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Effects of a thin body shape nudge and other determinants of adolescents' healthy and unhealthy food consumption in a school setting

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1. Introduction

A large number of adolescent schoolchildren in Germany are prone to unhealthy eating behavior (Hilbig, 2009; Krug, Finger, Lange, Richter & Mensink, 2018). Over the last thirty years, the consumption of sweets by German children has almost doubled. While 15–18 year-olds in 1988 consumed a daily average of 35.1 g of candy, in 2004 their consumption reached a daily average of 61.5 g (Winkler, 2007). A representative national survey revealed that 14–18 year-olds consume approximately 191.5 g of vegetables, 200.5 g of fruit on a daily basis (Heuer, Krems, Moon, Brombach & Hoffmann, 2015). Consequently, they do not meet the recommended daily fruit and vegetable consumption, while consuming too much sweets (Hesker & Hesker, 2019). In addition, male and female adolescents exhibit different eating behaviors; males often eat less healthily than females (e.g. Mohr, Dolgopolova, & Roosen, 2019). For example, adolescent males consume 51 g less fruit than adolescent females on a daily basis (Heuer et al., 2015). Because eating behavior is a consequence of a complex function, further factors, such as need and hunger, liking for food, regulating one's affect, or weight control, can influence eating behavior (Renner, Sproesser, Strohbach & Schupp, 2012). In conclusion, improving the eating behavior of adolescents poses a profound and complex challenge to today's society.

In improving adolescent eating habits, research is increasingly shifting towards assessing the potential of automatic, unconscious and non-invasive interventions called nudges (Vallgarda, 2012; Hollands et al., 2013). Thaler and Sunstein (2009) describe nudging as "… any aspect of the choice architecture that alters people's behavior in a predictable way without forbidding any options or significantly changing their economic incentives" (pp. 6). A nudge changes a decision-making context to promote a certain choice without forbidding any options. Nudges merely make a certain choice more prominent and salient, while impacting the automatic processes that take place during decision-making in individuals (Hollands et al., 2013).

Particularly within the health context, nudges have become an increasingly prominent and effective instrument. Within the general health context, empirical research reports nudging to be successful in 44% of the studies examined in a quantitative review (38 studies with 86 effects; Hummel & Maedche, 2019). In improving healthy eating behaviors empirical research shows a positive outcome for nudging in as many as 80% of the studies examined in a systematic review (10 review studies and 26 empirical research studies; Veccio & Cavallo, 2019). An average effect size of $d = 0.23$ has been reported for healthy eating nudges (Cadario & Chandon, 2019). Within a school setting, nudging increased students' fruit selection by 51.4% and vegetable selection by 29.7% compared to a control group (Miller, Gupta, Kropp, Grogan & Mathews, 2016). Additionally, a pictorial nudge depicting carrots on tableware increased carrot consumption by approximately 50% among schoolchildren compared to a control condition (Sharps, Thomas & Blissett, 2020). School settings are especially interesting for applying nudges tackling eating behavior, because adolescents spend long hours there often consuming at least one meal (Golan & Ahmad, 2018; Nornberg, Houlby, Skov & Perez-Cueto, 2015).

So far, nudges applied at school have mainly been tested in cafeteria settings and often involve changing the direct physical decision-making environment by placing certain foods closer to the individual or making certain foods more easily accessible (DeCosta, Moller, Frost & Olsen, 2017). For example, when asked to choose from among different chocolates, individuals more often chose the chocolate placed closer to them than more distant options (Van Gestel, Adriaanse & De Ridder, 2020). In addition, placing fruit or healthy snacks next to the cashier's counter (making them more easily accessible) instead of placing them less prominently increased sales by 73.3% in a hospital cafeteria (Cheung, Gillebaart, Kroese, Marchiori, Fennis & De Ridder, 2019) and by almost 50% at a train station kiosk (Kroese, Marchiori & de Ridder, 2015). While effective, these types of nudges cannot be applied in daily school situations outside the cafeteria, such as in corridors or classrooms. In conclusion, pictorial nudges which do not change the physical decision-making environment, constitute an interesting potential health

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intervention to influence eating habits in adolescents.

An effective pictorial nudge for improving eating behavior is the so-called Giacometti cue. This environmental prime consists of the artwork of Alberto Giacometti depicting a thin, genderless, human-like figure. It has been applied effectively to decrease unhealthy food consumption and increase healthy food consumption in the form of a screensaver (Brunner & Siegrist, 2012; Stämpfli & Brunner, 2016), a sticker (Stämpfli, Stöckli, Brunner & Messner, 2020) or a poster (Stöckli, Stämpfli, Messner & Brunner, 2016). Depicting a skinny figure activates body weight related mental contents within a person and consequently causes people to focus on body-weight related motives. This resulted in reduced chocolate consumption (approximately 4 g) and increased blueberry consumption (approximately 6 g; Stämpfli, Stöckli & Brunner, 2017) and led to weight loss (2.8% − 3.4% of body weight) over a six-month period of time (Stämpfli et al., 2020). In conclusion, a pictorial thin body shape nudge based on the Giacometti cue has the potential to effectively influence eating behavior without affecting the direct physical decision-making environment.

To the best of our knowledge nudges using thinness as a major design aspect have not yet been applied to influence adolescents' food consumption. Applying such a nudge to this target group is of particular interest for two reasons. First, eating habits formed in childhood often influence eating habits in adulthood. Improving eating behavior in the early years is thus likely to prevent obesity in adulthood (Schroeter & House, 2015). Second, adolescents are a potentially vulnerable target group. Eating disorders tend to arise during late adolescence (Stice, Marti, Shaw & Jaconis, 2009; Rohde, Stice & Marti, 2014) and are often caused by a perceived pressure to be thin (Stice, 2001). Researching the effects of a thin body shape nudge on adolescents is therefore important, especially when the media constantly expose adolescents to thin ideals (Ohtomo, 2017; Derenne & Beresin, 2006; Spettigue & Henderson, 2004; Harrison, 2016).

Our first research aim is to test the effectiveness of such a nudge for adolescents in a school setting. We carefully designed a thin body shape nudge using the established positive effects of the Giacometti cue as a benchmark. Our nudge is easy to apply throughout the school, for example in a classroom or corridor in the form of a poster without changing the immediate physical decision-making context. We describe the practical implications of tackling the societal problem of unhealthy eating behavior in adolescents. Our second research aim is to assess the impact of control variables on adolescent food consumption, because several factors have been shown to influence eating behavior (e.g. Heuer et al., 2015; Renner et al., 2012). We include gender, self-control, knowledge of healthy eating behavior, taste, hunger, and satisfaction with own body weight in our study.

