How physical cues surrounding foods influence snack consumption: The case of covering foods

Sanne Raghoebær a,b,*, Ellen van Kleef c, Emely de Vet a,b

a Consumption and Healthy Lifestyles Group, Wageningen University and Research, Hollandseweg 1, 6706 KN Wageningen, the Netherlands
b Strategic Communication Group, Wageningen University and Research, Hollandseweg 1, 6706 KN Wageningen, the Netherlands
c Marketing and Consumer Behaviour Group, Wageningen University and Research, Hollandseweg 1, 6706 KN Wageningen, the Netherlands

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ABSTRACT

Physical cues surrounding foods are known to influence consumption, but research into the underlying mechanisms is limited. This research aims to disentangle these underlying mechanisms, testing one specific physical aspect: the presence or absence of a cover on snack bowls. We hypothesized that the presence (versus the absence) of a cover would decrease the likelihood of consumption and that the effect would be explained through a) norm perceptions discouraging eating, b) heightened effort to take the foods, and c) lowered salience of attractive foods. In two field contexts (Study 1, 40 observation periods; Study 2, N = 711) and a lab experiment (Study 3, N = 151), the cover’s presence was manipulated and the number of snacks taken was observed. In Studies 2 and 3, perceptions of social norms, effort, and salience were reported. The likelihood of taking snacks indeed decreased when the cover was present versus absent (Studies 1–3). In Study 2, the presence (versus the absence) of the cover seemed to decrease perceived social norms (p = 0.05) and increased perceived effort, whereas in Study 3 a significant decrease in perceived social norms and salience and an increase in perceived effort were observed. Moreover, the effect of the cover on likelihood of consumption was mediated by perceptions of salience. The organization of physical aspects in food environments influences consumption and may change perceptions of social norms, effort, and salience. Particularly, perceptions of salience might explain the effect of the cover on likelihood of consumption.

1. Introduction

Food environments, broadly defined as ‘any opportunity to obtain food’ (Townshend & Lake, 2009), encompass many aspects including food availability and accessibility (Lake & Townshend, 2006). Attention is increasingly being paid to the types of foods available within a person’s food environment and the association with consumption and obesity, because unhealthy foods are now widely available and easily accessible (Pitt, Gallegos, Comans, Cameron, & Thornton, 2017; Story, Kaplingst, Robinson-O’Brien, & Glanz, 2008; Townshend & Lake, 2017). Although it is widely accepted that there is a relation between food accessibility and availability and food consumption, the mechanisms that drive consumption have received limited attention (Raghoebær, van Rongen, Lie, & de Vet, 2019). Increasing the understanding of the causal mechanisms explaining why we eat food that is available may improve (or optimize) the development of effective intervention strategies, specifically by providing insight into how to use (i.e., design and implement) such strategies (Marteau, Fletcher, Hollands, & Munafo, 2020; Szaszi, Palinkas, Palfi, Szollosi, & Acel, 2017). The importance of such an understanding has been highlighted by recent research providing explanations for why the relative availability of specific foods in food environments may lead to desired or undesired effects. Specifically, it was shown that this single aspect in the food environment (i.e., the relative availability of particular foods) may be perceived differently, and thereby dictate contradictory conduct, in different situations depending on their specific design and implementation (Raghoebær, Van Kleef, & De Vet, 2020). This may suggest that signals conveyed by or in connection to available foods are relevant to take into consideration when developing such intervention strategies.

In this article, we identify and study three explanatory mechanisms. First, we investigate how food accessibility affects consumption through a heightened salience of foods, as the relatively easy accessibility of attractive foods. In two field contexts (Study 1, 40 observation periods; Study 2, N = 711) and a lab experiment (Study 3, N = 151), the cover’s presence was manipulated and the number of snacks taken was observed. In Studies 2 and 3, perceptions of social norms, effort, and salience were reported. The likelihood of taking snacks indeed decreased when the cover was present versus absent (Studies 1–3). In Study 2, the presence (versus the absence) of the cover seemed to decrease perceived social norms (p = 0.05) and increased perceived effort, whereas in Study 3 a significant decrease in perceived social norms and salience and an increase in perceived effort were observed. Moreover, the effect of the cover on likelihood of consumption was mediated by perceptions of salience. The organization of physical aspects in food environments influences consumption and may change perceptions of social norms, effort, and salience. Particularly, perceptions of salience might explain the effect of the cover on likelihood of consumption.

* Corresponding author at: Consumption and Healthy Lifestyles Group, Wageningen University and Research, Hollandseweg 1, 6706 KN Wageningen, the Netherlands.
E-mail addresses: sanne.raghoebær@wur.nl (S. Raghoebær), ellen.vankleef@wur.nl (E. van Kleef), emely.devet@wur.nl (E. de Vet).

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foods might increase the foods’ visual salience by making their properties more vivid (Maas, de Ridder, de Vet, & De Wit, 2012). Second, we investigate the idea that high food accessibility lowers the effort required to obtain foods and that a low effort consequently might motivate people to obtain these easily accessible foods (Maas et al., 2012). Finally, we propose that social standards about what is normal and/or appropriate to eat may explain why people eat easily accessible foods (De Ridder, De Vet, Stok, Adriaans, & De Wit, 2013; Higgs & Thomas, 2016). Whereas salience and effort have repeatedly been proposed as explanatory processes (e.g., Hunter, Hollands, Couturier, and Marteau (2018); Knowles, Brown, and Aldrovandi (2019); Maas et al. (2012)), the social standard explanation is rather novel. Social standards have proved to be powerful in steering eating behavior, as they provide implicit guidelines for what is generally considered normal and/or appropriate behavior in a given situation – also referred to as social norms (see systematic reviews in Robinson, Thomas, Aveyard, and Higgs (2012); Stok, de Vet, de Ridder, and de Wit (2016)). To our knowledge, relatively few studies have focused on how these normative processes are embedded in physical food environments and determine consumption.

