UNIVERSITÄT BERN

How Environmental Health Cues Affect Dieting

Inauguraldissertation zur Erlangung der Würde eines

Doctor rerum oeconomicarum

der Wirtschafts- und Sozialwissenschaftlichen Fakultät

der Universität Bern

vorgelegt von

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von Meikirch, BE

Bern, November 2016

Urheberrechtlicher Hinweis

Die Fakultät hat diese Arbeit am 23.02.2017 auf Antrag der beiden Gutachter Prof. Dr. Claude Messner und Prof. Dr. Sandor Czellar als Dissertation angenommen, ohne damit zu den darin ausgesprochenen Auffassungen Stellung nehmen zu wollen.

Acknowledgements

First, I am grateful to Prof. Dr. Claude Messner and Prof. Dr. Sandor Czellar for reviewing my doctoral thesis. Thank you for your valuable time.

During my dissertation, I received great support and inspiration from many sources. I feel sincerely grateful to my supervisors, Prof. Dr. Claude Messner and Dr. Thomas A. Brunner, for giving me the opportunity to write the present thesis in their research project *Health Cues*. I would like to thank Thomas in particular for his pivotal groundwork and keen ideas for the present research. Moreover, his project acquisition skills enabled me to have mind-broadening experiences during the time of my dissertation. I want to thank Thomas especially for his solution-oriented thinking, guidance, and encouragement. I especially want to thank Claude for his motivating influence by challenging and accompanying me, for allowing me the freedom to pursue my own ideas but simultaneously pulling the strings of our project with care and experience. His ability to meet the individual needs of the members of his team guided his support where needed and helped me to significantly improve my scientific skills.

Many other people supported our project. I want to thank Sabrina Stöckli in particular for her motivating, inspiring, and fruitful cooperation. Focused hours of work but also exuberance advanced our project in essential ways. I am also grateful to Petra Haueter for her kind, dedicated, and reliable support, especially in conducting the longitudinal study. I would further like to thank Dr. Christoph Kopp for his steady advice on statistics and, especially, for his enriching and motivating cooperation regarding our work on multilevel analyses. I also want to thank Stefan Liechti for his clever and active contributions and Anna Schöpf for her valuable support during the concluding phase of my dissertation. Furthermore, I appreciated the help of Noelie Gerber, Felix Göldin, Anita Schafflützel, Jacqueline Barin, Lukas Messerli, and Lena Gilgen in conducting studies. Further, I want to thank Elizabeth Steele for her careful English proofreadings.

In general, I want to thank my colleagues from the University of Bern for the pleasant and inspiring climate and enriching exchanges. Thanks to Bettina, Michael D., Adrian, Michael S., Michelle, Eva, Stefan B., Sabrina G., and Franz. Equally, I want to thank my colleagues from the Bern University of Applied Sciences for their friendly interest and relaxing moments: Special thanks to Luca, Franziska, Louis, Jari, Raffaele, Evelyne, Markus, Katrin, Nicole, Marie-Hélène, Patrick, and Stefan.

It is also important for me to thank my friends for their open ears, helpful comments, encouragement, and distraction. I especially want to thank Christine, Marlène and Mario, Nadine, Claudia, Maria, Eva, Linda, Vanessa, and David.

Most of all, I want to thank my parents, Esther and Kurt, and my brother, Alexander, for their faith in me and their caring support despite harsh times. I dedicate my dissertation to my family.

Bern, September 2016

Aline E. Stämpfli

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Outline

Being overweight is costly in both health-related and economic terms. With regard to health, today's prevalent diseases are non-communicable diseases, such as cardiovascular diseases and diabetes. An essential component of them is caused by an unhealthy diet and overweight. The occurrence of non-communicable diseases is increasing (Federal Office of Public Health [FOPH], 2016; World Health Organization [WHO], 2013, 2015). As a result of this increase, the direct and indirect costs of being overweight and its sequelae are growing rapidly. For example, in Switzerland, these costs tripled between 2002 and 2012, amounting to CHF 8 billion in 2012 (FOPH, 2014).

However, as the global epidemic of overweight and obesity demonstrates, maintaining a healthy weight is challenging for many (WHO, 2016). Information-based strategies to support weight control, such as emphasizing calorie information, have failed (e.g., Downs, Loewenstein, & Wisdom, 2009). This is because knowledge hardly contributes to a person's eating behaviors (FOPH, 2012). Rather, eating is determined by both metabolic factors, i.e., physical needs, and non-metabolic factors, such as environmental cues, rewards, and cognitive and emotional factors. However, physical needs are often overpowered by the desire to eat. In our "obesogenic" environment, where high-caloric, palatable food is easily accessible, and where are plenty of food cues, people make over 200 unnoticed food decisions each day (Wansink & Sobal, 2007). Thus, individuals often eat even when they are satiated (Berthoud, 2006; Papies, Potjes, Keesman, Schwinghammer, & van Koningsbruggen, 2014).

Promisingly, however, similar to how food cues can trigger eating, environmental weight-control cues can encourage dieting. For instance, dieting-related meal descriptions in a restaurant menu increase low-calorie food choices (Papies & Veling, 2013), and the scent of fruit makes people more likely to choose meals containing fruit or vegetables (Gaillet, Sulmont-Rossé, Issanchou, Chabanet, & Chambaron, 2013). Environmental weight-control or health cues are thought to influence people at the moment of making the "wrong" eating decisions through priming—that is, by activating individuals' weight-control or health goals outside of their awareness (Papies, 2016; Stroebe, van Koningsbruggen, Papies, & Aarts, 2012). This priming effect seems to correspond to WHO's approach of facilitating losing weight through "making healthy choices easy choices" (WHO, 2016).

The present dissertation examines the approach of applying environmental cues to affect dieting. As a part of the National Research Program NRP 69—Healthy Nutrition and Sustainable Food Production (Swiss National Science Foundation, 2016), the studies of the present dissertation were financially supported by the Swiss National Science Foundation (grant 12 No. 145189). In our

studies, we focused first on whether making healthy choices easier with the help of environmental cues was possible in a complex real-world setting (Paper 1, Stöckli, Stämpfli, Brunner, & Messner, 2016). Second, we examined whether food choices influenced by environmental cues were in fact easy choices by examining the effortlessness of a cue's effect (Paper 2, Stämpfli & Brunner, 2016). Third, we determined for the "Giacometti cue," which has repeatedly been proven to influence food decisions in our studies, whether it activated a health- or a weight-related mental concept (Paper 3, Stämpfli, Stöckli, & Brunner, 2017). Finally, we conducted a longitudinal study to examine whether a weight-control cue could be applied intentionally by dieters over an extended period of time to lose weight (Manuscript 4).

Environmental Cues Affect Consumers' Food Choices at Vending Machines

In **Paper 1**, "An (un)healthy poster: When environmental cues affect consumers' food choices at vending machines" (Stöckli et al., 2016), we investigated the effects of environmental cues on food choices in public places. These studies revealed that environmental cues could influence individuals in complex real-world settings. In Study 1, a one-factorial within-subjects design with four conditions was applied. Consumers were exposed to posters with health-related motifs (activity or nature), a hedonic motif (a fun fair), or to no poster (control condition) at snack vending machines. Their subsequent choice of snack was recorded. The results revealed that consumers exposed to a health-related nature poster were more likely to buy healthy snacks than were those exposed to the hedonic fun fair poster or to no poster. Consumers were also more likely to buy healthy snacks when they were primed by an activity poster as opposed to when they were primed by the fun fair poster. Study 2 was conducted at the National Office of Public Health. Again, a one-factorial within-subjects design with four conditions was applied. The nature poster was replaced by a poster showing thin, human-like sculptures by the artist Alberto Giacometti. These figures have been proven in the laboratory to reduce the amount of food consumed (Brunner & Siegrist, 2012). Study 2 expanded the results of Study 1 by showing that when exposed to the Giacometti or activity poster, consumers were more likely to buy healthy snacks than when they were exposed to the hedonic fun fair poster or to no poster. Thus, making healthy choices easier with the help of environmental cues was possible in a complex real-world setting.