2. Material and methods

The present study was conducted from January, 10th to January 22th, 2019 at a secondary school in Germany. It is part of a research project at a German university. The project was approved by the ethics committee of the University of Bonn (sequence number 086/19) and therefore complies with the ethical standards of the Declaration of Helsinki. The principal of the secondary school also approved the study. Every individual participant provided written informed consent.

2.1. Sample

The sample consists of 96 secondary schoolchildren. Prior to the analyses five participants were removed from the sample (four participants because of lactose intolerance and one participant because of diabetes), yielding a sample of 91 schoolchildren in total. The sample has an average age of 17.7 years (ranging 17–20 years) and is composed of $n = 46$ female and $n = 45$ male participants. Participants exposed to the nudge ($n = 61$) had an average weight of 67.8 kg and an average height of 175.7 cm, yielding an average body mass index (BMI) of 21.9. Participants not exposed to the nudge ($n = 30$) weight 67.3 kg on average with an average height of 174.3 cm and an average BMI of 22.0.

2.2. Experimental design

A one-factorial quasi-experimental design with an experimental condition and a control group was used. The researcher allocated 91 participants to these conditions prior to the experiment to ensure that females were exposed to the female version of the nudge and that males were exposed to the male version of the nudge. We followed established research protocols as discussed in studies on the Giacometti cue (Brunner & Siegrist, 2012; Stämpfli et al., 2017; Stämpfli & Brunner, 2016, Stöckli et al., 2016; Stämpfli et al., 2020).

2.3. Intervention

In designing the present nudge (Fig. 1), we used the Giacometti prime of a thin body shape as well as salience effects as benchmarks to make it appear healthy. Combining priming and salience effects in nudging achieves the greatest impact (Wilson, Buckley, Buckley & Bogomolova, 2016). A systematic review with *meta*-analysis found low-calorie foods and thin models to effectively reduce food intake (Buckland, Er, Redpath & Beaulieu, 2018). We added healthy and low-calorie food items to the depiction of the thin body shape. This combination makes the nudge more salient and more suitable for adolescents than the Giacometti artwork alone. A male and a female version of the nudge was developed, because the majority of studies applies body shape primes matching the gender of the prime and the sample (Otterbring et al., 2020; Otterbring & Shams, 2019; Ohtomo, 2017; Huneke, Benoit, Shams & Gustafsson, 2015; Rodriguez, Finch, Buss, Guardino & Tomiyama, 2015; Campbell & Mohr, 2011).

Before conducting the study, we pre-tested different versions of the nudge with an independent sample to assess their quality without the targeted sample being exposed to the nudge. We invited 107 students (39.3% high school students; 60.8% university students) to rate the different nudges using adjectives like healthy, unpleasant, salient and vivid on a 7-point scale ranging from 1 (=*does not apply at all*) to 7 (=*applies completely*). The results identified the nudge presented (Fig. 1) as the most healthy and pleasant looking.

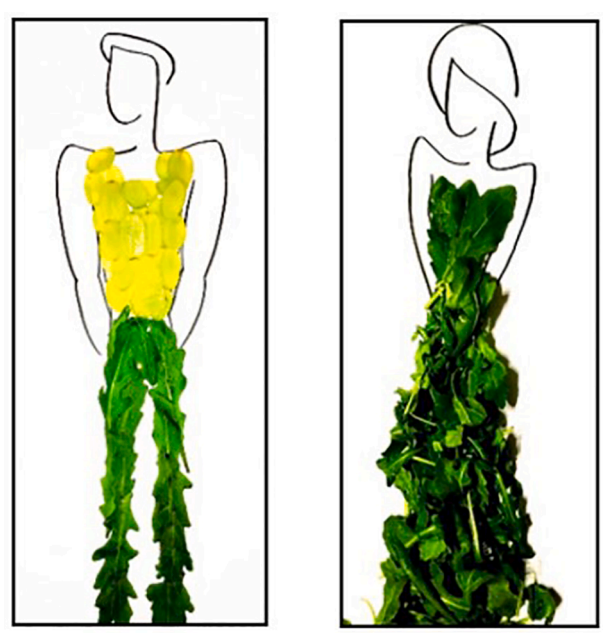

Fig. 1. The nudge (male and female version).

2.4. Study procedure

The experiment took place in a German school setting during a normal school day in an ordinary classroom (Figs. A.1–A.3 in the Appendix). To ensure unbiased participation, students were unaware of the specific contents and purpose of the experiment. No sessions were scheduled before 9:00, between 12:00 and 13:30 or after 16:00 to ensure that the food tasting did not occur at a time at which meals are normally consumed. On entering the room, participants were asked to sit at a table facing the wall. On the table were two ceramic bowls containing 20 blueberries and 20 pieces of chocolate. To prevent the positioning effects of placing the foods either left or right, the placement of the two bowls was counterbalanced across the conditions. The conditions received the same numbers of left and right placements of both foods. In the experimental condition the nudge printed on an A0-sized poster was attached to the wall. It was on show throughout the experiment directly facing the participants at a distance of approximately two meters. The female participants of the experimental condition were exposed to the female nudge poster, while the male participants saw the male nudge poster. The control group was not exposed to any kind of poster and faced a white wall during the experiment.

A female researcher (one of the authors of this article) who was aware of the purpose of the study and expectations hosted each standardized 30-minute session in both conditions. In order to be unobtrusive she (32 years old, average build) was dressed in jeans, a dark t-shirt and sweater throughout the data collection phase. When not interacting with the participants, she remained passive. Upon arrival, the researcher greeted the participants, asked them to take a seat and rearranged some papers next to the nudge poster (or white wall) to allow the participants to perceive the nudge (in the experimental condition). Participants then tasted and rated the blueberries (healthy food) and the chocolate (unhealthy food) for five minutes while the researcher left the room. They were explicitly invited to eat as much food as they liked. After the food tasting, the participants completed questionnaires on several control variables.

After the data collection period, full disclosure of the exact topic and aim of the study was provided to all participants. At that moment all participants also received information about nudging and its possible effects on eating behavior.

2.5. Measures

The dependent variables chocolate consumption and blueberry consumption were measured by assessing the amounts eaten during the food tasting. Both foods were weighed before and after each session unbeknown to the participants. Milk chocolate (single pieces weighing approximately 1.6 g) and blueberries (weighing approximately 0.9 g) have been used in multiple studies assessing the Giacometti cue (e.g. Brunner & Siegrist, 2012). Adolescents typically perceive chocolate as unhealthy and fruits as healthy food options (Perkovic, Otterbring, Schärli & Pachur, 2021). Care was taken that the single chocolate pieces and blueberries were similar in size.