Recent insights suggest that standards about what is normal and socially acceptable to consume can be inferred from physical aspects of food environments, even in the absence of a person being told or shown what and how much to eat (Burger et al., 2010; Herman, Polivy, Pliner, & Vartanian, 2019; Prinsen, de Ridder, & de Vet, 2013; Raghoebear, Haynes, Robinson, Van Kleef, & De Vet, 2019; Raghoebear, van Rongen et al., 2019). To illustrate, it has been shown that consumers interpret the amount of food served in a given situation as a social cue that determines their food intake 24 h later, as they are likely to believe that the served portion size was not chosen at random by the food provider. Specifically, participants who were served a smaller (rather than a larger) food portion reported a smaller social norm for portions of that food the next day (Raghoebear, Haynes, et al., 2019). Another series of experiments demonstrated that, rather than food availability itself, physical cues surrounding available foods drive consumption, presumably as these contextual details signal social information about the normal and/or appropriate course of action. Particularly, keeping food availability constant, it was shown that people tended to take more snacks in the presence of empty snack wrappers, compared to a situation in which there were no empty snack wrappers. It was assumed that the empty snack wrappers operationalized a social norm signaling that others in that situation had previously consumed the snacks, albeit that norm perceptions were not explicitly measured in these studies (Burger et al., 2010; Prinsen et al., 2013).

In a series of three experiments, we aim to disentangle the mechanisms underlying the effect of one specific, not yet tested, physical cue surrounding foods: the presence or absence of a cover on snack bowls. Specifically, we hypothesize that the presence (versus the absence) of a cover will decrease the likelihood of consumption (hypothesis 1) and that the effect will be explained through a) norm perceptions discouraging eating, b) heightened effort to take the foods, and c) lowered salience of attractive foods (hypothesis 2). We build our first hypothesis on former experimental studies demonstrating that physical aspects connected to available foods can influence consumption (e.g., Burger et al. (2010); Hunter et al. (2018); Keller, Markert, and Bucher (2015); Kroese, Marchiori, and de Ridder (2016); Maas et al. (2012); Prinsen et al. (2013); Rozin et al. (2011)). For example, the relative physical distance at which food is positioned (e.g., at 20 cm or 70 cm from armrest) can be regarded as such a physical cue, because increasing the distance to snack bowls resulted in a reduced proportion of snacks taken (Hunter et al., 2018; Maas et al., 2012). Given the aforementioned studies, we expect that the presence of a cover on snack bowls (compared to a situation in which the cover is absent) will function as a barrier to consumption and thus result in reduced snack consumption.

Furthermore, we propose that consumers may believe that there is some reasonable rationale behind the presence of the cover and therefore infer that it is less normal and/or appropriate to take snacks from a serving bowl when the cover is present (versus absent). This social norm interpretation of physical cues conforms with the rationale behind the effect of empty snack wrappers and served portion sizes on consumption (Burger et al., 2010; Prinsen et al., 2013; Raghoebear, Haynes, et al., 2019). Alternatively, the presence of the cover might influence consumption for reasons of a non-social nature, and one might argue that a covered serving bowl is less easily accessible and that more effort is required to obtain foods, compared to a situation in which the cover is absent. This reasoning accords with evidence that a larger physical distance to snacks resulted in a greater perceived effort to obtain the snacks, although the mediating role of perceived effort in the effect of distance on consumption was not tested in those studies (Hunter et al., 2018; Maas et al., 2012). Likewise, one could argue that snacks presented in a covered serving bowl are less salient to consumers, as the cover makes its properties less visible. Previous studies testing the effect of distance to snacks on perceived salience of the snacks did not find significant differences between the distant conditions (Hunter et al., 2018; Maas et al., 2012). However, it might be plausible that snacks presented in covered serving bowls are less vivid than a situation in which relatively small changes are made in physical distance to snacks.

1.1. Research overview

In three experiments, we investigated whether a cover on snack bowls being present (discouraging condition) rather than absent (control condition) would decrease the proportion of snacks taken, and the mechanisms that might explain the effect by examining perceptions of social norms, effort, and salience. The first study was conducted in a field context (front desk of a university building) and focused specifically on the effect of the cover on snack consumption. The second study was conducted in another field context in which more (competing) food cues were present, testing the same hypotheses under more complex circumstances attempting to conceptually replicate the effects under different conditions (i.e., seeking to validate the phenomenon under various circumstances) (Earp & Trafimow, 2015; Nosek, Spies, & Motyl, 2012; Schmidt, 2009). Specifically, Study 2 was performed at the checkout corner of a petrol station shop, and included preliminary measures of perceptions of social norms, effort, and salience. Study 3 was performed in a controlled laboratory setting, testing effects under ideal conditions and focused specifically on the role of perceived social norms, effort, and salience as possible underlying mechanisms of the cover effect on consumption. A third condition was included in the study design, in which the cover was removed from the bowl in the participants’ presence (encouraging condition), thereby testing whether a snack bowl presented without a cover (in this study treated as the control condition) could be considered as an encouraging condition in itself, or whether the physical removal of the cover was needed to encourage participants to take snacks.

2. Study 1

2.1. Method

2.1.1. Design and procedure

A quasi-experimental field study employing a one-factor design was conducted at the front desk of a university building. A transparent jar with chocolate bars was placed on the desk, varying the presence (discouraging condition: see Fig. 1a) or absence (control condition: see Fig. 1b) of a transparent lid covering the jar between conditions. In both conditions, the jar was accompanied with a signboard stating: “Have a nice day on behalf of the staff”, suggesting that the snacks were offered for free and increasing the salience of the jar. All experiments (1–3) were conducted according to the Declaration of Helsinki guidelines and complied with the Wageningen University & Research code of conduct.

