected by distraction.

Keywords: eating behavior; smartphone; food intake; attention; television

INTRODUCTION

The mechanism that controls eating behavior is very complex. Many studies have shown that biological factors such as blood sugar levels, gastric function, and hormone levels are important factors related to food intake [1,2]. In addition, several recent studies have proven that psychological factors are also related to reckless eating [3,4], indicating that they are related to eating behavior. One psychological factor that has received considerable research interest over the past few years is distraction during food intake [5-8]. Food intake is influenced by various distractions that require the use of cognitive functions,

such as the auditory sense, audiovisual sense, and combined functions using the hands [9,10]; distraction may draw the attention away from the food being consumed and inhibit monitoring of food intake [6,7]. This could result in inaccurate evaluation of food intake and cause overeating when compared to non-distracting situation [8-11]. Considering this, this study aimed to evaluate the effects of different levels of distraction on food intake.

METHODS

Participants

Participants were recruited through advertisements placed in a local newspaper. Individuals who responded to the advertisements were interviewed to ensure they met the following criteria: healthy men or women; aged 20–50 years; with a body mass index of 18–25 kg/m^2. Potential participants were interviewed to determine whether they were in good health, were not currently on a weight-loss diet or trying to gain weight, were not using medication known to affect dietary intake or appetite, had no food allergies or food restrictions that could affect dietary intake, and regularly ate 3 meals per day. The potential participants completed the following questionnaires: Eating Attitudes Test (EAT-40) [12], which is used to detect symptoms of an eating disorder, and the Zung Self-Rating Depression Scale (Zung Questionnaire) [13], which is used to assess depression. The potential participants were excluded if they scored ≥ 30 on the EAT-40 and ≥ 40 on the Zung Questionnaire.

Procedures

The study was conducted using a repeated-measures design. The participants were served test meals at 4 experimental lunch sessions on different days, at intervals of at least 7 days between sessions. In the first session, the participants consumed the meals without distraction. In the second session, audio distraction (radio, 45 dB) was provided while the participants ate the meals. In the third session, audiovisual distraction (television) was provided while the participants ate the meals. In the fourth session, audiovisual distraction and hand-use distraction (smartphone) were employed while the meals were eaten. In the second and third sessions, the radio and television content were arbitrarily determined by the researcher. In the fourth session, the participants were allowed to choose their smartphone content. The participants were asked to keep their evening meals and activity levels as similar as possible on the days before each test day, and to refrain from consuming any food or energy beverages for 3 hours before the experiment. The participants were seated in individual cubicles at the start of each test meal. Except for the form of distraction, the conditions for each test meal were the same.

Curry rice (800 g; Ottogi Co., Eumseong, Korea) was served to each participant during each session. Large servings of the meal were provided to ensure that food intake was not limited by the amount of food served. The curry rice contained 117.9 kcal, 22.2 g total carbohydrates, 2.4 g sugar, 2.7 g protein, 2.0 g total fat, 0.8 g saturated fat, and 2.4 mg cholesterol per 100 g. The participants were instructed to consume as much of the rice as they wanted, to the point of comfortable satiation; they were also allowed to request additional curry rice. The exact start and completion times for the consumption of each meal were recorded. The amount of the food consumed was calculated by weighing the plate before and after the meal.

This study was approved by the Ethical Committee for Human Experimentation of Jeonju University (jjIRB-220526-HR-2022-0401). Written informed consent was obtained from all the included participants.

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Subjective satiety ratings

Subjective satiety ratings were measured using a 100 mm visual analogue scale (VAS). The descriptors on the scale ranged from "not at all" to "extremely." The participants completed the VAS 5 times on each test day: immediately before and after eating the test meal, and 30 minutes, 60 minutes, and 120 minutes after eating the meal. The participants were also presented with 10 g samples of curry rice that were rated for palatability (appearance, odor, taste, and texture) using a VAS.

Statistical analysis

All statistical analyses were performed using SPSS Statistics 23 (IBM Corp., Armonk, NY, USA). Data were analyzed using repeated-measures analysis of variance with Bonferroni-adjusted pairwise comparisons. The results are reported as mean ± standard error of the mean. Statistical significance was set at $p < 0.05$.

RESULTS

Subject characteristics

Thirty individuals (males, 14; females, 16) were selected to participate participation in this study. Four participants (males, 2; females, 2) failed to complete the study. Three participants (males, 2; female, 1) consumed all the test meals that were served. They were excluded from the analysis because they may not accurately reflect the effect of eating behavior on food intake. Twenty-three participants consumed all 4 experimental meals provided. Thus, the data of a total of 23 individuals (males, 10; females, 13) were included in the analysis. Subject characteristics are shown in **Table 1**. The age of the participants ranged from 21 to 43 years (mean, 24.96 years), and their average height and weight were 166.17 cm (males, 173.40 cm; females, 160.62 cm) and 63.98 kg (males, 72.15 kg; females, 57.69 kg), respectively. The mean EAT-40 and Zung Questionnaire scores of the participants were 13.94 and 41.22 points, respectively. Regarding the palatability of the meals rated using a VAS, the participants indicated that the test meals were not significantly different (data not shown).