We assessed the following control variables: trait self-control (German version of the *Brief Self-Control Scale* by Sproesser, Strohbach, Schupp & Renner, 2011), knowledge regarding healthy eating behavior (*How do you rate your knowledge regarding healthy eating behavior;* 5-point scale ranging from *very bad* to *very good*), hunger (5-point scale ranging from *very hungry* to *not hungry at all*) and taste (7-point scale ranging from *very good* to *very bad)*. Further control variables were satisfaction with own body weight (5-point scale ranging from *very satisfied* to *not satisfied at all*) and current dieting behavior (*yes* or *no*). The German version of the *Restraint Scale* was administered (Dinkel, Berth, Exner & Balck, 2005) assessing *concern for dieting* (3-point scale ranging from *never/not at all* to *always/strongly*) and *weight fluctuations* (scale ranging from 0 to 4). In the experimental condition, participants reported how they liked the nudge, their level of awareness of the nudge and the influence the perceived the nudge to have had had on their food consumption on a 5-point scale ranging from *completely agree* to *do not agree at all* (Brunner & Siegrist, 2012). Demographic questions included gender, age, height (in cm) and weight (in kg).

2.6. Analyses

For all inferential analyses, this study assumes a significance level of 0.05. Before the analyses, participants' chocolate and blueberry consumption was calculated by subtracting the weight of the foods after the tasting session from the weight before the tasting session. For chocolate consumption two outliers were identified in the dataset based on z-scores above 3.29 (Field, 2013) and were therefore winsorized, replacing these extreme values with a value generated by multiplying the standard deviation of the variable in question by 3. Bootstrapping was used; the number of bootstrap samples for the percentile bootstrap confidence intervals was 1000, with a level of confidence for all confidence intervals of 95%. Missing values were deleted listwise.

To examine the effectiveness of the nudge, first we calculated one-factorial ANOVAs using the nudge as a factor and chocolate as well as blueberry consumption respectively as dependent variables. Second, to control for other factors that might influence chocolate and blueberry consumption, we used hierarchical regression analyses of chocolate and blueberry consumption respectively each involving three stages; Stage one with gender as a predictor, stage two adds knowledge regarding healthy eating behavior, self-control, taste rating of the food, hunger and satisfaction with own body weight as predictors, and stage three adds the nudge as a predictor. Finally, we apply ANOVAs for male and female participants using the nudge as an independent variable and chocolate as well as blueberry consumption respectively as dependent variables.

3. Results

3.1. Descriptive statistics and manipulation check

Table 1 summarizes the descriptive statistics of the control variables for the nudge and no nudge conditions while displaying Cronbach's α values. All scales have acceptable to good reliability (from $\alpha = 0.68$ to $\alpha = 0.78$).

The two conditions do not differ in self-control ($t(85) = 0.60, p = .554$), blueberry rating ($t(88) = 0.24, p = .815$), chocolate rating ($t(89) = 0.31, p$

Table 1
Means, standard deviations and frequencies of the control variables for the nudge and no nudge condition with Cronbach's α values.

	Nudge (n = 61)	No nudge (n = 30)	Cronbach's α (number of items)
Self-control	3.20 (0.54)	3.13 (0.46)	0.77 (13)
Knowledge	3.51 (0.98)	3.93 (0.69)	–
Blueberry taste rating[1]	2.61 (0.96)	2.56 (0.94)	0.78 (3)
Chocolate taste rating[1]	2.38 (0.95)	2.32 (0.74)	0.73 (3)
Hunger[2]	3.48 (1.26)	3.30 (1.12)	–
Satisfaction with weight[3]	2.39 (1.08)	2.17 (0.99)	–
Dieting behavior	9 yes (14.8 %) 52 no (85.2 %)	1 yes (3.3 %) 29 no (96.7 %)	–
Concern for diet[4]	46.05 (2.86)[6]	42.83 (2.11)[7]	0.68 (5)
Weight fluctuations[4]	44.62 (2.64)[6]	45.79 (2.67)[7]	0.73 (3)
Nudge rating[5]	2.73 (0.86)	–	0.78 (3)
Nudge perceived[5]	3.97 (1.33)	–	–
Nudge perceived influence[5]	1.38 (0.78)	–	–

Notes: [1]Taste rating ranges from 1 = very good to 7 = very bad; [2]Hunger ranges from 1 = very hungry to 5 = not hungry at all; [3]satisfaction ranges from 1 = very satisfied to 5 = not satisfied at all; [4]median; [5]only assessed in the experimental nudge conditions; [6]n = 60; [7]n = 29; Standard Deviations in parentheses.

Table 2
Hierarchical regression analysis on chocolate consumption ($N = 91$).

	Chocolate consumption				
	b	*β*	*p*	R^2	ΔR^2
Step 1				0.119	0.119**
Constant	21.72 (2.65)		0.000		
Gender[1]	−5.73 (1.69)	−0.35	0.001		
Step 2				0.215	0.096**
Constant	31.59 (6.81)		0.000		
Gender[1]	−4.26 (1.71)	−0.26	0.015		
Knowledge	−0.64 (0.92)	−0.07	0.489		
Self-control	−1.07 (1.73)	−0.07	0.539		
Taste rating	−0.37 (0.93)	−0.04	0.692		
Hunger[2]	−1.93 (0.73)	−0.28	0.010		
Satisfaction with weight	0.47 (0.78)	0.06	0.547		
Step 3				0.229	0.014**
Constant	34.74 (7.23)		0.000		
Gender	−4.20 (1.71)	−0.25	0.016		
Knowledge	−0.36 (0.95)	−0.04	0.702		
Self-control	−1.32 (1.73)	−0.08	0.447		
Taste rating	−0.44 (0.93)	−0.05	0.639		
Hunger[2]	−1.95 (0.73)	−0.28	0.009		
Satisfaction with weight	0.35 (0.78)	0.05	0.657		
Nudge[3]	−2.18 (1.80)	−0.13	0.229		

Notes: Standard Error in parentheses; [1]Gender is coded 1 = male, 2 = female; [2] Hunger ranges from 1 = very hungry to 5 = not hungry at all; [3]nudge vs. no nudge; $^{**}p < .01$.