Conditions were counterbalanced between four timeslots a day: 9am
to 11am, 11am to 1 pm, 1 pm to 3 pm, and 3 pm to 5 pm. Both conditions were run equally during these timeslots for a period of 10 days (Monday–Friday), resulting in 20 observation periods per condition. In both conditions, the jar was three-quarters full with 600 g of individually packaged mini chocolate bars (Twix, 10 g per unit). The jar was monitored several times during each timeslot and refilled when the jar was half full. Before and after each timeslot, the jar was weighed to determine the number of chocolate bars taken (grams), treated as the outcome variable in this study.

2.2. Results

2.2.1. Test of hypothesis 1: Consumption

On average, 268.50 g of chocolate bars (±27 pieces, \(SD = 139.13\) g) were taken per two-hour timeslot. An ANCOVA was performed to compare the number of snacks taken (grams) per timeslot (dependent variable) when the lid was present and absent (independent variable), controlling for day and time effects. As consumption data deviated from a normal distribution, a square root transformation was performed. When the lid was present and absent (independent variable), were taken per two-hour timeslot. An ANCOVA was performed to control for day and time effects. As consumption data deviated from a normal distribution, a square root transformation was performed.

2.3. Discussion

The number of snacks taken (grams) was significantly lower when the lid was present rather than absent, indicating that the lid functioned as a barrier to consumption. The second study aimed to extend this finding in an environment in which more (competing) food cues were present: a Dutch petrol station shop. Unlike in Study 1, we attempted to measure the number of people that have taken the snacks in Study 2, as well as the number of snacks taken by each person, as it is hard to establish from the current study whether the cover manipulation affected the number of people that have taken snacks and/or the amount of snacks taken by each person. Furthermore, perceptions of social norms, effort, and salience regarding the snacks were measured in Study 2.

3. Study 2

3.1. Method

3.1.1. Participants and design

Customers who encountered the checkout corner in a Dutch petrol station shop were observed in a quasi-experimental field study employing a one-factor design \((N = 720)\), in which 203 customers (called questionnaire participants) participated in an additional questionnaire to measure their perceptions of social norms, effort, and salience regarding the snacks. Most participants who declined to complete the questionnaire stated that they had no time. Participants who indicated any allergies or intolerances for the foods included in the study were excluded from analyses, as well as participants who indicated not having encountered the checkout corner, did not follow the study instructions, or were not capable of completing the questionnaire. The final analytic sample included 711 customers and 194 questionnaire participants (see Fig. 2). The questionnaire participants – 163 males and 31 females – had an average age of 45.16 years \((SD = 15.81, N = 190)\).

The experimental manipulation was similar to Study 1. In both conditions, the jar was placed on the checkout corner next to the pin device, accompanied with a sign board stating, “Have a nice trip on behalf of [petrol station name]”. Conditions were counterbalanced between two timeslots a day during rush hours: 7.30am to 11.30am and 2.30 pm to 6.30 pm. Both conditions were run equally during these timeslots for a four-day period (Monday–Thursday). Accordingly, customers were automatically assigned to either the discouraging condition (see Fig. 3a) or the control condition (see Fig. 3b).

3.1.2. Procedure

During each timeslot, petrol shop employees counted the number of customers who encountered (within one-meter distance) the checkout corner. Again, the jar was three-quarters full with 600 g of individually packaged mini chocolate bars (Twix, 10 g per unit). To determine the number of chocolate bars taken, the researcher counted the number of chocolate bars before and after each timeslot.

Customers leaving the petrol station shop were invited to complete a questionnaire about consumer choices in petrol stations (cover story). The questionnaires were administered by two female researchers using two tablets. First, participants provided their informed consent. Thereafter, they reported their rush state and their hunger state, then their healthy eating goal and their weight goal (also a filler item asking about their money goal). Then, participants reported their liking for the offered snacks, as well as their desire to eat the offered snacks to measure potential compensatory after-effects (Supplementary Method S1). Subsequently, participants indicated whether other people were present in the line at the checkout corner (responses: yes/no). Thereafter, it was checked whether participants had noticed the snack jar (responses: yes/no). Participants who indicated noticing the jar reported the number of chocolate bars taken, as well as their perceptions of social norms, effort, and salience regarding the snacks. Participants then reported whether the snack jar was covered by a lid (responses: yes/no/do not know). Finally, all participants reported their demographics (age and sex) and indicated any allergies or intolerances. Participants were thanked for
their participation and could give their email address to win a free tank of fuel, which was raffled among questionnaire participants.

3.1.3. Measures

3.1.3.1. Proposed mediators. The items measuring perceptions of social norms, effort, and salience are described in Table 1. A mean score was calculated for variables (perceptions of social norms and salience) with Cronbach’s α ≥ 0.70. As reliability analysis showed a low level of internal consistency between items measuring perceptions of effort, items were analyzed separately.

3.1.3.2. Descriptive information. Hunger state was measured by asking, ‘how hungry are you at the moment?’ (1: not hungry at all to 7: very hungry). Healthy eating goal was measured by stating (Salmon, Fennis, de Ridder, Adriaanse, and De Vet (2014)), ‘in my daily live I strive to eat healthily’ (1: not important at all to 7: very important). Weight goal was measured by stating, ‘in my daily life I strive to watch my weight’ (1: not important at all to 7: very important). General liking for the offered snacks was measured by asking (Maas et al. (2012)), ‘how tasty or non-tasty do you find [snacks]?’ (1: very non-tasty to 7: very tasty). Rush state was measured by asking, ‘to what extent are you in a hurry at the moment?’ (1: no hurry at all to 7: very much hurry).

Fig. 2. Flowchart of customers and questionnaire participants. The participant excluded because of noncompliance with study instructions purposely took four chocolate bars after completion of the questionnaire although initially not aware of the jar.