Effortlessness of the Effect of the Giacometti Cue

Whether the food choices influenced by environmental cues were actually easy choices to make was then examined in **Paper 2**, "The art of dieting: Exposure to thin sculptures effortlessly reduces

the intake of unhealthy food in motivated eaters" (Stämpfli & Brunner, 2016). In a chip tasting, half of the participants exposed to the Giacometti sculptures were cognitively loaded to determine how much effort was required to process the cue. A 2 (cue vs. no cue) × 2 (low vs. high cognitive load) between-subjects design was applied. Either the Giacometti cue or neutral white pictures were unobtrusively placed as screensavers on laptop computers. In the low cognitive load condition, participants were given two digits to memorize during the tasting; in the high cognitive load condition, they were given 10 digits to memorize. The results indicated that the sculptures reduced the participants' chip intake independently of cognitive load and, thus, of the limited cognitive resources available. This is a crucial advantage when considering the application of such a cue in complex, real-world settings. Furthermore, the results revealed that the sculptures reduced chip intake only when the participants liked the chips. The weight-control cues could thus have influenced participants when they were motivated to eat, and the cues were useful.

Weight-Related Giacometti Cue

Paper 3, "A nudge in a healthier direction: How environmental cues help restrained eaters pursue their weight-control goal," deals with the semantic relatedness of the Giacometti cue. Both a health-related and a weight-related mental concept could have conceivably driven the "Giacometti effect" found in the previous studies (Brunner & Siegrist, 2012; Stämpfli & Brunner, 2016; Stöckli et al., 2016). Despite a vast amount of empirical evidence on the effects of environmental cues, the understanding of the specific semantic content activated by a cue is often not revealed (Bargh, 2006; e.g., Papies & Veling, 2013). However, a detailed understanding of the semantic drivers of the environmental cues' effects is critical in determining the purpose of a cue and the appropriate target group. In other words, understanding the semantic relatedness of a cue would indicate which choices can be made easy choices and for whom using this specific cue. Two laboratory studies revealed that the Giacometti cue was primarily weight-related. Study 1 applied a 2 (cue vs. no cue) × 2 (unhealthy vs. healthy food) between-subjects design in a tasting. The results indicated that the cue reduced food intake independently of food healthiness; i.e., of whether the participants tasted chocolates or blueberries. Furthermore, restrained eating moderated the "Giacometti effect." Restrained eaters, who are known for having a weight-control goal (Herman & Mack, 1975; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008), ate less after having been exposed to the thin sculptures. In Study 2, a one-factorial (cue vs. no cue) between-subjects design was applied to examine the cue's influence on how participants completed fragmented words in a word completion task. The results of Study 2 pointed

in the same direction as Study 1, indicating that restrained eaters completed more fragmented words with weight-related rather than neutral words after being exposed to the sculptures. This indicates that the Giacometti cue is primarily weight-related, and that it could help individuals with an existing weight-control goal to pursue this goal.

Promising Longitudinal Data

In **Manuscript 4**, we examined whether the Giacometti cue can actually make it easier for dieters to pursue their goal of losing weight. Thus far, we have found evidence that the Giacometti cue is weight-related and can influence individuals at the "right" moments when they are motivated to eat. We have also observed the cue's influence on food choices in a complex real-world setting at snack vending machines. This could be explained with the further finding that the cue's effect is independent of cognitive load. However, these were all observations on the short-term effects of an environmental cue. In general, empirical evidence of effects of environmental cues in the long run is scarce (Klesse, Goukens, Geyskens, & de Ruyter, 2012). Furthermore, it is as yet unexplored whether individuals can apply environmental cues intentionally to support their own goal pursuit. Normally, study participants are exposed to environmental cues without their knowledge. In addition, they are typically not aware that they are being influenced (Chartrand, 2005; Stämpfli & Brunner, 2016).

To bridge this gap in the research, we conducted a six-month longitudinal study with participants who had the goal of losing weight. We applied a 2 (cue: semantically neutral Rothko picture vs. semantically weight-related Giacometti picture) × 2 (awareness of the cue's influence: unaware vs. aware) mixed-subjects design. Over the course of six months, the participants were exposed to the Giacometti or Rothko picture in weight diaries. They were either told (awareness conditions) or not told (unawareness conditions) that the cues had been proven to support weight loss. This design resulted in three experimental conditions related to weight. The weight-related conditions were either semantically related to weight (Giacometti-unaware), related by learning (Rothko-aware), or both, semantically and by learning (Giacometti-aware). The condition Rothko-unaware served as the control condition. We hypothesized that environmental cues related to weight could help individuals to pursue a weight-loss goal over a longer period of time. Furthermore, we assumed that awareness of a cue aligned with one's goal would enhance a cue's effect—such as a knot in a handkerchief as reminder of one's goal.

The results were ambiguous. However, they pointed in the direction that the weight-related cues—whether semantically related, related by learning, or both—helped with weight loss. By

tendency, they helped high-restrained eaters with their chronic weight-control goal (Herman & Mack, 1975; Stroebe et al., 2008). Furthermore, the results indicated that participants' awareness of a cue's influence may be more important for activating the goal of losing weight than the mere semantic relatedness of a cue with weight.

The results of the longitudinal study revealed that high-restrained eaters could intentionally apply environmental cues to lose approximately two kilograms in half a year. This is important as adults gain on average 0.5 to 1 kilogram per year (Hutfless et. al., 2013). For a typical male, gaining an extra kilogram a year comes from eating 24 calories too much per day (Seeley & Woods, 2003). This is equivalent to about one piece of chocolate from a chocolate bar for dessert a day. When weight-control cues can influence us in such situations, in opposition to our "obesogenic" environment (Papies et al., 2014), they can help in preventing obesity (Hill, Wyatt, Reed, & Peters, 2003). For example, this could be initiated by simply pinning a picture to the refrigerator's door to serve as a weight-control cue. In this way, dieters can successfully pursue their weight-control or health goals with minimal effort on their part.

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Paper 1

An (Un)healthy Poster:

When Environmental Cues Affect Consumers' Food Choices

at Vending Machines

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. doi:10.1016/j.appet.2015.09.034

Appetite 96 (2016) 368–374

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

An (un)healthy poster: When environmental cues affect consumers' food choices at vending machines

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ARTICLE INFO

Article history:
Received 9 April 2015
Received in revised form
26 September 2015
Accepted 28 September 2015
Available online 22 October 2015

Keywords:
Environmental cue
Healthy nutrition
Food choice
Priming
Mental concept

ABSTRACT

Environmental cues can affect food decisions. There is growing evidence that environmental cues influence how much one consumes. This article demonstrates that environmental cues can similarly impact the healthiness of consumers' food choices. Two field studies examined this effect with consumers of vending machine foods who were exposed to different posters. In field study 1, consumers with a health-evoking nature poster compared to a pleasure-evoking fun fair poster or no poster in their visual sight were more likely to opt for healthy snacks. Consumers were also more likely to buy healthy snacks when primed by an activity poster than when exposed to the fun fair poster. In field study 2, this consumer pattern recurred with a poster of skinny Giacometti sculptures. Overall, the results extend the mainly laboratory-based evidence by demonstrating the health-relevant impact of environmental cues on food decisions in the field. Results are discussed in light of priming literature emphasizing the relevance of preexisting associations, mental concepts and goals.

Apple or chocolate? Water or lemonade? Food choices seem to be among the simplest decisions. However, as today's global obesity epidemic reveals, food decisions are complex and driven by many factors (Köster, 2009; World Health Organization, 2014). Food decisions depend on motives such as hunger, pleasure, sociability, weight control, and health (Renner, Sproesser, Strohbach, & Schupp, 2012) but also on our environment. Environmental cues can influence *how much* people eat (e.g., Brunner, 2010). A poster promoting a slim figure can result in a reduced amount of test snacks being eaten (Papies & Hamstra, 2010). More subtly, consumers eat less chocolate when there is a body-weight scale or a picture of skinny human-like Giacometti sculptures in the laboratory (Brunner, 2010; Brunner & Siegrist, 2012).

This paper is not focused on the influence of environmental cues on the amount of consumption but on the influence on consumption choice. The main question is whether environmental cues can influence the preference for healthy or unhealthy food. Two field studies with vending machines examine whether posters with a health-evoking but not directly food-related image lead to more sales of healthy over unhealthy foods compared to no poster or a poster with a hedonic-evoking motif.

1. When environmental cues determine food decisions

The homeostatic system is an internal signal structure that maintains a person's energy homeostasis. In contrast, the non-homeostatic system is driven by environmental cues. It is well known that the latter system particularly facilitates overindulgence and adds to today's increasing obesity rates (Berthoud, 2006; Hill & Peters, 1998; Seeley & Woods, 2003; Wadden, Brownell, & Foster, 2002).