= .761), hunger (t (89) = 0.65, p = .519), satisfaction with their own body weight (t (89) = 0.97, p = .337), dieting behavior (χ^2 (1, N = 91) = 2.69; p = .102), concern for dieting (U = 807.0; p = .577) and weight fluctuations (U = 847.0; p = .839). However, respondents in the no nudge condition rated their own knowledge regarding healthy eating behavior higher than those in the nudge condition (t (89) = -2.13, p = .036).

3.2. Chocolate and blueberry consumption

3.2.1. Effects of the nudge

To assess the effectiveness of the nudge on chocolate and blueberry consumption we used one-factorial ANOVAs. Participants in the nudge condition consumed M = 13.8 g of chocolate (SD = 8.67) and M = 9.0 g of blueberries (SD = 5.38), while participants in the no nudge condition consumed M = 11.8 g of chocolate (SD = 7.06) and M = 8.6 g of blueberries (SD = 5.33). No significant effect of the nudge on chocolate (F (1, 89) = 1.18, p = .281; η^2 = 0.013) and blueberry consumption (F (1, 89) = 0.128, p = .721; η^2 = 0.001) was found.

3.2.2. Effects of control variables

To control for other factors that might influence chocolate and blueberry consumption, hierarchical regression analyses was executed. All variance inflation factors (VIF) were between 1.00 and 1.20, indicating no multicollinearity.

For chocolate consumption (Table 2), the hierarchical regression revealed gender as a significant predictor; males consumed more chocolate than did females. Hunger was significantly related to chocolate consumption; the hungrier the participants were, the more chocolate

Table 3
Hierarchical regression analysis on blueberry consumption ($N = 91$).

	Blueberry consumption				
	b	*β*	*p*	R^2	ΔR^2
Step 1				0.000	0.000
Constant	9.23 (1.81)		0.000		
Gender[1]	-0.17 (1.16)	-0.02	0.883		
Step 2				0.083	0.083
Constant	19.26 (5.14)		0.000		
Gender[1]	-0.57 (1.26)	-0.05	0.650		
Knowledge	-0.14 (0.64)	-0.02	0.829		
Self-control	-0.84 (1.20)	-0.08	0.484		
Taste rating	−1.42 (0.67)	-0.25	0.036		
Hunger[2]	-0.62 (0.51)	-0.14	0.224		
Satisfaction with weight	-0.21 (0.55)	-0.04	0.708		
Step 3				0.089	0.006
Constant	20.51 (5.45)		0.000		
Gender	-0.55 (1.26)	-0.05	0.662		
Knowledge	-0.03 (0.66)	-0.01	0.967		
Self-control	-0.95 (1.21)	-0.09	0.438		
Taste rating	−1.43 (0.67)	-0.25	0.035		
Hunger[2]	-0.63 (0.51)	-0.14	0.220		
Satisfaction with weight	-0.26 (0.56)	-0.05	0.645		
Nudge[3]	-0.88 (1.26)	-0.08	0.485		

Notes: Standard Error in parentheses; [1]Gender is coded 1 = male, 2 = female; [2] Hunger ranges from 1 = very hungry to 5 = not hungry at all; [3]nudge vs. no nudge; $^{**}p < .01$.

Table 4
Sub group analyses for the nudge and no nudge conditions.

	Males (n = 45)				
	Nudge (n = 30)	No nudge (n = 15)			
	M (SD)	*M (SD)*	*F* (1, 43)	*p*	η^2
Chocolate consumption	17.3 (9.19)	13.4 (8.15)	1.91	0.174	0.043
Blueberry consumption	8.9 (5.48)	9.4 (6.43)	0.072	0.790	0.002
	Females (n = 46)				
	Nudge (n = 31)	No nudge (n = 15)			
	M (SD)	*M (SD)*	*F* (1, 44)	*p*	η^2
Chocolate consumption	10.4 (6.71)	10.2 (5.61)	0.01	0.923	0.000
Blueberry consumption	9.1 (5.37)	7.7 (4.01)	0.740	0.394	0.017

Notes: M and *SD* in grams.

they consumed. The nudge was not significantly related to chocolate consumption. In total, the proposed model significantly explains 22.9% of the variance in the participants' chocolate consumption.

For blueberry consumption (Table 3), the blueberry taste rating was identified as a significant predictor. The more the participants liked the taste of the blueberries, the more they consumed. The nudge was not significantly related to blueberry consumption. In total, the proposed model accounts for 8.6% of the variance in the participants' blueberry consumption and does not reach statistical significance.

3.2.3. Nudge effects by gender

Hierarchical regression analyses revealed gender to affect chocolate consumption in such a way that males consumed more chocolate than females. We further investigated the effects of the nudge on chocolate und blueberry consumption. A one-factorial ANOVA for both males and females (Table 4 with descriptive statistics) was applied.

The findings suggest that men's chocolate consumption is higher in the nudge condition than in the no nudge condition, while blueberry consumption is lower in the nudge condition than in the no nudge condition. Neither of these differences is significant. Women's chocolate consumption is equal in both conditions, but lower than men's chocolate consumption. Women's blueberry consumption is higher in the nudge condition than in the no nudge condition. These differences are not significant. The effect sizes indicate that the nudge affected the male and female participants differently; a medium effect for males on chocolate consumption, but no effect for females on chocolate consumption. For men no nudge effect was observed for blueberry consumption, while for women a small effect on blueberry consumption was detected.

4. Discussion and conclusion

The present study focused on two aim: 1) to test the effects of a thin body shape nudge on adolescents within a school setting; 2) to assess the effects of several factors on healthy and unhealthy food consumption at school. We exposed the target group to a newly designed nudge in a controlled setting and measured their chocolate and blueberry consumption.

Research has shown that nudging is effective. For example, a quantitative review of the effect sizes identified nudging within a health context as effective in 44% of the empirical studies examined (including 38 studies and 86 effects; Hummel & Maedche, 2019). Contrary to our expectations, exposing adolescents to a thin body shape nudge did not decrease chocolate or increase blueberry consumption. Our nudge was not effective.

We propose two main explanations and one tentative explanation for the present failure to find a nudge effect. First, we used a different target group for our study; adolescent schoolchildren. So far, research on the Giacometti cue has been based on older target groups. A typical finding has been that this cue decreased chocolate consumption by between 2 and 4 g in participants aged 35–49 years (e.g. Brunner & Siegrist, 2012; Stämpfli et al., 2017). The same cue increased blueberry consumption by approximately 6 g (e.g. Stämpfli et al., 2017). In the present study, however, adolescents were not affected by the nudge. Several studies reported that younger individuals are subjected to a pervasive presence of thin body shapes by the media (Derenne & Beresin, 2006; Spettigue & Henderson, 2004; Hogan & Strasburger, 2008). Due to this omnipresence adolescents may have grown accustomed to thin body shape cues and remained unaffected.