Fig. 3. Snack jar used in Study 2: (a) discouraging condition; (b) control condition.
Table 1
Overview of items measuring perceptions of social norms, effort, and salience.

| Measures                              | Items                                                                 |
|---------------------------------------|----------------------------------------------------------------------|
| Perceptions of social norms           | 1. 'did you feel free to take [snacks]? (1: not free at all to: very free) |
| (Cronbach’s α = 0.82)                 | 2. 'did you feel that the [snacks] were meant to be taken? (1: not at all to: very much) |
|                                       | 3. 'how normal or abnormal do you think it was to take [snacks]? (1: very abnormal to 7: very normal) |
|                                       | 4. 'how appropriate or inappropriate do you think it was to take [snacks]? (1: very inappropriate to 7: very appropriate) |
| Perceptions of effort (Maas et al. (2012)) (Cronbach’s α = 0.18) | 1. 'the [snacks] required effort to take' (1: strongly disagree to 7: strongly agree) |
|                                       | 2. 'the [snacks] were up for grabs' (1: strongly disagree to 7: strongly agree) [reverse coded] |
| Perceptions of salience (Maas et al. (2012)) (Cronbach’s α = 0.87) | 1. 'the [snacks] stood out' (1: strongly disagree to 7: strongly agree) |
|                                       | 2. 'the [snacks] attracted attention' (1: strongly disagree to 7: strongly agree) |

3.2. Results

3.2.1. Descriptive statistics and randomization check

Questionnaire participants’ (N = 194) descriptive statistics are presented in Supplementary Table S1 (reported per condition). Pearson chi-square analysis showed no significant difference in accuracy of noticing the snack jar between participants in the discouraging condition (30.5% reported noticing the jar) and the control condition (33.3% reported noticing the jar), X²(1) = 0.18, p = 0.68.

Participants who indicated noticing the jar were included in further analyses (N = 62); see their descriptive statistics per condition in Table 2. In the discouraging condition, 62.1% of the participants correctly indicated the presence of the cover (20.7% incorrectly indicated the absence of the cover and 17.2% did not know), and 60.6% of the participants in the control condition correctly indicated the absence of the cover (3.0% incorrectly indicated the presence of the cover and 36.4% did not know). A randomization check was performed to ascertain whether this subsample of participants was comparable across conditions regarding the descriptive variables (age, sex, hunger state, healthy eating goal, weight goal, general liking for the offered snacks, rush state, and presence of others). Likelihood ratio chi-square analysis comparing the presence of others between conditions showed a significant difference and was continuously included as a covariate in further analyses. To check for other possible covariates, correlations between the descriptive variables and the outcome variables (proposed mediators and desire) were checked (Supplementary Table S2). Rush state was significantly associated with perceptions of salience (r = 0.29, p = 0.02), and general liking for the offered snacks was significantly associated with desire to eat the offered snacks (r = 0.56, p < 0.001). Consequently, rush state and general liking for the offered snacks were included as covariates in these specific analyses. Results without the inclusion of covariates are reported when they differed significantly from results including covariates. Results of desire are described in Supplementary Results S1.

3.2.2. Test of hypothesis 1: Consumption

The relative likelihood (RL) of chocolate bars being taken when the lid was present versus absent was calculated using the online calculator MedCalc (https://www.medcalc.org/calc/relative_risk.php), including all customers that encountered the checkout corner (N = 711). In total, four chocolate bars were taken when the jar was covered by a lid, whereas 12 chocolate bars were taken when the jar was presented without a lid. RL estimates showed that it was less likely for a chocolate bar to be taken when the lid was present rather than absent (RLcontrol−discouraging = 0.32, 95% CI [11, 0.99], p = 0.049). Of the questionnaire participants who indicated noticing the jar (N = 62), 11.3% reported taking a chocolate bar (discouraging condition: N = 3, control condition: N = 4). None of these participants reported taking more than one chocolate bar.

3.2.3. Test of hypothesis 2: Perceptions of social norms, effort, and salience

An ANCOVA testing the effect of condition on perceptions of social norms, with presence of others as a covariate, showed a marginally significant effect (N = 61, Table 2). Participants who were presented the jar covered by a lid (compared to without a lid) reported a marginally significantly weaker norm to take snacks. An ANCOVA testing the effect of condition on perceptions of effort (item 1: ‘the Twix bars required effort to take’), with presence of others as a covariate, showed no significant effect (N = 61, Table 2), whereas results of a similar ANCOVA including the second item measuring perceptions of effort (‘the Twix bars were up for grabs’ [reverse coded]) showed a significant effect (N = 61, Table 2). Participants who were presented the jar covered by a lid (compared to without a lid) reported that the chocolate bars were significantly less up for grabs. An ANCOVA testing the effect of condition on perceptions of salience, with presence of others and rush state as covariates, showed no significant effect (N = 61, Table 2).

Table 2
Means, SDs, and statistics for descriptive variables and proposed mediators per condition (N = 62, Study 2).

|                     | Discouraging condition (N = 29) | Control condition (N = 33) | Test statistic | p-value |
|---------------------|----------------------------------|-----------------------------|----------------|---------|
| Mean (SD) or number (%) | 4.69 (2.01) or 86 (34) | 4.64 (2.11) or 85 (35) | F(1,60) | 0.72 |
| Differences between conditions in descriptive variables |                     |                            |               |         |
| Age (y)             | 33.61 (15.35)                   | 38.62 (15.93)              | F(1,58)       | 0.22 |
| Sex (female)        | 5 (17.2%)                       | 6 (18.2%)                  | X²(1) = 0.01  | 0.92  |
| Presence of others  | 3.24 (1.90)                     | 3.88 (2.01)                | F(1,60)       | 0.21  |
| Healthy eating goal | 5.17 (1.63)                     | 4.94 (1.77)                | F(1,60)       | 0.59  |
| Weight goal         | 4.79 (1.84)                     | 4.55 (1.89)                | F(1,60)       | 0.60  |
| General liking snacks | 5.34 (1.29)                   | 5.18 (1.83)                | F(1,60)       | 0.69  |
| Rush state          | 3.90 (2.16)                     | 4.27 (2.07)                | F(1,60)       | 0.49  |
| Presence of others  | 28 (96.6%)                      | 25 (78.1%)                 | A = 5.08      | 0.02  |
| Effect of condition on proposed mediators |                     |                            |               |         |
| Perceptions of social norms | 3.63 (1.51)                | 5.40 (1.67)                 | F(1,58)       | 0.05 |
| Perceptions of effort (item 1) | 3.21 (1.90)                | 2.76 (2.05)                 | F(1,58)       | 0.37 |
| Perceptions of effort (item 2) | 3.55 (2.15)                | 2.45 (1.64)                 | F(1,58)       | 0.03 |
| Perceptions of salience | 5.74 (1.39)                | 5.47 (1.57)                 | F(1,57)       | 0.43 |