Environmental cues can affect *how much* and *what* people eat or drink (see Wansink, 2004; for a review). A poster promoting a slim figure, or an experimenter stating that chocolate makes people happy but fat, decrease consumption volume (Brunner, 2010; Papies & Hamstra, 2010) and fruit odor brings people to prefer meals with fruits or vegetables (Gaillet, Sulmont-Rossé, Issanchou, Chabanet, & Chambaron, 2013). As shown by these examples, environmental cues influence people in various manifestations. Besides sensory cues such as odors (Gaillet et al., 2013), light (Areni & Kim, 1994), and music (North, Hargreaves, & McKendrick, 1999), normative cues such as ideal weight-reminders (Brunner, 2010; Papies & Hamstra, 2010), plate size (Van Ittersum & Wansink,

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http://dx.doi.org/10.1016/j.appet.2015.09.034
0195-6663/

2012), and eating companions (Brunner, 2010; Herman Koenig-Nobert, Peterson, & Polivy, 2005) also influence eating. For example, chocolate tasters tend to eat as much or as little as their companions do. Since our environment is full of cues, these can overpower each other. This becomes evident when the chocolate tasters of the previous illustration are additionally influenced by a body-weight scale and thus eat little regardless of their companion's food intake (Brunner, 2010). All in all, these examples imply that existing associations and concepts are considerable factors in determining which environmental cue is decisive in food choice situations (Bargh, 2006).

2. The role of priming, associations and concepts

Environmental cues can serve as primes, activate mental concepts and thereby influence decisions (see Bargh, 2006; for a review). As the example of reduced food intake after subtle exposure to Giacometti sculptures illustrates, applying the priming paradigm to the food consumption area has been proven to be effective (Brunner & Siegrist, 2012). Similar to Kay, Wheeler, Bargh, and Ross' (2004) activation of a competition concept by related objects (e.g., business suits), the Giacometti effect leads to the conclusion that body-weight or figure related cues activate corresponding concepts such as dieting. A similar mechanism occurs when the unconscious perception of fruit odor activates a fruit and vegetable concept and thus causes people to more frequently opt for meals with than without fruits or vegetables (Gaillet et al., 2013). Likewise, a diet recipe poster on a butcher's store door led customers with but not without a dieting goal to eat fewer test snacks, suggesting the activation of a motivational dieting concept (Papies & Hamstra, 2010). In line with priming research (see Bargh, 2006; for a review), these examples imply that environmental cues can activate various types of mental concepts such as traits, stereotypes, schemata or goals and thus induce a subsequent process or behavior (e.g., Bargh, 1990; Bargh & Gollwitzer, 1994; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Custers & Aarts, 2005, 2007; Förster, Liberman, & Friedman, 2007; Sela & Shiv, 2009). Specific to the food consumption area, the idea of activating mental concepts by means of related environmental cues (see Bargh, 2006; for a review) implies that health-related or hedonic-related cues can increase the accessibility of healthy or hedonic dieting concepts. Notably, activating a certain diet-relevant concept requires a sufficiently strong associative cue-concept-link (Gaillet et al., 2013). Since people have both healthy and hedonic concepts, a person's association between an environmental cue and a health concept must be sufficiently strong in order to cause a healthy behavior.

In conclusion, two major generalizations can be drawn about the conditions under which environmental cues are effective in encouraging healthy food choices: First, a mental concept of healthy dieting should preexist. Second, the mental ties of these mental representations with the environmental cue must be sufficiently strong (cf. Gaillet et al., 2013).

Note that most of the existing findings stem from laboratory experiments (e.g., Brunner, 2010; Brunner & Siegrist, 2012; Harris, Bargh, & Brownell, 2009), but not from naturalistic settings (e.g., Papies & Hamstra, 2010). In order to learn more about the practical application of environmental cues, empirical attention should be given to the effectiveness of environmental cues in the field.

3. Research overview

The aim of the studies was to examine whether one's actual food choice can be influenced by environmental cues in a naturalistic setting. Contrary to previous studies, the present research focused on actual food choices (e.g., cookies vs. apples) rather than on quantitative decision aspects (e.g., one vs. two snacks). Whether specific snacks were presumed to be healthy or unhealthy was determined by people's perception rather than by actual nutritional value.

Two field studies tested the hypothesis that visual environmental cues with an associative link to (un)healthy food lead to choices of (un)healthy food alternatives. Both field studies were conducted using vending machines. The environmental cues were posters with a healthy or a hedonic motif, which were placed beside the vending machines. Thus, the field studies tested whether a poster with a healthy motif results in healthy snack choices whereas a poster with an unhealthy motif leads to unhealthy snack choices.

4. Field study 1

4.1. Method

4.1.1. Sample

A total of 634 snack purchases from vending machines at three locations of a European University of Applied Sciences were registered. Snack decisions were measured retrospectively by the amount of sales and not individually. Hence, no demographics for the sample were obtained. However, an independent survey with ten individuals at each of the three vending machine locations was conducted, giving a better notion of the sample. Data from these 30 individuals (25 females, $M_{age} = 29.60$, $SD_{age} = 9.77$) suggest that a campus sample can be assumed. Purchases of several non-food products (i.e., chewing gum or beverages) were excluded. Due to a daily altering assortment, sandwiches were also not considered for the analysis. The exclusion of these 106 purchases bypasses the ambiguity of classifying the products as healthy or unhealthy snacks. A final sample of 528 snack purchases remained for the analysis.

4.1.2. Design and procedure

The field study employed a one-factorial within-subjects design with four conditions. One of four options (a nature, activity, or fun fair poster or no poster) was placed next to the vending machine, with each option displayed for one fourth of the time. According to a Latin-square design, the four poster conditions were permuted and counterbalanced across the three test locations. In a period of one month (from April 28 to May 25, 2014), poster conditions were systematically combined with the vending machine at each test location in weekly intervals. Each poster-location combination was tested once.

Consumers were primed with a poster placed next to a vending machine. All testing occurred during the regular term time, that is, during a period with no exams or holidays and with a constant opening time. All snack purchases were registered in collaboration with the owner of the vending machines, a regional bakery. This was conducted in line with the usual and periodic vending machine restock. Specifically, the number of healthy and unhealthy snack purchases was subsequently measured by a daily inventory of snack sales for each condition and location.

4.1.3. Materials

4.1.3.1. Posters. In the treatment conditions, a nature poster, an activity poster, or a fun fair poster was placed in the consumers' visual line. No poster was placed for the control condition. All poster motifs were chosen by means of an exploratory pilot study. An accumulation of potential motifs was determined by unstructured single in-depth interviews with male and female students, asking what they associate with healthy and hedonic nutrition. All associations were collected in the form of key words. Frequently

stated key words were discussed in expert groups. After that, two health-relevant and one hedonic motif were extracted. Specifically, nature and activity were considered to evoke associations with a healthy diet. In contrast, a fun fair was perceived as representative of hedonic needs.

The results of the pilot study served as the basis for the poster selection. Therefore the nature poster showed grassland, trees and a blue sky with clouds. In the activity condition there were running legs in sport shoes with asphalt in the background. In contrast, the fun fair poster showed two carousels with a summery blue sky in the background. All poster motifs were retrieved from an online database of free stock photos (http://www.fotocommunity.de/). Posters did not show text or food. The Web version of this paper offers an appendix with an example situational view of the test locations.

4.1.3.2. Snack choice. Consumers selected among a large variety of snacks (approximately 15 products). At each location, these were arranged and cooled in equally sized compartments on a ten-level carousel vending machine. The composition of the snack display was adapted for the field study. All vending machines offered a constant snack display. Since the snack offer was maintained in order to adhere to the usual naturalistic setting, individual vending machines offered a slightly different snack assortment. Likewise, snack displays in the individual vending machines and prices were held constant.

Each snack of the assortment was categorized as healthy or unhealthy. The categorization resulted from an independent pretest with 97 participants evaluating all snack alternatives from 1 (*very unhealthy*) to 7 (*very healthy*). Ratings were used to measure *snack choice*, that is, coding snack purchases as healthy ($M \geq 4$) or unhealthy ($M < 4$). The Web version of this paper offers an appendix with an overview of the snack display and perceived healthiness for all snacks.