Second, we found only small effect sizes of the nudge (e.g. $\eta^2_{\text{chocolate consumption}} = 0.013$). Even though the Giacometti cue typically produced a medium effect size ranging from $d = 0.39 - 0.65$ (Stämpfli et al., 2017), some research suggested wide variations in nudge effectiveness (e.g. Wilson et al., 2016). For example, a review study on nudging within a school context reported varying increases in fruit selection by schoolchildren ranging from 13% to 71% comparing nudge and no nudge conditions (DeCosta et al., 2017). Our findings are in line with those of studies reporting only small effects of nudging. It is possible that our nudge effect was not powerful enough. Nevertheless, we deem it relevant to report these findings as these are useful for possible meta-analysis (Lakens, 2021).

Third, the lack of a nudge effect is tentatively attributed to psychological reactance. Several studies suggest that exposure to a thin body shape as a health intervention leads to a behavior opposite to that intended by the intervention (e.g. Brunner & Siegrist, 2012; Stämpfli et al., 2020). Specifically, the Giacometti cue is suggested to result in reactance, when consciously perceived (Brunner & Siegrist, 2012); as was the case in the present study. This cue has also been suggested to result in reactance, when individuals are aware of the purpose of the cue being incongruent with their goals (Stämpfli et al., 2020). As the present study mainly consists of non-dieters (10 dieters versus 81 non-dieters), arguably the purpose of the nudge was not in line with the participants' goals. Male adolescents are more prone to reactant behavior than are female adolescents (Bryan et al., 2016; Seeman, Buboltz, Jenkins, Soper & Woller, 2004; Woller, Buboltz & Loveland, 2007). We tentatively attribute the large amounts of chocolate consumed by male adolescents to psychological reactance.

Already in adolescence males and females exhibit different eating behaviors; males often exhibit unhealthier eating patterns than do females (e.g. Mohr et al., 2019; Heuer et al., 2015). Further studies found gender differences within the food domain when confronting individuals with primes of other individuals. These primes, for example, increased the preference for meat in males, but not in females (Chan & Zlatevska,

2019). Females were inclined to spend more money on healthy food and less money on unhealthy food, while men were not (Otterbring, 2018). Also, priming longer-term body image goals led females to reduce their food intake, but not males (Minas, Poor, Dennis & Bartelt, 2016). In line with these studies, we found gender to predict chocolate consumption; male schoolchildren consumed more chocolate than did female schoolchildren.

Research shows that individuals, especially younger people, make unhealthy food choices when hungry (Miller et al., 2016), specifically consuming larger amounts of chocolate (Bossel, Geyskens & Goukens, 2019; Geyskens, Dewitte, Pandelaere & Warlop, 2008) and even overeating (Cheung, Kroese, Fennis & De Ridder, 2017). Hunger also reduced the likelihood of choosing fruit (Forwood, Ahren, Hollands, Ng & Marteau, 2015) and increased the likelihood of choosing chocolate bars (Read & Van Leeuwen, 1998). Due to an orientation on present needs, hungry individuals made more hedonic, rather unhealthy food choices (Otterbring, 2019). Priming with food-related stimuli increased visual attention in hungry individuals to objects that can satisfy their needs (Gidlöf, Ares, Aschemann-Witzel & Otterbring, 2021). We also found hungry schoolchildren to consume more chocolate than did satiated schoolchildren.

The liking for food is one of the motivating factors in food consumption. For Germans, it is even the highest ranked factor of the *Eating Motivation Survey*. This scale describes our motivation behind our eating behavior (Renner et al., 2012). Younger Germans perceived eating palatable food as more important than older individuals (Renner et al., 2012). We also found that schoolchildren liked the taste of blueberries more the more they consumed.

We conclude the following for our two research aims: 1) the nudge did not increase healthy or decrease unhealthy food consumption in adolescent schoolchildren. Nevertheless, the present study contributes to the existing research on nudging. It underlines the importance of testing the effectiveness of a nudge before applying it to a new target group; especially when considering the potential negative effects of a thin body shape nudge. A thin body shape does not necessarily reflect healthy eating behavior or a healthy lifestyle, but is omnipresent in the lives of adolescents; 2) other factors play a role in adolescent food consumption. Schoolchildren's chocolate consumption was affected by gender and hunger. Males consumed more chocolate than females and hungry schoolchildren consumed more chocolate than satiated schoolchildren. Blueberry consumption was influenced by taste; the more the adolescents liked the taste of the blueberries, the more they consumed.

4.1. Limitations and future research

We suggested two main explanations for the lack of a nudge effect: 1) adolescents as a target group, and 2) small effect sizes of the nudge. To assess whether the first explanation holds, our nudge needs to be applied to a middle-aged target group in future studies. Regarding our second explanation, we computed post hoc analyses regarding required sample sizes using G*power (Faul, Erdfelder, Lang & Buchner, 2007). In this way, we can discover whether our sample size ($N = 91$; 2 conditions) yielded enough power to achieve a nudge effect. Based on previous sample sizes and effect sizes in the Giacometti studies [e.g. $N = 80$ with 2 conditions (Brunner & Siegrist, 2012); $N = 114$ participants with four conditions (Stämpfli et al., 2020); Cohen's $d = 0.39 – 0.65$], we assumed a small to medium effect with $\alpha = 0.05$; power $= 0.8$. Comparing our nudge ($n = 61$) and no nudge ($n = 30$) condition with a medium effect size of Cohen's $d = 0.55$ resulted in an acceptable actual power of 0.8. For the hierarchical regression analysis with a medium effect size of Cohen's $f^2 = 0.2$ (6 predictors) we obtained an acceptable actual power of 0.81. Comparing our nudge effect separately for males ($n_{nudge} = 30$; $n_{no\ \mathrm{nudge}} = 15$) and females ($n_{nudge} = 31$; $n_{no\ \mathrm{nudge}} = 15$) only resulted in an acceptable actual power of 0.8 when we assumed a large effect size of Cohen's $d = 0.8$. These analyses suggest that our sample size provides enough power to detect a nudge effect with a medium or large Cohen's d effect size. To detect a small nudge effect a larger sample size is needed. Due to resource constraints our sample size could not be extended as almost all the students available participated in the study. Future studies should include larger sample sizes to achieve more robust findings. Special attention should be paid to the numbers of participants in the sub groups when more detailed analyses or crossover effects with other possible factors are planned.