*Measured on a 7-point scale (range 1–7). b N = 28 for age. c N = 32 for age and presence of others. Age values were missing because of an unrealistically high reported age, and one participant did not know whether other people were present in the line at the checkout corner.

1 An ANOVA testing the effect of condition on perceptions of social norms showed a significant effect (F(1,60) = 4.60, p = 0.036, η² = 0.07, N = 62).
3.3. Discussion

Customers were less likely to take a snack when a cover on the snack jar was present (versus absent), although snacks were hardly taken in both conditions and more than two thirds of the questionnaire participants indicated that they had not noticed the snack jar. Participants perceived (significantly) an increased effort to obtain snacks when the cover on snack bowls was present (versus absent) and also seemed to perceive a decreased social norm to take snacks when the cover was present (versus absent) though this should be interpreted with caution ($p = 0.05$). As the first two studies were conducted in a field context, not allowing for random assignment of participants to conditions, the third study was conducted in a controlled laboratory setting and focused particularly on the mechanisms underlying the effect of the cover on consumption.

4. Study 3

4.1. Method

4.1.1. Participants and design

In total, 156 participants who indicated any allergies or intolerances for the foods included in the study were excluded from analyses (discouraging condition: $N = 3$; control condition: $N = 1$; encouraging condition: $N = 1$). The final analytic sample included 151 participants (56 males and 95 females), with an average age of 23.83 years ($SD = 8.17$), and 84.8% were students from more than 20 different study programs.

Different from Studies 1 and 2, a third condition (labeled as the encouraging condition) was included in the design to test whether a snack bowl presented without a cover (treated here as the control condition) could be considered as an encouraging condition in itself, or whether the physical removal of the cover was needed to encourage participants to take snacks. Participants were randomly assigned to one of the three conditions, according to a predetermined computer-generated random sequence of conditions. All participants were unobtrusively presented a bowl of small gingerbread cookies (given the small unit size, about 2 g per unit) while performing a bogus coffee taste task for 10 min. Thereafter, participants indicated their perceptions of social norms, effort, and salience regarding the snack bowl. Different from Study 2, additional items were included in Study 3 (e.g., measuring perceptions of freshness, presentation, and hygiene), to allow for a more specific examination of the effects which is facilitated by the controlled laboratory setting (compared to the field settings in Study 1 and 2). The presence or absence of a transparent foil covering the snack bowl was manipulated between conditions (see Fig. 4).

4.1.2. Procedure

Each participant was tested individually by one female researcher to ensure that participants could not influence one another. The study was promoted as a bogus coffee taste test for a new coffee that would soon be served in grand cafés. To bolster the cover story, the experiment was conducted in an ambiance room mimicking a grand café (Supplementary Method S2). First, participants provided their informed consent, after which they completed a questionnaire to assess their demographics (age, sex, and occupation), hunger state, healthy eating goal, and weight goal (using similar items as in Study 2, including six filler items; e.g., ‘how thirsty are you at the moment?’ (1: not thirsty at all to 7: very thirsty). After completion of the questionnaire, the researcher returned with a tray including a coffee pot, a mug on a saucer served with a spoon, sweetener, sugar, coffee milk, a water pitcher, and a glass. Also, a white non-transparent bowl with 110 g small gingerbread cookies (equal to 500 kcal) was presented on the tray, varying the presence or absence of the cover according to the condition (discouraging, control, or encouraging) to which they were assigned (see Fig. 4). Participants in the encouraging condition were presented the bowl covered by transparent foil, but the researcher removed the foil before leaving the room and placed it next to the bowl (see Fig. 4c). All participants were invited to taste the coffee and were told that the study focused mainly on the aftertaste of the coffee and therefore the researcher left the room for 10 min (nothing was mentioned about the snacks).

After 10 min, the researcher removed the product tray and measured consumption out of sight of the participants (by subtracting the post-bowl weight from the pre-bowl weight; both likelihood of taking (yes/no) and amount of intake (grams) were defined). Participants completed a second questionnaire about the bogus coffee taste test (including 23 filler questions; e.g., ‘how tasty or non-tasty did you find the aftertaste of the coffee?’ (1: very non-tasty to 7: very tasty), after which they indicated their specific liking for the eaten snacks (Supplementary Method S3), as well as their general liking for the offered snacks (measured as in Study 2). They also indicated their desire to eat the offered snacks and the attractiveness of the offered snacks to measure potential compensatory after-effects (Supplementary Method S3). Furthermore, they completed the proposed mediator items (perceptions of social norms, effort, and salience). As a manipulation check, participants reported their perceptions of freshness, presentation, and hygiene regarding the snacks, to exclude these alternative interpretations of the presence of the cover. Finally, they wrote down their thoughts on the study aim and indicated any allergies or intolerances. Afterwards, they were thanked and reimbursed for their participation. Furthermore, 10 small bags of small gingerbread cookies and 10 small packs of fruit biscuits were presented in an open basket. Participants were instructed to choose either a bag of small gingerbread cookies or a pack of fruit biscuits, again to measure potential compensatory after-effects (Supplementary Method S3). When data collection was finished, participants were debriefed about the true study aim.