4.2. Results and discussion

The trend of the results is in line with the hypothesis. Based on a 4 × 2 (poster [nature vs. activity vs. fun fair vs. control] × food [healthy vs. unhealthy]) contingency table, a chi-square test revealed an association between poster exposure and snack choice ($\chi^2(3, 528) = 10.45$, $p < .05$). While in the nature condition, 34% (or 46 out of 135) of the chosen snacks were healthy (vs. 66% unhealthy snacks), in the activity condition, 28% (or 33 out of 118) of the selected snacks were healthy (vs. 72% unhealthy). In contrast, the percentage of healthy snacks in the control condition was 22% (or 28 out of 128; vs. 78% unhealthy snacks) and in the fun fair condition 18% (or 27 out of 147; vs. 82% unhealthy snacks).

A post-hoc analysis with six separate 2 × 2 (poster × food [healthy vs. unhealthy]) comparisons revealed three significant relations, indicating poster-related differences in snack choices. As expected, when consumers were exposed to the nature poster rather than to the fun fair poster healthy snacks were chosen more frequently than unhealthy snacks ($\chi^2(1, 282) = 9.05$, $p < .01$). Furthermore, when consumers were exposed to the nature poster rather than to no poster healthy snacks were chosen more frequently than unhealthy snacks ($\chi^2(1, 263) = 4.84$, $p < .05$). Consistent with the hypothesis, when consumers were exposed to the activity poster rather than to the fun fair poster healthy snacks were selected marginally more frequently than unhealthy snacks ($\chi^2(1, 265) = 3.44$, $p = .06$). In line with the hypothesis, when consumers were exposed to either the nature poster or the activity poster no differences in the chosen amount of healthy or unhealthy snacks occurred ($\chi^2(1, 253) = 1.09$, $p = .30$). Likewise, when consumers were exposed to either the activity poster or to no poster no differences in the chosen amount of healthy or unhealthy snacks was observed ($\chi^2(1, 246) = 1.22$, $p = .27$). Finally, when consumers were exposed to the fun fair poster or to no poster no differences in the chosen amount of healthy or unhealthy snacks appeared ($\chi^2(1, 275) = 0.53$, $p = .47$).

Fig. 1 illustrates the frequencies of healthy and unhealthy snack choices in all poster conditions, accentuating those poster conditions that did not result in different influences on snack choice.

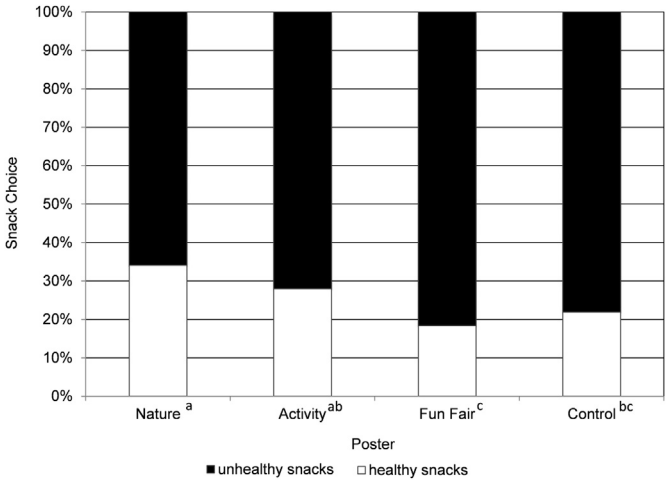

Fig. 1. Number of healthy versus unhealthy snack purchases in the four poster conditions of field study 1. Snack choices in the conditions marked with the same letter did not differ.

In conclusion, exposure to a poster affected the choice between healthy and unhealthy snacks. Importantly, the extent of this influence differed between the tested posters. Whereas individuals with a nature poster chose a healthy snack more often than individuals exposed to a fun fair or no poster, individuals in the activity condition were more likely to choose healthy snacks than those in the fun fair condition. No difference was found for consumers in the control condition compared with consumers primed by activity and fun fair posters. As assumed, consumers primed by the activity and nature poster did not differ in their snack choice. Overall, the trend of the results is in line with the hypothesis.

In order to improve generalizability and further demonstrate ecological validity, a replication study was designed. Thus, field study 2 aimed at replicating the previously observed effect, but with a different sample and an additional environmental cue.

While field study 1 was limited to the nature, activity and fun fair posters, field study 2 included an additional poster. Since the added poster showed the Giacometti sculptures, which are assumed to address a weight-related concept, consumers should theoretically respond by more frequently choosing healthy compared to unhealthy food. Thus, field study 2 examined whether the Giacometti effect is limited to quantitative food decisions as shown in research by Brunner and Siegrist (2012) or can be expanded to food choice. Furthermore, the validity of the impact of the Giacometti sculpture on food decisions was studied in a naturalistic setting.

5. Field study 2

5.1. Method

5.1.1. Sample

A total of 253 purchases from a vending machine at the National

Office of Public Health was registered. As in field study 1, the data gathering was conducted retrospectively by the amount of sales, and consumers were not individually registered and actively assigned to conditions. Thus, no demographics were available for the main study. However, an independent survey with 34 employees of the National Office of Public Health provided a rough estimate of the sample composition (21 females, $M_{age} = 42.53$, $SD_{age} = 10.34$). Similar to field study 1, one ambiguous purchasing option (soft drink produced from milk whey) was not included in the sample. Thus, a final sample of 252 snack purchases was included in the analysis.

5.1.2. Design and procedure

A similar design and procedure to that in field study 1 was used. That is, a one-factorial within-subjects design with four conditions was employed. One of four options (the Giacometti sculptures, activity or fun fair poster or no poster) was placed above the vending machine, with each option displayed for one fourth of the time. The poster conditions changed in weekly intervals for one month (from June 2 to June 30, 2014).

The primed consumers all chose from the provided food display under natural and constant environmental conditions. Their purchases were registered by means of the electronically controlled stock monitoring system of the vending machine operator. All transmitted data allowed the frequency of healthy and unhealthy purchases for each condition to be determined.

5.1.3. Materials

5.1.3.1. Posters. As in field study 1, the treatment conditions consisted of three posters, which were placed in consumers' visual line. No poster was used for the control condition. While the activity and fun fair posters remained identical to field study 1, the Giacometti motif was chosen on the strength of Brunner and Siegrist (2012) demonstration of its food-reducing influence.

5.1.3.2. Snack choice. Consumers selected among healthy and unhealthy foods. The arrangement and prices of all food were employed unmodified and held constant. To measure food choice as a dependent variable, each purchase was coded as either healthy or unhealthy. Based on the online pretest of field study 1, subcategories of healthy and unhealthy foods were extracted and used to either classify purchases as healthy (natural snacks and natural drinks) or unhealthy (chocolate, pastries, chips, and soft drinks). The Web version of this paper offers an appendix with an overview of all purchased food and its categorization.

5.2. Results and discussion

The results are in line with the hypothesis. As in field study 1, a chi-square test revealed a relation between poster exposure and food choice ($\chi^2(3, 252) = 16.94$, $p < .001$). The percentage of healthy snack purchases in the Giacometti condition was 58% (or 42 out of 73; vs. 42% unhealthy snacks), 44% (or 37 out of 85; vs. 56% unhealthy snacks) in the activity condition, 29% (or 19 out of 66; vs. 71% unhealthy snacks) in the fun fair condition and 21% (or 6 out of 28; vs. 79% unhealthy snacks) in the control condition.

Subsequently, a post-hoc analysis with separate 2 × 2 (poster × food [healthy vs. unhealthy]) comparisons revealed five significant relations, indicating poster-related differences in food choices. Specifically, consumers were found to be influenced in all health-related poster conditions. As expected, when consumers were exposed to the Giacometti poster rather than to the fun fair poster, healthy compared to unhealthy snacks were chosen more frequently ($\chi^2(1, 139) = 11.63$, $p < .001$). Likewise, when consumers were exposed to the Giacometti poster rather than to no poster, healthy snacks compared to unhealthy snacks were purchased more frequently ($\chi^2(1, 101) = 10.58$, $p = .001$). In line with the hypothesis, when consumers were exposed to the activity poster rather than to no poster, healthy snacks compared to unhealthy snacks were selected more frequently ($\chi^2(1, 113) = 4.6$, $p < .05$). Additionally, when consumers were exposed to the activity poster rather than to the fun fair poster, healthy snacks compared to unhealthy snacks were chosen marginally more frequently ($\chi^2(1, 151) = 3.46$, $p = .06$). When consumers were exposed to the Giacometti poster rather than to the activity poster healthy snacks compared to unhealthy snacks were chosen marginally more frequently ($\chi^2(1, 158) = 3.46$, $p = .08$).