Our experimental design was largely based on the Giacometti studies (e.g. Brunner & Siegrist, 2012). We introduced a male and a female nudge. Whether participants received the male or female version depended on their own gender. We suggest that future studies elaborate on our idea of gender specific nudges.

4.2. Practical implications

Despite the fact that the thin body shape nudge did not have the expected effect, we can still draw important conclusions that help to tackle the societal problem of unhealthy eating behavior in adolescent schoolchildren. The research so far has not revealed a clear understanding of how, when, for which target group, and what types of nudges work. This lack of a clear understanding is in part attributable to the lack of a specific nudge theory (Bauer, Bietz, Rauber & Reisch, 2021). Our study shows that previously effective nudges do not always show the expected effect when applied to a different target group. A careful design and assessment of nudge effectiveness is imperative. Especially when designing nudge interventions targeting eating behavior for adolescents, potential negative effects must always be kept in mind. Gender, hunger, and taste predicted food consumption in our study. These findings are of interest to German school officials because most German schools provide food for their students, for example in cafeterias. Offering a wider variety of healthy, tasty food, and fewer unhealthy food options is in line with our results. Desserts, for example, could include fresh, sweet fruits instead of sugary options.

Declaration of Competing Interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

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Appendix

Fig A1. The classroom in which the experiment took place.

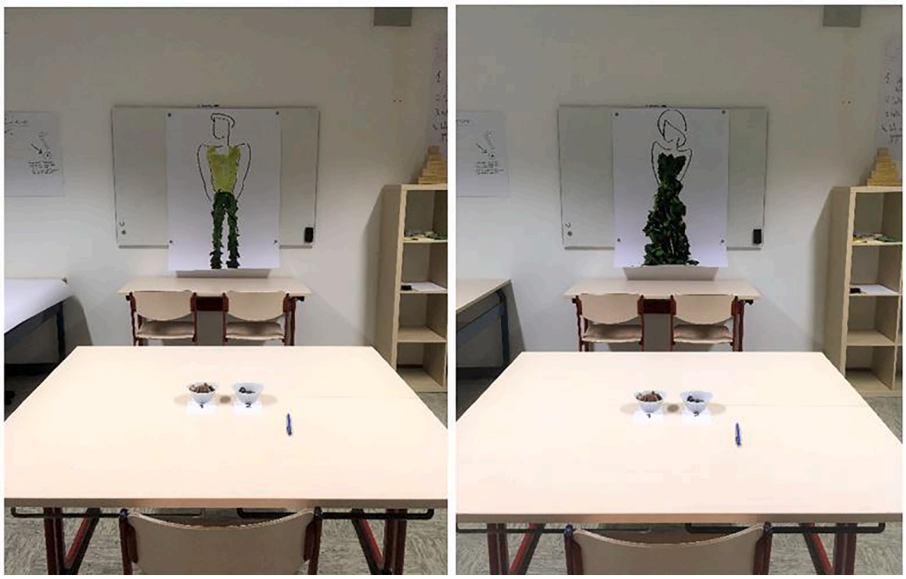

Fig A2. Experimental set-up for the male and female nudge experimental conditions.

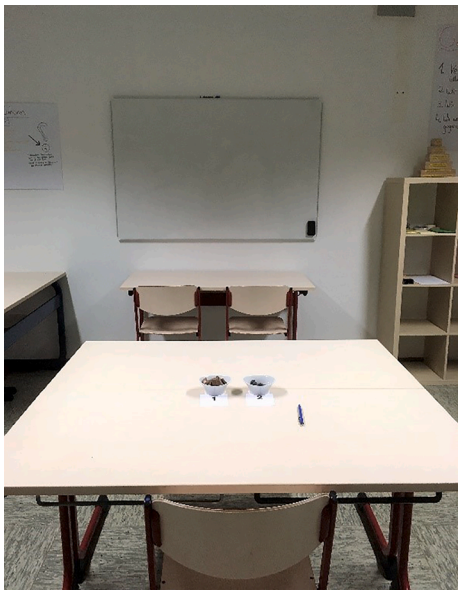

Fig A3. Experimental set up for the no nudge condition.

References

Bauer, J. M., Bietz, S., Rauber, J., & Reisch, L. A. (2021). Nudging healthier food choices in a cafeteria setting: A sequential multi-intervention field study. *Appetite, 160*, 105106. https://doi.org/10.1016/j.appet.2021.105106

Bossel, V., Geyskens, K., & Goukens, C. (2019). Facing a trend of brand logo simplicity. The impact of brand logo design on consumption. *Food Quality and Preferences, 71*, 128–135. https://doi.org/10.1016/j.foodqual.2018.06.009

Brunner, T. A., & Siegrist, M. (2012). Reduced food intake after exposure to subtle weight-related cues. *Appetite, 58*(3), 1109–1112. https://doi.org/10.1016/j.appet.2012.03.010

Bryan, C. J., Yeager, D. S., Hinojosa, C. P., Chabot, A., Bergen, H., Kawamura, M., & Steubing, F. (2016). Harnessing adolescent values to motivate healthier eating. *Proceedings of the National Academy of Sciences, 113*(39), 10830–10835. https://doi.org/10.1073/pnas.1604586113

Buckland, N. J., Er, V., Redpath, I., & Beaulieu, K. (2018). Priming food intake with weight control cues. Systematic review with a meta-analysis. *International Journal of Behavioral Nutrition and Physical Activity, 15*(66), 1–25.

Cadario, R., & Chandon, P. (2020). Which healthy eating nudges work best? A meta-analysis of field experiments. *Marketing Science, Articles in Advance, 39*(3), 465–486. https://doi.org/10.1287/mksc.2018.1128

Campbell, M. C., & Mohr, G. S. (2011). Seeing is eating: How and when activation of a negative stereotype increases stereotype-conducive behavior. *Journal of Consumer Research, 38*(3), 431–444. https://doi.org/10.1086/659754

Chan, E. Y., & Zlatevska, N. (2019). Is meat sexy? Meat preference as a function of the sexual motivation system. *Food Quality and Preference, 74*, 78–87. https://doi.org/10.1016/j.foodqual.2019.01.008

Cheung, T. T. L., Gillebaart, M., Kroese, F. M., Marchiori, D., Fennis, B. M., & De Ridder, D. T. D. (2019). Cueing healthier alternatives for take-away. A field experiment on the effects of (disclosing) three nudges on food choices. *BMC Public Health, 19*(974). https://doi.org/10.1186/s12889-019-7323-y