![Fig. 4. Snack bowl used in Study 3: (a) discouraging condition; (b) control condition; (c) encouraging condition.](image-url)
4.1.3. Measurements

4.1.3.1. Proposed mediators. Perceptions of social norms were measured using eight items that were averaged (Cronbach’s α = 0.89). In addition to the four-item social norm scale used in Study 2 (Table 1), four additional items were included to allow for a more specific measurement of social norms. The following additional items were included: ‘did you feel uncomfortable about taking [snacks]?’ [reverse coded] (1: not at all; 7: very uncomfortable), ‘do you think you were supposed to take [snacks]?’ (1: not at all; 7: very supposed), ‘did you feel encouraged or discouraged to take [snacks]’ (1: very encouraged to 7: very discouraged), and ‘how likely or unlikely is it that other participants took [snacks]?’ (1: very unlikely to 7: very likely). Perceptions of effort (Cronbach’s α = 0.88) and salience (Cronbach’s α = 0.87) were measured using the same items as in Study 2 (Table 1), mean scores were calculated.

4.1.3.2. Manipulation check. Perceptions of freshness, presentation, and hygiene were measured by stating, ‘the [snacks] looked fresh’, ‘the [snacks] looked well-presented’, and ‘the [snacks] looked hygienic’. Responses ranged from 1: strongly disagree to 7: strongly agree.

4.2. Results

4.2.1. Descriptive statistics and randomization check

Descriptive statistics of participants per condition are reported in Table 3. One participant in the encouraging condition mentioned the link between the presentation of the snacks (presence/absence of the cover) and snack intake and was consequently categorized as having guessed the study aim. Results after exclusion of this participant did not significantly deviate from results including this participant; therefore, results with this participant included are further reported.

Conditions did not differ significantly in the descriptive variables (age, sex, hunger state, healthy eating goal, weight goal, and general liking for the offered snacks), confirming successful randomization. To check for other possible covariates, correlation coefficients between the descriptive variables and the outcome variables (consumption, proposed mediators, specific liking for the eaten snacks, and potential compensatory after-effects (e.g., desire)) were checked (Supplementary Table S3). Age, sex, hunger state, and general liking for the offered snacks were significantly associated with one or more of the outcome variables (all p < 0.04). Consequently, these variables were included as covariates in further analyses when they correlated significantly with an outcome variable. Results without the inclusion of covariates are reported when they significantly differed from results including covariates. Results of specific liking for the eaten snacks and potential compensatory after-effects (desire, attractiveness, and participation reward) are described in Supplementary Results S2 and Supplementary Table S4.

4.2.2. Manipulation check

Three separate univariate ANOVAs testing the effect of condition on perceptions of freshness (F(2,147) = 1.57, p = 0.21, ηp² = 0.02, N = 150), presentation (F(2,148) = 2.06, p = 0.13, ηp² = 0.03, N = 151), and hygiene (F(2,148) = 1.77, p = 0.17, ηp² = 0.02, N = 151) showed no significant effects, suggesting a successful manipulation.

4.2.3. Test of hypothesis 1: Consumption

In the discouraging condition, 44.0% of the participants took some snacks, whereas 82.7% in the encouraging condition and 69.4% in the control condition took some snacks. Pearson chi-square analyses showed a significant difference in likelihood of taking between the conditions (Table 3). To predict the likelihood of participants taking snacks based on the condition to which they were assigned (all three levels of condition were dummy coded), two binary logistic regression analyses were performed: controlling for hunger state and general liking (N = 150). Hunger state and general liking were entered in block 1, and two dummy variables of condition were entered in block 2 (the encouraging condition and the control condition in the first analysis and the encouraging condition and the discouraging condition in the second analysis). The results showed a significant effect between condition and likelihood of taking. Specifically, in comparison to the discouraging condition, participants in the control condition (OR discouraging vs. control = 2.67, Wald = 4.28, 95% CI (1.05, 6.78), p = 0.04) and the encouraging condition (OR discouraging vs. encouraging = 6.29, Wald = 12.44, 95% CI (2.27, 17.49), p < 0.001) were significantly more likely to take snacks. No differences in likelihood of taking were observed between the control condition and the encouraging condition (OR control vs. encouraging = 2.36, Wald = 2.55, 95% CI = (0.82, 6.75), p = 0.11).

A square root transformation on amount of intake data (grams) was performed, as residuals were not normally distributed. An ANCOVA testing the effect of condition on amount of intake (including transformed data), with hunger state and general liking as covariates, showed a marginally significant effect (N = 150, Table 3). Post hoc tests (Bonferroni) demonstrated that participants in the discouraging condition (Madj = 1.65) had a marginally significantly lower amount of intake than participants in the encouraging condition (Madj = 2.45), p = 0.088. No differences in amount of intake were observed between the control condition (Madj = 2.31) and the discouraging condition, p = 0.22, and the control condition and the encouraging condition, p = 1.00.

4.2.4. Test of hypothesis 2: Perceptions of social norms, effort, and salience

An ANCOVA testing the effect of condition on perceptions of social norms, with age as a covariate, showed a significant effect (N = 150). Two separate univariate ANOVAs testing the effect of condition on perceptions of effort (N = 151) and salience (N = 149) also showed a significant effect (Table 3). Particularly, post hoc tests (Bonferroni) demonstrated that participants in the discouraging condition (social norms: Madj = 4.49; effort: Madj = 4.24; salience: Madj = 5.09) reported a significantly weaker norm to take snacks, higher effort to obtain the snacks, and a lower salience of the snacks than participants in the encouraging condition (social norms: Madj = 2.45, p = 0.088). No differences in intake amount were observed between the control condition (Madj = 2.31) and the discouraging condition, p = 0.22, and the control condition and the encouraging condition, p = 1.00.