Food intake and mealtime duration for each distraction situation

The amount of food consumed and the mealtime duration for each distraction situation are shown in **Table 2**. The participants consumed more food (624.52 g) while using a smartphone than they did in other distraction situations (without distraction, 535.63 g; audio distraction, 558.13 g; audiovisual distraction, 560.35 g). However, this difference between distraction situations was not significant. In addition, the participants took significantly longer to

Table 1. Subject characteristics

Characteristics	Subjects total (n = 23)	
	Males (n = 10)	Females (n = 13)
Age (yrs)	24.96 ± 1.36	
	25.60 ± 1.56	24.46 ± 2.13
Height (cm)	166.17 ± 1.73	
	173.40 ± 2.08	160.62 ± 1.14
Weight (kg)	63.98 ± 2.93	
	72.15 ± 2.30	57.69 ± 4.16
BMI (kg/m^2)	23.08 ± 0.94	
	24.08 ± 0.93	22.31 ± 1.51

Values are means ± standard error of the mean.
BMI, body mass index, body weight (kg)/(height [m])^2.

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Table 2. Food intake and mealtime duration for each distraction situation

Characteristics	Without distraction	Distractions		
		Radio	Television	Smartphone
Intake (g)	535.65 ± 45.43^{NS}	558.13 ± 41.05	560.35 ± 46.60	624.52 ± 38.96
Mealtime (min)	10.36 ± 0.79^{a}	8.31 ± 0.69^{a}	9.61 ± 0.65^{a}	13.74 ± 1.85^{b}

Values are presented as mean ± standard error of the mean. Food intake and mealtime were analyzed during 4 distraction sessions: the first session (without distraction), second session (audio distraction, radio), third session (audiovisual distraction, television), and fourth session (audiovisual distraction and hand-use, smartphone).
NS, not significant.
Different letters indicate significant differences ($p < 0.05$) among distraction situations by repeated-measures analysis of variance with Bonferroni-adjusted pairwise comparisons and Duncan multiple range test.

eat while using a smartphone than they did in other distraction situations (audiovisual distraction and hand-use, 13.74 minutes vs. without distraction, 10.36 minutes; audio distraction, 8.31 minutes; and audiovisual distraction, 9.61 minutes; $p < 0.05$).

Satiety ratings before and after the test meals served at each distraction situation

The VAS subjective satiety ratings obtained before and after the test meals were served in each distraction situation are shown in **Fig. 1**. The initial satiety ratings among the distraction situations did not differ. Although there was no significant difference in food intake among the distraction sessions, the participants felt significantly fuller at 30 minutes after eating the test meal in the first session (without distraction) than they did in the other distraction situations (without distraction, 84.23 mm vs. audio distraction, 76.07 mm; audiovisual distraction, 68.93 mm; and audiovisual distraction and hand-use, 74.70 mm; $p < 0.05$).