Cheung, T. T., Kroese, F. M., Fennis, B. M., & De Ridder, D. T. (2017). The hunger games: Using hunger to promote healthy choices in self-control conflicts. *Appetite, 116*, 401–409. https://doi.org/10.1016/j.appet.2017.05.020

DeCosta, P., Moller, P., Frost, M. B., & Olsen, A. (2017). Changing children's eating behavior: A review of experimental research. *Appetite, 113*, 327–357. https://doi.org/10.1016/j.appet.2017.03.004

Derenne, J. L., & Beresin, E. V. (2006). Body image, media, and eating disorders. *Academic Psychiatry, 30*(3), 257–261. https://doi.org/10.1176/appi.ap.30.3.257

Dinkel, A., Berth, H., Exner, W., & Balck, F. (2005). Deutsche Adaption der Restraint Scale zur Erfassung gezügelten Essverhaltens. *Diagnostica, 51*(29), 67–74. https://doi.org/10.1026/0012-1924.51.2.67

Faul, F., Erdfelder, E., Lang, A.-G., & Buchner, A. (2007). G*Power 3: A flexible statistical power analysis program for the social, behavioral, and biomedical sciences. *Behavior Research Methods, 39*(2), 175–191.

Field, A. (2013). *Discovering statistics using IBM SPSS statistics*. Los Angeles: Sage.

Forwood, S. E., Ahren, A. L., Hollands, G. J., Ng, Y.-L., & Marteau, T. M. (2015). Priming healthy eating. You can't prime all the people all of the time. *Appetite, 89*, 93–102. https://doi.org/10.1016/j.appet.2015.01.018

Geyskens, K., Dewitte, S., Pandelaere, M., & Warlop, L. (2008). Tempt me just a little bit more. The effect of prior food temptation actionability on goal activation and consumption. *Journal of Consumer Research, 35*(4), 600–610. https://doi.org/10.1086/591106

Gidlöf, K., Ares, G., Aschemann-Witzel, J., & Otterbring, T. (2021). Give us today our daily bread: The effect of hunger on consumers' visual attention towards bread and the role of time orientation. *Food Quality and Preference, 88*, 104079. https://doi.org/10.1016/j.foodqual.2020.104079

Golan, M., & Ahmad, W. A. (2018). School-based versus after-school delivery of a universal wellness program – a randomized controlled multi-arm trial. *Eating Behaviors, 31*, 41–47. https://doi.org/10.1016/j.eatbeh.2018.08.003

Harrison, K. (2006). The body electric. Thin-ideal media and eating disorders in adolescents. *Journal of Communication, 50*(3), 119–143.

Hesker, H., & Hesker, B. (2019). *Die Nährwerttabelle*. Neustadt an der Weinstraße: Neuer Umschau Buchverlag.

Heuer, T., Krems, C., Moon, K., Brombach, C., & Hoffmann, I. (2015). Food consumption of adults in Germany. Results of the German National Nutrition Survey II based on diet history interviews. *The British Journal of Nutrition, 113*(10), 1603–1614. https://doi.org/10.1017/S0007114515000744

Hilbig, A. (2009). Wie isst Deutschland? Auswertung der Nationalen Verzehrsstudie II zum Lebensmittelverzehr. *Ernährungs-Umschau, 56*, 16–23.

Hogan, M. J., & Strasburger, V. C. (2008). Body image, eating disorders, and the media. *International Journal of Adolescent Medicine and Health, 19*, 521–546.

Hollands, G. J., Shemilt, I., Marteau, T. M., Jebb, S. A., Kelly, M. P., Nakamura, R., … Ogilvie, D. (2013). Altering micro-environments to change population health behavior. Towards an evidence base for choice architecture interventions. *BioMed Central Public Health, 13*, 1218–1223. https://doi.org/10.1186/1471-2458-13-1218

Hummel, D., & Maedche, A. (2019). How effective is nudging? A quantitative review on the effect sizes and limits of empirical nudging studies. *Journal of Behavioral and Experimental. Economics., 80*, 47–58. https://doi.org/10.1016/j.socec.2019.03.005

Huneke, T., Benoit, S., Shams, P., & Gustafsson, A. (2015). Does service employees' appearance affect the healthiness of food choice? *Psychology & Marketing, 32*(1), 94–106. https://doi.org/10.1002/mar.20765

Kroese, F. M., Marchiori, D. R., & de Ridder, D. T. D. (2015). Nudging healthy food choices: A field experiment at the train station. *Journal of Public Health, 38*(2), 133–137. https://doi.org/10.1093/pubmed/fdv096

Krug, S., Finger, J. D., Lange, C., Richter, A., & Mensink, G. B. M. (2018). KIGGS Welle 2. Die Gesundheit von Kindern und Jugendlichen in Deutschland. *Journal of Health Monitoring, 3*(2), 1–80. https://doi.org/10.17886/RKI-GBE-2018-065

Lakens, D. (2021). Sample size justification. Manuscript submitted for publication.

Miller, G. F., Gupta, S., Kropp, J. D., Grogan, K. A., & Mathews, A. (2016). The effects of pre-ordering and behavioral nudges in National School Lunch Program participants' food item selection. *Journal of Economic Psychology, 55*, 4–16. https://doi.org/10.1016/j.joep.2016.02.010

Minas, R. K., Poor, M., Dennis, A. R., & Bartelt, V. L. (2016). A prime a day keeps calories away: The effects of supraliminal priming on food consumption and the moderating role of gender and eating restraint. *Appetite, 105*, 494–499. https://doi.org/10.1016/j.appet.2016.05.022

Mohr, B., Dolgopolova, I., & Roosen, J. (2019). The influence of sex and self-control on the efficacy of nudges in lowering the energy content of food during a fast food order. *Appetite, 141*, 104314. https://doi.org/10.1016/j.appet.2019.06.006

Nornberg, T. R., Houlby, L., Skov, L. R. & Perez-Cueto, F. J. A. (2015). Choice architecture interventions for increased vegetable intake and behaviour change in school setting. A systematic review. Perspectives in Public Health. DOI: 10.1177/1757913915596017.

Ohtomo, S. (2017). Exposure to diet priming images as cues to reduce the influence of unhealthy eating habits. *Appetite, 109*, 83–92. https://doi.org/10.1016/j.appet.2016.11.022

Otterbring, T. (2018). Healthy or wealthy? Attractive individuals induce sex-specific food preferences. *Food Quality and Preference, 70*, 11–20. https://doi.org/10.1016/j.foodqual.2017.02.014

Otterbring, T. (2019). Time orientation mediates the link between hunger and hedonic choices across domains. *Food Research International, 120*, 124–129. https://doi.org/10.1016/j.foodres.2019.02.032

Otterbring, T., Gidlöf, K., Rolschau, K. & Shams, P. (2020). Cereal deal. How the physical appearance of others affects attention to healthy foods. Perspectives on Behavior Science. DOI: https://doi.org/10.1007/s40614-020-00242-2.