4.2.4.1. Test of hypothesis 3: Mediation

A multiple mediation analysis was performed using Hayes’s (2017) PROCESS tool for SPSS, controlling for hunger state and general liking (N = 149). A priori, it was checked whether conditions for mediation were
met by performing separate multiple linear regression analyses (to test the effect of condition on the proposed mediators) and separate binary logistic regression analyses (to test the effect of the proposed mediators on likelihood of consumption) (Yzerbyt, Muller, Batailler, & Judd, 2018). Perceptions of social norms, effort, and salience were included in mediation analyses, as both component paths of the indirect effect were significant (Supplementary Table S5). The percentile bootstrapping method was applied to generate 95% confidence intervals, based on 10,000 resamples. To allow for the use of bootstrapping with an independent variable (condition with three levels, two dummy coded variables were created using indicator coding (Hayes and Preacher (2014)), with the discouraging condition as the reference group (no matter which specific condition is selected as the reference group, significant conclusions remain similar). Relative to the discouraging condition, the absence of a cover on snack bowls indirectly influenced likelihood of consumption through perceptions of salience (control condition: relative indirect effect = 0.30, SE = 0.20, 95% CI (0.01, 0.78); encouraging condition: relative indirect effect = 0.37, SE = 0.23, 95% CI (0.05, 0.95)), but not through perceptions of social norms (control condition: relative indirect effect = 0.15, SE = 0.18, 95% CI (-0.15, 0.58); encouraging condition: relative indirect effect = 0.23, SE = 0.27, 95% CI (-0.23, 0.86)) and perceptions of effort (control condition: relative indirect effect = -0.36, SE = 0.71, 95% CI (-1.87, 0.96); encouraging condition: relative indirect effect = -0.35, SE = 0.70, 95% CI (-1.84, 0.93)).

### 5. General discussion

The present research investigated whether the presence (versus the absence) of a cover on snack bowls affected consumption (Studies 1–3) and whether this effect was explained through a) perceived social norms about snack consumption, b) perceived effort needed to obtain snacks, and c) perceived salience of the snacks (Studies 2 and 3). In line with our expectations, the results indicate that being presented a snack bowl with (versus without) a cover decreases the likelihood of taking snacks both in field contexts (Studies 1 and 2) and in a lab context (Study 3). In Study 2, the presence of the cover on snack bowls (significantly) increased perceptions of effort to obtain snacks and also seemed to decrease perceptions of social norms to take snacks and salience of the snacks, because of incorrect values. *N = 48 for weight goal and perceptions of salience, because of incorrect values.

Table 3

| Differences between conditions in descriptive variables | Discouraging condition (N = 50) | Control condition (N = 49) | Encouraging condition (N = 52) | Test statistic | p-value | η² |
|--------------------------------------------------------|-------------------------------|---------------------------|-----------------------------|----------------|---------|----|
| Age (y)                                                 | 23.30 (6.23)                 | 24.35 (10.01)             | 23.87 (8.00)                | F(2,148) = 0.20 | 0.82    | 0.00 |
| Sex (female)                                            | 30 (60.0%)                   | 31 (63.3%)                | 34 (65.4%)                 | X²(2) = 0.32   | 0.85    | -  |
| Hunger state                                            | 3.40 (1.41)                  | 3.51 (1.62)               | 3.62 (1.47)                | F(2,148) = 0.26 | 0.77    | 0.00 |
| Healthy eating goal                                     | 5.54 (0.95)                  | 5.84 (0.92)               | 5.85 (0.87)                | F(2,148) = 1.82 | 0.17    | 0.02 |
| Weight gain                                             | 4.44 (1.57)                  | 4.79 (1.58)               | 4.96 (1.39)                | F(2,147) = 1.57 | 0.21    | 0.02 |
| General liking snacks                                    | 5.31 (1.31)                  | 5.69 (0.96)               | 5.69 (1.20)                | F(2,147) = 1.82 | 0.17    | 0.02 |
| Effect of condition on consumption                      |                               |                           |                            |                |        |     |
| Likelihood of taking (yes)                              | 22 (44.0%)                   | 34 (69.4%)                | 43 (82.7%)                 | X²(2) = 17.37  | < 0.001 | -   |
| Amount of intake (grams)                                | 6.15 (12.43)                 | 9.76 (12.88)              | 9.77 (12.22)               | F(2,145) = 2.72 | 0.069   | 0.04 |
| Effect of condition on proposed mediators               |                               |                           |                            |                |        |     |
| Perceptions of social norms                             | 4.47 (1.23)                  | 5.01 (0.71)               | 5.32 (0.94)                | F(2,146) = 9.44 | < 0.001 | 0.12 |
| Perceptions of effort                                   | 4.24 (1.54)                  | 1.61 (0.71)               | 1.70 (0.88)                | F(2,148) = 92.03 | < 0.001 | 0.55 |
| Perceptions of salience                                 | 5.59 (1.26)                  | 5.69 (1.23)               | 5.83 (1.03)                | F(2,146) = 5.48 | 0.01    | 0.07 |

*pMeasured on a 7-point scale (range 1–7). N = 49 for general liking snacks, perceptions of social norms, and perceptions of salience, because of incorrect values. *N = 48 for weight goal and perceptions of salience, because of incorrect values.
understand how these environmental changes work rather than encouraging desired behavioral outcomes – this needs to be investigated in future research. We thereby acknowledge that our dietary decisions may also be impacted by other cues in environments (e.g., the behavior of other people in that environment), individual factors (e.g., habits and a priori preferences) or more macro levels of influence, such as pricing strategies, laws, policies and food marketing (Story et al., 2008). A recent study showed positive effects on healthy food purchases by combining environmental cues (coloured frames and arrows encouraging healthier food choices in this study) with pricing strategies (salient price increases and/or discounts specifically) (Hoinkx et al., 2020). It would be interesting to examine the interaction between physical cues functioning as a barrier to consumption and such pricing strategies on people’s dietary decisions and perceptions of social norms.