Finally, when consumers were exposed to either the fun fair poster or to no poster, no difference in the amount of chosen healthy or unhealthy snacks occurred ($\chi^2(1, 94) = 0.54$, $p = .46$). The frequencies of healthy and unhealthy snack choices in all poster conditions are illustrated in Fig. 2.

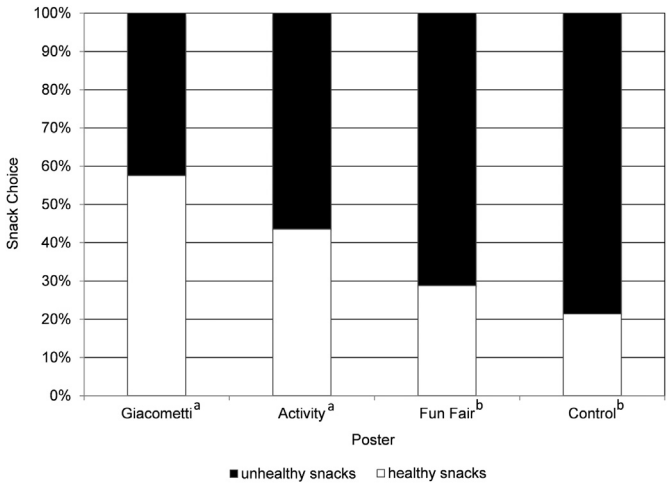

Fig. 2. Number of healthy versus unhealthy snack purchases in the four poster conditions of field study 2. Snack choices in the conditions marked with the same letter did not differ.

In conclusion, the results indicate that a poster can influence the choice between healthy and unhealthy foods and hence support the hypothesized effect. As in field study 1, the effects of poster images were substantial. That is, the three tested posters influenced food choices differently. Compared to the hedonic-related fun fair poster, the health-related Giacometti and activity posters were more likely to influence food choices.

6. General discussion

Environmental cues can affect food decisions (see Wansink, 2004; for a review). While laboratory research has repeatedly demonstrated the food-reducing or food-increasing influence of environmental cues (e.g., Brunner & Siegrist, 2012), less is known about environmental cues' impact on actual food decisions. The present studies asked whether environmental cues can direct consumers' real world food choices in favor of healthy or unhealthy snack alternatives. Overall, present findings are in line with priming research, revealing that environmental cues in the form of posters with content associated with (un)healthy diet influence food choices in favor of (un)healthy snacks. Specifically, while nature and activity posters increased preferences for healthy snacks, a fun fair poster increased preferences for unhealthy snacks (field study 1). The effect in favor of healthy food choices reoccurred for a poster

with the Giacometti sculptures (field study 2). Moreover, findings contribute to previous research examining the impact of the environment on food decisions by indicating that environmental cues with only slight health or diet associations can be effective in influencing one's food decisions.

6.1. Growing evidence for environmental influences on food decisions

Past research has demonstrated that environmental cues such as Giacometti sculptures influence consumption volume decisions, that is, *how much* people eat (Brunner, 2010; Van Ittersum & Wansink, 2012). The present research adds to this by revealing that visual environmental cues are likewise able to influence food choices, that is, *what* people choose to eat. Thereby, evidence of the Giacometti effect was extended by showing that it appears not to be limited to reducing food intake but also occurs when choosing between healthy and unhealthy foods.

So far, the specific food consumption literature lacks a deep understanding of the effectiveness of environmental cues in shaping one's food decisions. This may be eliminated by an intensified consideration of more general findings of the priming research focusing on associations (e.g., Dijksterhuis, Aarts, Bargh, & van Knippenberg, 2000; Dijksterhuis & Smith, 2005), concepts (e.g., Bruner, 1957; Higgins, Rholes, & Jones, 1977), goals (e.g., Aarts, 2007; Bargh et al., 2001), and the level of awareness (e.g., Aarts, 2007; Chartrand, 2005).

6.2. The power of priming, associations, concepts and goals

The influence of environmental cues depends on associative links to a relevant concept (Aarts & Dijksterhuis, 2003). On one hand, the present findings imply an associative link between health and nature, activity, or Giacometti sculptures. On the other hand it supports the idea of an associative link between indulgence and a fun fair.

Regarding the stronger tendency to opt for healthy snacks in the nature compared to the activity condition as observed in field study 1, two explanations may be proposed. First, the nature compared to the activity poster might have been more likely to activate a healthy diet concept because of its stronger health-relevant associations. Second, it may be possible that both posters activated a diet concept, but that the nature concept more intensively fostered a healthy diet.

In respect to the importance of the activated associations, one can likewise argue that concepts other than a health or hedonic concept became activated. For instance, the Giacometti sculptures in field study 2 could have activated a body-weight concept (Brunner & Siegrist, 2012). However, it intuitively seems that a body-weight concept and health concept share some associations. It is also possible that the Giacometti sculptures primed other concepts such as culture or art. Nevertheless, this seems unlikely since there is no reason to expect an association between culture or art and eating behavior. Of course, this is speculative and future research should include the diversity of activatable associations.

Note that although the influence of environmental cues on food choices by priming seems plausible, the present study did not explicitly test this. Future research could apply lexical decision tasks (Wyer & Srull, 1989) to prove whether environmental cues effectively cause priming effects. By way of example, individuals exposed to nature, activity, or Giacometti posters are assumed to be faster in recognizing health-relevant words than individuals primed by a fun fair or no poster. Similarly, they should be more likely to complete word fragments with health-relevant instead of hedonic-relevant words (Kay et al., 2004; Tulving, Schacter, & Stark, 1982). This line of research could thus enable researchers to specify activated associations and to further investigate underlying processes.

While it is a general characteristic of mental concepts (e.g., traits, stereotypes, schemata and goals) to become activated by environmental cues, goals possess the specific characteristic of opening the doors for such priming effects by increasing the accessibility of environmental cues (Aarts, 2007; Aarts et al., 2005; Aarts, Dijksterhuis, & de Vries, 2001; Bargh et al., 2001; Bargh, 2006; Bruner, 1957; Custers & Aarts, 2010). In field study 2, health-related posters were more effective than a hedonic-related poster in influencing consumers' choices. Since data was collected in a health context, one could speculate that this is due to the health sensitivity of the sample. Indeed, National Office of Public Health employees are constantly concerned with matters of health. Assuming that the sample has a prevailing health goal, one could speculate that the accessibility of health-relevant cues is relatively likely. In fact, this would conform to the pattern showing that health-motivated people are relatively likely to respond to health-related cues (Fedoroff, Polivy, & Peter Herman, 2003; Herman et al., 2005). Here, the idea of selective attention is pivotal. According to this, one's active goal causes selective perception of goal-relevant environmental cues which make corresponding associations more likely to be activated (Aarts et al., 2001; Bruner, 1957).

Interestingly, when considering the influences of the posters in the two field studies, the activity poster appeared to be more effective in field study 2 than in field study 1. Specifically, in field study 2, differing consumer responses were found between the activity and control poster as well as between the activity and fun fair poster. Meanwhile, in field study 1, differing consumer responses only occurred between the activity and fun fair poster, but not between the activity and control poster. A speculative interpretation of this might be that the sample of field study 2 compared to the sample of field study 1 is more likely to pursue a health goal and thus to respond to a health-relevant cue. This study was not meant to analyze whether the different extent of the influence of the activity poster mirrors the interaction of environmental cues and consumers' goals. Still, this issue seems to be of practical relevance and further academic interest.

Considering that one might have both a health and a hedonic goal, one could speculate that people are influenced by environmental cues in terms of a compromise. For example, when primed by a nature poster, one may be more likely to choose the healthier chocolate cereal bar than the unhealthier pure chocolate bar and thus partially cope with both health and hedonic goals. Future research might incorporate this aspect in the definition of the dependent variable by measuring the effect on another level of extremeness. For example, participants could be faced with the choice between a relatively healthy cereal-chocolate bar and a pure, unhealthier chocolate bar instead of the usual healthy apple and the unhealthy chocolate bar.