Otterbring, T., & Shams, P. (2019). Mirror, mirror, on the menu: Visual reminders of overweight stimulate healthier meal choices. *Journal of Retailing and Consumer Services, 47*, 177–183. https://doi.org/10.1016/j.jretconser.2018.11.019

Perkovic, S., Otterbring, T., Schärli, C., & Pachur, T. (2021). The perception of food products in adolescents, lay adults, and experts: A psychometric approach. *Journal of Experimental Psychology, preprint.*. https://doi.org/10.31234/osf.io/uya7m

Read, D., & Van Leeuwen, B. (1998). Predicting hunger: The effects of appetite and delay on choice. *Organizational Behavior and Human Decision Processes, 76*(2), 189–205. https://doi.org/10.1006/obhd.1998.2803

Renner, B., Sproesser, G., Strohbach, S., & Schupp, H. T. (2012). Why we eat what we eat. The Eating Motivation Survey (TEMS). *Appetite, 59*(1), 117–128. https://doi.org/10.1016/j.appet.2012.04.004

Rodriguez, A. C. I., Finch, L. E., Buss, J., Guardino, C. M., & Tomiyama, A. J. (2015). An experimental field study of weight salience and food choice. *Appetite, 89*, 215–218. https://doi.org/10.1016/j.appet.2015.02.016

Rohde, P., Stice, E., & Marti, C. N. (2015). Development and predictive effects of eating disorder risk factors during adolescence. Implications for prevention efforts. *International Journal of Eating Disorders, 48*(2), 187–198. https://doi.org/10.1002/eat.v48.210.1002/eat.22270

Schroeter, C., & House, L. A. (2015). Fruit and vegetable consumption of college students. What is the role of food culture? *Journal of Food Distribution Research, 46*(3), 131–147. https://doi.org/10.22004/ag.econ.212995

Seeman, E. A., Buboltz, W. C., Jenkins, S. M., Soper, B., & Woller, K. M. P. (2004). Ethnic and gender differences in psychological reactance. The importance of reactance in multicultural counselling. *Counselling Psychology Quarterly, 17*(2), 167–176. https://doi.org/10.1080/09515070410001728316

Sharps, M. A., Thomas, E., & Blissett, J. M. (2020). Using pictorial nudges of fruit and vegetables on tableware to increase children's fruit and vegetable consumption. *Appetite, 144*, 104457. https://doi.org/10.1016/j.appet.2019.104457

Spettigue, W., & Henderson, K. A. (2004). Eating disorders and the role of the media. *The Canadian Child and Adolescent Psychiatry Review, 13*(1). Retrieved on 01.11.2020 from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC2533817/pdf/0130016.pdf.

Sproesser, G., Strohbach, S., Schupp, H., & Renner, B. (2011). Candy or apple? How self-control resources and motives impact dietary healthiness in women. *Appetite, 56*(3), 784–787. https://doi.org/10.1016/j.appet.2011.01.028

Stämpfli, A. E., & Brunner, T. A. (2016). The art of dieting. Exposure to thin sculptures effortlessly reduces the intake of unhealthy food in motivated eaters. *Food Quality and Preferences, 50*, 88–93. https://doi.org/10.1016/j.foodqual.2016.01.012

Stämpfli, A. E., Stöckli, S., & Brunner, T. A. (2017). A nudge in a healthier direction: How environmental cues help restrained eaters pursue their weight-control goals. *Appetite, 110*, 94–102. https://doi.org/10.1016/j.appet.2016.11.037

Stämpfli, A. E., Stöckli, S., Brunner, T. A., & Messner, C. (2020). A dieting facilitator on the fridge door: Can dieters deliberately apply environmental dieting cues to lose

weight? *Frontiers in Psychology, 11*, Article 582369. https://doi.org/10.3389/fpsyg.2020.582369

Stice, E. (2001). A prospective test of the dual-pathway model of bulimic pathology. Mediating effects of dieting and negative affect. *Journal of Abnormal Psychology, 110* (1), 124–135. https://doi.org/10.1037//0021-843X.110.1.124

Stice, E., Marti, C. N., Shaw, H., & Jaconis, M. (2009). An 8-year longitudinal study of the natural history of threshold, subthreshold, and partial eating disorders from a community sample of adolescents. *Journal of Abnormal Psychology, 118*(3), 587–597. https://doi.org/10.1037/a0016481

Stöckli, S., Stämpfli, A. E., Messner, C., & Brunner, T. A. (2016). An (un)healthy poster: When environmental cues affect consumers' food choices at vending machines. *Appetite, 96*, 368–374. https://doi.org/10.1016/j.appet.2015.09.034

Thaler, R. H., & Sunstein, C. R. (2009). *Nudge: Improving decisions about health, wealth and happiness*. London: Penguin Books Ltd.

Vallgårda, S. (2012). Nudge: A new and better way to improve health? *Health Policy, 104* (2), 200–203. https://doi.org/10.1016/j.healthpol.2011.10.013

Van Gestel, L. C., Adriaanse, M. A., & De Ridder, D. T. D. (2020). Beyond discrete choices – investigating the effectiveness of a proximity nudge with multiple alternative options. *Frontiers in Psychology, 11*. https://doi.org/10.3389/fpsyg.2020.01211

Vecchio, R., & Cavallo, C. (2019). Increasing healthy food choices through nudges: A systematic review. *Food Quality and Preference, 78*, 103714. https://doi.org/10.1016/j.foodqual.2019.05.014

Wilson, A. L., Buckley, E., Buckley, J. D., & Bogomolova, S. (2016). Nudging healthier food and beverage choices through salience and priming: Evidence from a systematic review. *Food Quality and Preference, 51*, 47–64. https://doi.org/10.1016/j.foodqual.2016.02.009

Winkler, C. (2007). Süßwaren- und Softdrinkkonsum bei Jugendlichen in Deutschland (final thesis). Universität Potsdam. Retrieved on 11.01.2020 from https://edoc.rki.de/bitstream/handle/176904/5336/winkler.pdf?sequence=1&isAllowed=y.

Woller, K., Buboltz, W., & Loveland, M. J. (2007). Psychological reactance: Examination across age, ethnicity, and gender. *The American Journal of Psychology, 120*, 15–24. https://doi.org/10.2307/20445379