As expected, the current results suggest that the presence (versus the absence) of a cover on snack bowls decreases people’s perceived social norms to take snacks, although we failed to show that perceptions of social norms underlie the effect of the cover on likelihood of consumption. To our knowledge, the present research is the first to show evidence for the proposition that social norms can be inferred from physical cues surrounding foods, with food availability kept constant (Burger et al., 2010; Prinsen et al., 2013; Raghoebar, van Rongen, et al., 2019), by directly hypothesizing and demonstrating the normative interpretation of such physical cues. Generally, two types of social norms are distinguished in the literature: descriptive norms and injunctive norms (Cialdini, Reno, & Kallgren, 1990; Deutsch & Gerard, 1955). First, participants may have interpreted the presence of the cover as a signal that previous participants did not consume any snacks. This interpretation relates to a descriptive norm describing the behavior of others in identical situations (Cialdini et al., 1990; Raghoebar, Haynes, et al., 2019). Second, participants may (also) have interpreted the presence of the cover as signaling a deliberate choice by the food provider and inferred that there was some justification behind its presence; this interpretation relates more to an injunctive norm prescribing the behavior that one ought to exhibit (Cialdini et al., 1990; Raghoebar, Haynes, et al., 2019). Unfortunately, the social norm measure used in the present research precluded separating descriptive from injunctive norm interpretations. Future studies should disentangle both norm types and evaluate them independently.

Alternatively, it was examined whether the presence of the cover influenced consumption for reasons of a non-social nature by investigating perceptions of effort and salience. Consistent with expectations, the findings from the lab experiment suggest that perceived salience of the snacks is decreased when the cover on snack bowls is present (versus absent), whereas perceived effort to obtain snacks is increased. Remarkably, only perceptions of salience significantly underlay the effect of the cover manipulation on likelihood of consumption. In other words, the presence (absence) of the cover resulted in a lower (higher) likelihood of consumption, as the snacks were perceived as less (more) visible or salient due to the presence (absence) of the cover. The impact of food salience on consumption accords with the rationale behind the ban on point-of-sale tobacco product displays, implemented in many countries (He, Shang, Huang, Cheng, and Chaloupka, 2018). It has been shown that seeing tobacco product displays serves as a cue to smoke, even on impulse (i.e., unintentionally) and among people trying to avoid smoking (Wakefield, Germain, & Henrikson, 2008). One could reason that seeing snacks in our study acted as a cue to consume and that covering snacks thus might support people’s self-regulation strategies to inhibit snacking. However, non-significant results of the cover manipulation on perceptions of salience were observed in the petrol station shop context. This inconsistency in results might be related to the transparency of the bowls used in both studies. Although in both studies the snacks were clearly visible, the snacks in the petrol station shop study were presented in a transparent jar in which the snacks were visible through the transparent snack jar (see Fig. 3), whereas the snacks in the lab study were presented in a non-transparent white bowl in which the snacks were visible only from above (see Fig. 4).

It should be noted that snacks were hardly taken in the petrol station shop context regardless of the presence or absence of the cover; this might be observed as a limitation of the current study. One interpretation of the low consumption numbers could be that people in general considered it less normal and/or appropriate to take snacks in the petrol station shop context, especially given that the snack jar was surrounded by plenty of other food cues that were not offered for free. This interpretation is supported by the relatively low social norms ratings observed in the petrol station shop study compared to the lab study. A different explanation for the low consumption numbers might be that approximately two third of the customers reported not noticing the snack jar; this might also be caused by the presence of other food cues surrounding the snack jar. Another remarkable finding of Study 2 pertains to the observation that approximately one fifth of the participants in the discouraging condition incorrectly reported the absence of the cover. One possible explanation for this incorrect recollection of the situation may be that some participants did not notice the (probably unexpected) presence of the cover. One may reason that this environmental cue was unnoticed by some participants due to a lack of attention, as rather unexpected cues may be overlooked when one is attending to other cues or tasks in that environment (e.g., the snack jar itself or the pin device at the checkout corner). This phenomenon is called inattentional blindness and may also be an explanation for the large number of customers reporting not noticing the snack jar itself (Simons & Chabris, 1999).

The quasi-experimental design employed in both field studies is associated with several limitations. For instance, no conclusions can be drawn on an individual level. Across the studies, three different kind of sweet snacks were included. This variation in snack type makes it harder to compare the findings across studies, as the snacks may differ in their popularity or convenience to take the snacks. For example, recent research showed that snacks presented with a layer of wrapping (as in Study 1 and 2) were perceived as less salient and requiring more effort compared to unwrapped snacks (as in Study 3), and the presence of the wrapper may affect consumption (Knowles, Brown, & Aldrovandi, 2020). Therefore, future research could examine the generalizability across product types. Our studies however showed that the effect of the cover occurred with different types of snacks and different kind of consumption situations, as we attempted to validate the phenomenon under different circumstances, testing similar hypotheses. Another methodological limitation of the current research is that the social norms measure was not validated and precluded separating descriptive from injunctive norm interpretations. Furthermore, we assessed mainly compensatory after-effects by self-report measures (Stok, de Vet, de Wit, Renner, & de Ridder, 2015), and it is unclear whether people compensated at a later stage and/or in a different context. It is also unclear whether the cover effect sustains after repeated exposure to the cover manipulation; this should be examined in future research. Finally, the impact of physical cues on consumption and perceptions of social norms, effort, and salience was limited to testing one specific cue. Future research should investigate the influence of other physical cues, such as the transparency of serving bowls or the relative availability of healthy versus less healthy snacks.

5.1. Conclusion

The present findings indicate that the presence (versus the absence) of a cover on snack bowls can decrease the likelihood of taking snacks in both field and lab contexts, suggesting that physical cues surrounding foods can influence consumption. Further, first indications suggest that a cover being present (rather than absent) might decrease both perceptions of social norms to take snacks and the salience of the snacks, whereas perceived effort to obtain the snacks is increased. These results suggest that the organization of physical aspects in food environments can change perceptions of social norms, effort, and salience, although...
Appendix A. Supplementary data

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