6.3. Conscious versus unconscious influences of environmental cues

While both consciously and unconsciously perceived cues can trigger reactions (Bargh, 2006; Schacter, Chiu, & Ochsner, 1993), the influence of environmental cues is primarily thought to occur outside of one's awareness (Dijksterhuis et al., 2000). People are usually not consciously aware of the presence of environmental cues and almost never aware of the unconsciously activated processes or behavior patterns (Chartrand, 2005). For example, Giacometti-primed people do not consciously perceive that their food intake has been influenced (Brunner & Siegrist, 2012).

Importantly, the influence of environmental cues can vanish when cues are consciously perceived, but not when they are

unconsciously perceived. For instance, when seeing a photo with a bottle of mineral water in the background, people are less likely to subsequently choose a bottle of the same brand when remembering the bottle compared to when not remembering it (Ferraro, Bettman, & Chartrand, 2009). This relates to the fact that whereas consciously perceived cues are controllable, unconsciously perceived cues are not (Chartrand, 2005; Daza, Ortells, & Noguera, 2007). Therefore, the influence of environmental cues on food decisions seems to be more effective when underlying processes are implicit, unconscious, and automatic rather than planned, conscious, and rational (Brunner & Siegrist, 2012; Ferraro et al., 2009). It is meaningful that the manipulation in the present studies was done in an unobtrusive rather than in a clearly unconscious way. Hence, it is unclear to what degree the cue's impact occurred outside of conscious awareness. The present results must, therefore, be interpreted with caution regarding underlying processes of the found effects. Future field research could test to what level of consciousness subtle environmental cues are perceived and processed and whether the effectiveness is higher when occurring on an unconscious rather than on a conscious level. Since unconscious influence requires nearly no cognitive resources, researchers could compare people's response to the exposure of cues with and without additional cognitive load (e.g., remembering numbers). Additional cognitive load reduces one's cognitive resources, and thus the ability to consciously perceive environmental cues declines. If the influence of environmental cues is conscious and thus cognitively costly, then the attenuated cognitive resources should lead to a reduced or no effect (McFerran, Dahl, Fitzsimons, & Morales, 2010). As the influence of environmental cues is assumed to be mainly unconscious, an influence irrespective of additional cognitive load seems more likely (McFerran et al., 2010; Uhlmann, Pizarro, & Bloom, 2008).

6.4. Practical relevance

The limited success of public awareness campaigns and health warnings to prevent obesity requires additional measures to damp strong affective impulses such as temptation and self-control conflicts (Downs, Loewenstein, & Wisdom, 2009; Fedoroff et al., 2003; Fishbach & Shah, 2006). As the present research proposes, more subtle approaches can be meaningful. That is, environmental cues can be applied as interventions for policy makers to shape people's behavior toward a healthier diet. Clearly, one may question the marginal benefit of choosing yogurt instead of a Twix bar. Indeed, it seems implausible that somewhat more than 100 calories can improve society's health and lower healthcare costs. Nevertheless, an accumulation of effective applications of environmental cues can help people to shed their extra calories and moreover to obtain the required intake of healthy nutrients over a long time.

Health professionals are therefore encouraged to complement current measures with subtle, less cognitive strategies. This can include structuring public places such as stores, restaurants, or schools. In doing so, literature suggests that monitoring and directing people's health-related and diet-relevant associations, concepts and goals are essential and an effective way of support a healthy diet. Future research should provide a more comprehensive understanding of the interaction of associations, concepts, goals and the level of awareness of subtle environmental cues in the food consumption area and thus help to implement more efficient health measures.

7. Conclusion

The present research indicates that environmental cues influence food choices in a naturalistic setting. While posters with an associative link to health lead to an increased choice of healthy food, environmental cues with an associative hedonic link increase the choice of unhealthy food. Overall, these findings offer a basis for improving society's food-related health.

Acknowledgments

This research was financially supported as part of the National Research Program NRP69—Healthy Nutrition and Sustainable Food Production, by Grant 12 No. 145189 from the Swiss National Science Foundation. We are grateful to Eva Meyer. She helped to conduct field study 1 for her Master's theses, which was submitted to the University of Bern.

Appendix A. Supplementary data

Supplementary data related to this article can be found at http://dx.doi.org/10.1016/j.appet.2015.09.034.

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Paper 2

The Art of Dieting:

Exposure to Thin Sculptures Effortlessly

Reduces the Intake of Unhealthy Food in Motivated Eaters

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 Preference, 50,* 88–93. doi:10.1016/j.foodqual.2016.01.012

Food Quality and Preference 50 (2016) 88–93

Contents lists available at ScienceDirect

Food Quality and Preference

journal homepage: www.elsevier.com/locate/foodqual

Short Communication

The art of dieting: Exposure to thin sculptures effortlessly reduces the intake of unhealthy food in motivated eaters

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ARTICLE INFO

Article history:
Received 17 October 2015
Received in revised form 28 January 2016
Accepted 28 January 2016
Available online 29 January 2016

Keywords:
Environmental cue
Priming
Nudging
Effortless influence
Dieting goal
Motivation
Eating
Food intake

ABSTRACT

Thin, human-like sculptures by the artist Alberto Giacometti, applied as environmental cues, have been found to facilitate dieting by reducing chocolate intake and promoting healthy snack choices. However, the processes underlying this "Giacometti effect" have been left unexplored so far. The present study therefore first examines the effortlessness of the effect. More specifically, it aims to determine whether the sculptures reduce unhealthy food intake when only few cognitive resources for their influence are available. For this purpose, the participants in a chip tasting were given the cognitive load task of memorizing either 10 or two digits during the tasting. The results indicate that the sculptures reduced participants' chip intake independent of the cognitive load. Thus, they influenced participants' eating behavior even when only few cognitive resources were available. The results also indicate that the sculptures reduced chip intake only when the participants liked the chips. The sculptures could thus exert their influence when individuals were motivated to eat and the dieting cues were useful. The finding that the Giacometti sculptures, applied as environmental dieting or health cues, influenced individuals when only few cognitive resources were available, could indicate a crucial advantage for the application of these cues in complex, real-world settings.

1. Introduction

Many people may consider dieting to lose weight for health reasons or to conform to today's ideal of thinness. However, as evidenced by the global obesity epidemic, successfully pursuing a dieting goal is challenging. Generally, there are two ways to pursue a goal: a rather effortful and a rather effortless one (see dual-process models; e.g., Kahneman, 2003). Traditionally, effortful conscious reflection and intent have been considered to drive goal pursuit (Aarts, 2007; e.g., Ajzen, 1991). However, promising research has shown that environmental cues may be able to help individuals achieve their goals more effortlessly (see Wansink & Chandon, 2014). For example, a poster on the door of a butcher's store announcing a recipe that was "good for a slim figure" was found to reduce the amount of unhealthy samples dieters ate while in the store (Papies & Hamstra, 2010). Other studies have examined thin, human-like sculptures by the artist Alberto Giacometti as environmental health cues (Brunner & Siegrist, 2012; Stöckli, Stämpfli, Messner, & Brunner, 2016). These sculptures have been shown to reduce participants' chocolate intake in the laboratory (Brunner & Siegrist, 2012) and to increase the share of consumers' healthy snack choices at vending machines (Stöckli et al., 2016).

However, the processes underlying this "Giacometti effect" have been left unexplored so far. The present study aims to shed some light on these processes by examining the effortlessness of the effect. More specifically, the goal of this study is to determine whether Giacometti sculptures, applied as environmental cues, can reduce unhealthy food intake, even when only few cognitive resources for their influence on eating are available.

1.1. When environmental cues serve as health primes

The first indications of the Giacometti effect's underlying processes can be found in the literature on priming in health behavior (see Sheeran, Gollwitzer, & Bargh, 2013). This research indicates that environmental cues can act as primes. Primes work by temporarily activating mentally represented constructs, such as goals, outside of individuals' awareness (Aarts, 2007; Bargh & Chartrand, 2000; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Papies & Aarts, 2010). These goals can then influence behavior.

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http://dx.doi.org/10.1016/j.foodqual.2016.01.012
0950-3293/

For example, television commercials with slim models or dieting-related products reduced the caloric intake of dieters (Anschutz, van Strien, & Engels, 2008). Similarly, diet reminders in restaurant menus influenced dieters to more frequently choose low-calorie dishes over higher-calorie options (Papies & Veling, 2013).