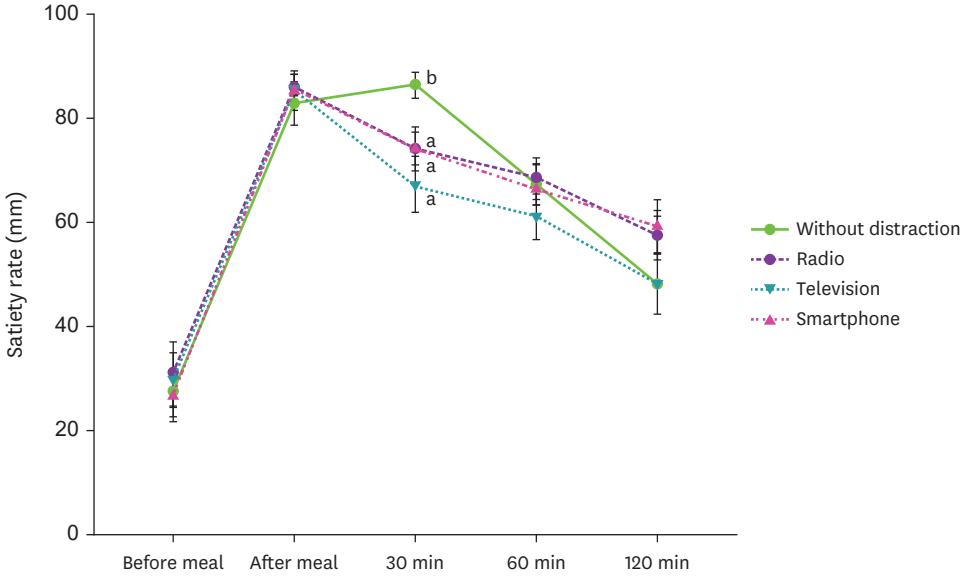

Fig. 1. Satiety ratings before and after the test meals served at each distraction situation.
Values are presented as mean ± standard error of the mean. Satiety ratings were analyzed during 4 distraction sessions: the first session (without distraction), second session (audio distraction, radio), third session (audiovisual distraction, television), and fourth session (audiovisual distraction and hand-use, smartphone).
Different letters indicate significant differences ($p < 0.05$) among distraction situations by repeated-measures analysis of variance with Bonferroni-adjusted pairwise comparisons and Duncan multiple range test.

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DISCUSSION

The participants consumed more food during the fourth session than during other sessions. In addition, the mealtime duration in the fourth session was longer than that in the other sessions. As the satiety ratings obtained before and after consumption of the test meals in each distraction session, participants felt significantly fuller at 30 minutes after consuming the test meal in the first session than they did in the other distraction sessions.

The reported effects of distraction on food intake are conflicting. Some studies have shown that distraction affects food intake amount and mealtime duration, while others point out that the effects of distraction may not be as clear as sometimes reported, or report no evidence of the effects of distraction on food intake [8-11]. Although there was no significant difference in food intake between the non-distraction and distraction situations, there was a trend of increasing food intake and mealtime duration in the distraction situations in this study. The audio and audiovisual distractions did not affect mealtime duration, whereas the hand-use distraction significantly affect. Compared to eating while listening to the radio or watching television, using a smartphone while eating requires concurrent use of the hands for meal consumption and smartphone manipulation. Since using a smartphone while eating involves the use of the hands, eating in such a distraction situation takes longer than eating in other distraction situations that are not related to the use of the hands. This is believed to affect the amount of food consumed.

Even though there was a partial difference in the food intake amount and mealtime duration depending on the distraction situation, participant satiety 30 minutes after eating significantly differed among sessions. In the absence of distraction, participants reported that they felt significantly fuller at 30 minutes after food intake, and even felt more full right after eating. Oldham-Cooper et al. [14] revealed that the participants who played a computer game while eating reported being less full after eating a test meal at lunch than non-distracted participants. Higgs and Woodward [11] also reported that the participants who watched television while eating had less vivid memories of food intake and consumed more at a subsequent meal than they did while eating in a non-distraction situation. The result of previous studies mean that distractions not only affect participants' eating behavior, but also affect their emotional responses to meals. Distraction, such as playing computer game or watching TV, take participants' attention away from meals and makes their memories of meals not vividly, and then it can lead overeat. The results of this study that the without distraction situation showed a significant difference in the satiety of 30 minutes after meals compared to other distraction situations supported the results of previous studies. Affective signals are known to be involved in regulating food intake through reduction of the motivation to eat prior to the onset of physiological satiety signals [15]. The results of the present study, which showed a propensity for increased food intake in distracted situations and differences in satiety felt at 30 minutes after meals, indicate that controlling distractions during meals affects the amount of food eaten and emotional responses, such as satiety. In addition, while the audio and audiovisual distractions used in this study comprised non-selective distraction provided by the researcher, hand-use distraction using smartphone was selected by the participants themselves. Participants' choice of distraction can also affect food intake behavior. Choosing a distraction situation while eating means that participants' attention could be taken away from the meal, and in this case, it may greatly affect their emotional response along with their eating behavior. Therefore, further research on individual choices that may affect food intake behavior is needed.

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In conclusion, the present study showed that different levels of distraction can have different effects on eating behaviors and when distractions became diverse and selectable, food intake may be affected by distraction. In addition, this study indicated that the effects of various distractions from the surroundings on eating behaviors appear to be influenced by yet-to-be-identified elements. There are some limitations to our study. In this study, numbers of subjects were small. Further studies based on these results will need a lager sample size. And the limitations of this study were not to measure biological factors such as blood sugar, gastric function, and hormone levels that could affect food intake. This study contributes to the urgent need for more evidence on mechanisms underlying the effect of different levels of distraction on food intake, mealtime duration and satiety ratings. Future studies should consider the long-term effects of distraction on eating behaviors.

SUMMARY

This study aimed to evaluate the effects of different levels of distraction on eating behaviors. The participants consumed more food during the fourth session than during other sessions. In addition, the mealtime duration in the fourth session was longer than that in the other sessions. As the satiety ratings obtained before and after consumption of the test meals in each distraction session, participants felt significantly fuller at 30 minutes after consuming the test meal in the first session than they did in the other distraction sessions. This study showed that different levels of distraction can have different effects on eating behaviors and when distractions became diverse and selectable, food intake may be affected by distraction.

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