In accordance with the mechanism of priming, individuals are typically unaware of being influenced by environmental cues (Chartrand, 2005). Either way, the cues' influence does not seem to depend on this awareness. Even if an individual thinks about an environmental cue while being influenced by that cue, the cue's effect does not seem to be altered. For example, a health-related recipe flyer reduced unhealthy snack purchases in a grocery store among overweight customers regardless of whether or not they had been thinking about the flyer while shopping (Papies, Potjes, Keesman, Schwinghammer, & van Koningsbruggen, 2014). Regarding whether the awareness of a cue at the time of initial exposure alters the cue's influence, there is contrasting evidence (Harris, Bargh, & Brownell, 2009; Papies et al., 2014).

In conclusion, if environmental cues influence food decisions even when individuals do not consciously think about these cues while being influenced by them (Papies et al., 2014), then environmental cues may work without much effort on the part of the individual.

1.2. How effortless environmental cues work

However, unconsciousness and effortlessness do not always go hand in hand (Bargh, 1994; Papies & Aarts, 2010; Ward & Mann, 2000). On the one hand, unconscious goal priming can occupy at least some mental resources, as shown by the effects of priming on performance in effortful working memory tasks. While priming for achievement improved individuals' performance on effortful working memory tasks, priming for an unrelated goal reduced performance (Hassin, Aarts, Eitam, Custers, & Kleiman, 2009). On the other hand, effortless processes can still have some conscious elements. For example, typing on a computer or driving a car are both activities that can be performed quite effortlessly, but both are still consciously started and stopped (Bargh, 1994). Therefore, the study of the effortlessness with which environmental cues work should rely on research that examines priming under conditions of different degrees of cognitive resources available, e.g., by applying a cognitive load (Bargh & Chartrand, 2000).

Such research has indicated that priming effects do not depend on the cognitive load. For example, individuals were found to recognize a goal more quickly following exposure to a relevant prime regardless of whether they had memorized nine digits during the lexical decision task (Fishbach, Friedman, & Kruglanski, 2003). Similarly, regardless of whether a cognitive load was induced, individuals exposed to fruit and vegetable advertisements were more likely to choose fruits over unhealthy snacks than those not primed by fruit and vegetable advertisements (Forwood, Ahern, Hollands, Ng, & Marteau, 2015).

1.3. Pursuing a dieting goal with or without effort

Although evidence to support this hypothesis is scarce (Fishbach et al., 2003; Forwood et al., 2015), Giacometti sculptures, when placed as environmental cues, may activate a dieting goal and influence an individual's eating behavior without much effort on the part of the individual. However, some effortful processes may also be at work for this effect. The thin sculptures may influence individuals by making them explicitly think about their own weight (Van de Veer, van Herpen, & van Trijp, 2015).

In the present study, we aimed to test the effortlessness with which the Giacometti sculptures work by inducing a cognitive load during a potato chip tasting. If the sculptures influenced the participants' food intake independent of the cognitive load, and thus also when only few cognitive resources were available, an effortless influence of the sculptures would be indicated. In contrast, if the cues only had an impact when the participants were not cognitively loaded, this would indicate that the Giacometti sculptures require cognitive resources to influence eating.

2. Study

2.1. Materials and methods

2.1.1. Participants

Members of a sensory consumer panel were invited to a sensory laboratory for a chip tasting. The chip tasting served as the cover story for the study. Because the consumer panel members had previously acted as participants in food taste tests, it can be assumed that they did not suspect that the evaluation of the tasted chips was not the main interest of the present study. No additional cover story was given to the participants regarding the additional tasks they had to complete or questions they had to answer. One hundred and thirty-seven panelists participated in the study, each receiving a compensation of 25 Swiss francs.

Nine participants were excluded from the analyses because they had difficulty memorizing or remembering the 10 digits in the cognitive load task. Two of them admitted that they had not attempted to memorize the digits, while the other seven remembered the correct place of less than six of the digits and, in addition, rated the memorization task as not being difficult. Data from the remaining 128 participants were used for the analyses (M_{age} = 46.35 years, SD_{age} = 14.20; 73.44% female).

2.1.2. Design

A 2 (cue vs. no cue) × 2 (high vs. low cognitive load) between-subjects design was applied. About half of the participants entered the laboratory in the cue condition, where screensavers with thin, human-like sculptures by the artist Alberto Giacometti were running on the computer screens in the cubicles. The other participants found the computers protected by white screensavers.

For the cognitive load task, again about half of the participants memorized a 10-digit number within 30 s. The other participants received a low cognitive load; they were given the task of memorizing a two-digit number within 30 s.

2.1.3. Materials

The Giacometti screensaver was created using a picture showing three thin figures from Giacometti's sculpture *Piazza*. To generate a realistic screensaver appearance, the picture was moving in front of a black background. The neutral screensaver showed a static white picture. The 10-digit number was 5826748139. To ensure a high cognitive load, care was taken to avoid common sequences of digits. The two-digit number was 47. Participants completed a computer-based questionnaire.

The chips used in the tasting were Pringles Original. Each participant was served 20 chips. On average, the sample of chips provided to each participant weighed 46.83 g (SD = 1.14; minimum 44.00 g, maximum 51.00 g).

2.1.4. Measures

The main variable in this study was *consumption volume*. To measure this dependent variable, the weight difference between the original amount of chips (20) given to the participants and the chips remaining after the participants had completed the tasting was calculated.

Information on the participants' *liking of the chips* was collected during the tasting. Two questions concerned the flavor of the chips,

while one involved the appearance and one the participants' willingness to buy the chips ($\alpha = .83$). The responses to the items "*These chips taste very good*," "*These chips look appealing*," and "*If these chips were available at an appropriate price where I normally shop, I would buy them*" were collected on a 7-point Likert scale (1 = "*I do not agree at all*"; 7 = "*I entirely agree*"; note: the items and scale items were translated from German). The responses to the fourth item, "*Compared to the best chips I have ever eaten, these chips taste...*", were collected on a 7-point scale from "*a lot worse*" to "*a lot better*".

For the cognitive load manipulation check, participants' subjective feeling of effort regarding the cognitive load task was collected on a 7-point Likert scale. Participants were asked how demanding it was for them to evaluate the chips in the tasting while keeping in mind the memorized number. They also had to state their approval when answering the reverse-coded item: "*It was easy to remember the number*" ($\alpha = .84$).

The participants in the cue condition were also asked if they remembered the screensaver on their screen at the beginning of the study, a question they answered with a "*yes*" or "*no*" response. If they answered "*yes*," they were asked to describe the screensaver in an open format. The participants in the cue condition were also asked, using a 7-point scale, to assess the degree to which they believed the screensaver influenced how many chips they had eaten during the tasting.

2.1.5. Procedure

When the participants arrived at the sensory laboratory, they were welcomed and given the initial instructions in front of the laboratory's closed door. The participants then entered the room, chose a cubicle, and seated themselves. During this time, they were exposed to the screensavers for approximately 30 s. The experimenter then gave the participants the input to start the questionnaire by pressing a certain key on the computer keyboard. At the beginning of the questionnaire, the participants were given the cognitive load task of memorizing either 10 digits or two digits. Afterwards, each participant was served 20 chips on a plate. The participants tasted and rated the chips for five minutes. They had been instructed to eat as many chips as they wanted. After the tasting, the participants were asked to recall the digits from the cognitive load task as precisely as possible. Finally, the participants completed the rest of the questionnaire.

2.2. Results

2.2.1. Manipulation check

The manipulation check indicated that the cognitive load manipulation had been successful. That is, it was a more cognitively demanding task for participants to remember the 10-digit number ($M = 4.99$, $SD = 1.59$) than it was for the other participants to remember the two-digit number ($M = 1.21$, $SD = 0.62$), $t(126) = 17.67$, $p < .001$, $d = 3.12$.

2.2.2. Effortless Giacometti effect

A two-factor ANOVA, which examined the effects of the *cue*, *cognitive load*, and their interaction on *consumption volume*, revealed that the Giacometti screensaver reduced the amount of chips participants ate (see Fig. 1); main effect of *cue*, $F(1, 124) = 4.70$, $p = .032$, $\eta_p^2 = .04$. The participants who had been exposed to the Giacometti screensaver consumed less ($M = 11.48$ g, $SD = 6.18$) than the participants who had been exposed to the neutral white screensaver ($M = 14.56$ g, $SD = 9.37$), $t(126) = 2.18$, $p = .031$, $d = 0.39$. The Giacometti effect occurred independently of the cognitive load; that is, it occurred when participants had memorized a two-digit number, as well as when they had memorized a 10-digit number; interaction of *cue* and *cognitive load*, $F(1, 124) = 0.71$, $p = .400$, $\eta_p^2 = .01$. The cognitive load itself did not influence the amount of chips consumed; main effect of *cognitive load*, $F(1, 124) = 0.01$, $p = .907$, $\eta_p^2 = .00$.

Regarding the influence of the Giacometti screensaver independent of the cognitive load, a Bayesian model comparison revealed that the model that only considered the effects of the cue and cognitive load explained the data almost three times better than the full model, which also included the interaction between the two variables. This substantiated that the cognitive load did not have an influence on the Giacometti effect (see Kruschke, 2011).

Since the Giacometti screensaver also influenced intake when cognitive resources were reduced, the assumption that the cue influenced intake effortlessly is supported. In terms of the consciousness of the environmental cue and its influence, the results showed that 96.72% of the participants in the cue condition did not think that they had been influenced by the screensaver, but that 75.41% of the participants in the cue condition remembered the details of the cue itself. More specifically, 52.46% remembered seeing Giacometti's sculptures or mentioned words related to thinness, while 22.95% remembered seeing figures or humans. However, the participants who remembered the details of the Giacometti screensaver did not eat more or less ($M = 11.48$ g, $SD = 5.53$) than the participants who did not remember them ($M = 12.20$ g, $SD = 7.72$), $t(59) = 0.40$, $p = .693$, $d = 0.11$.

2.2.3. How liking facilitates the Giacometti effect

Because the cognitive load neither influenced participants' consumption volume nor the cue's effect on consumption volume, we omitted cognitive load in the remaining analyses. An ANCOVA, which examined the effects of the *cue*, *liking of chips*, and their interaction on *consumption volume*, revealed that the Giacometti effect was facilitated by participants' liking of the tasted chips (see Fig. 2); interaction of *cue* and *liking of chips*, $F(1, 124) = 4.21$, $p = .042$, $\eta_p^2 = .03$; main effect of *cue*, $F(1, 124) = 1.65$, $p = .201$, $\eta_p^2 = .01$. The Giacometti screensaver had an influence when the participants liked the chips, upwards of 3.81 on the 7-point scaled moderator variable liking of chips. This result was gained using the Johnson–Neyman technique, whereby the transition point from insignificant to significant of the conditional effect of the cue on consumption volume along the moderator variable continuum (liking of chips) was mathematically derived (Hayes, 2013; with a significance level of $\alpha = .05$). Examining the mean of liking of chips, plus/minus one standard deviation, substantiated that those participants who had relatively high ratings for liking of chips were influenced by the cue, $\theta_{(X\rightarrow Y)|M+1SD=5.23} = -5.84$, $t(124) = 3.05$, $p = .003$; $\theta_{(X\rightarrow Y)|M=3.97} = -3.04$, $t(124) = 2.26$, $p = .026$, whereas those participants who had relatively low ratings were not influenced by the cue, $\theta_{(X\rightarrow Y)|M-1SD=2.72} = -0.25$, $t(124) = 0.13$, $p = .897$. Liking, in general, increased participants' consumption volume; main effect of liking of chips, $F(1, 124) = 8.66$, $p = .004$, $\eta_p^2 = .07$.

3. Discussion

The present study examined how thin, human-like sculptures by the artist Alberto Giacometti reduced unhealthy food intake when used as subtle environmental cues. Prior to this study, the processes underlying the Giacometti effect were largely unexplored (Brunner & Siegrist, 2012). As such, the aim of this study was to examine the question of the effortlessness with which the cues influenced food intake. Therefore, we induced a cognitive load during a chip tasting. The results of this study revealed that the sculptures reduced chip intake independent of cognitive load, which indicated that the sculptures also exerted their influence when only few cognitive resources were available.

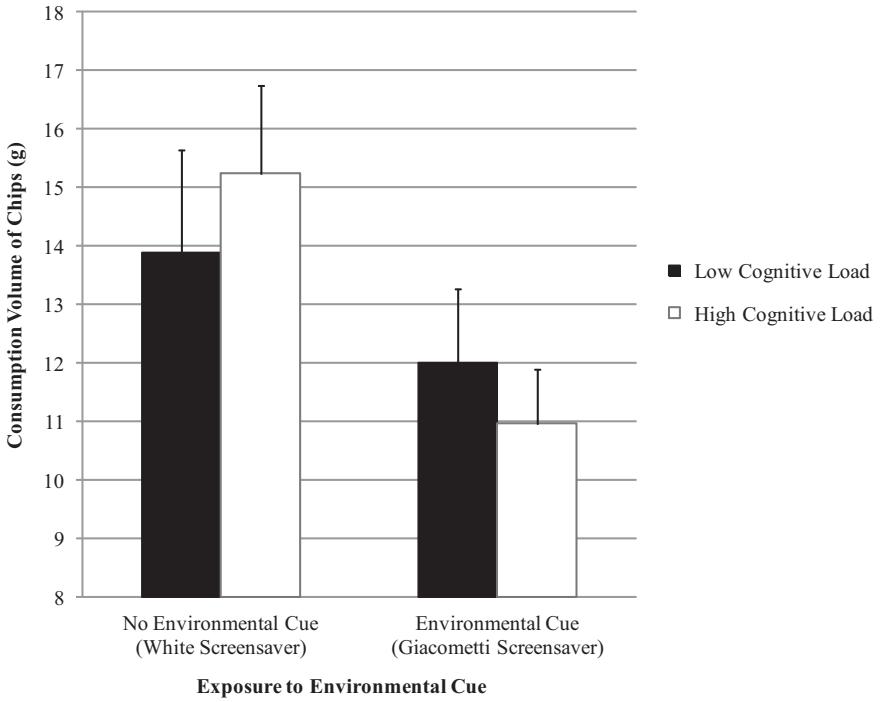

Fig. 1. Mean consumption volume of chips (in grams) for the four conditions (cue/no cue × low/high cognitive load). Participants exposed to a screensaver with thin Giacometti sculptures consumed fewer chips than participants exposed to a neutral white screensaver. Cognitive load did not alter this effect (error bars represent standard errors).

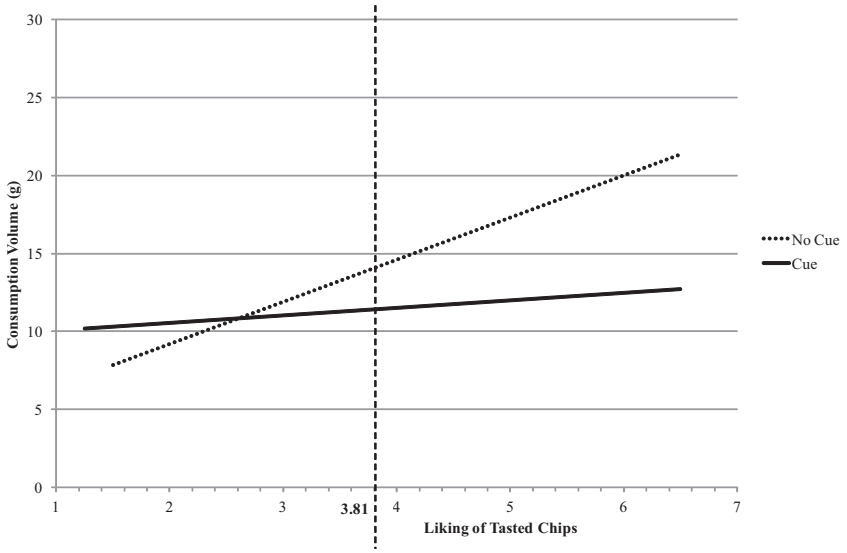

Fig. 2. Chip consumption as a function of liking of the tasted chips and exposure to an environmental cue. A screensaver with Giacometti sculptures reduced the chip intake of participants who liked the chips tasted (significant influence of the cue's conditional effect on consumption volume upwards from 3.81 on the moderator variable liking of chips).

This effortlessness of the cues' influence seems to be a crucial advantage for the effectiveness of dieting cues in complex, real-world settings, in which individuals have limited cognitive resources with which to confront a multitude of demands (Bargh & Chartrand, 2000; Papies et al., 2014). In such circumstances, information-based approaches, such as disclosing calorie information, have proved to be unsuccessful (Downs, Loewenstein, & Wisdom, 2009). The use of dieting cues that involve little effort on the part of the individual also seems to be an effective strategy regarding the general lack of attention individuals pay to their everyday eating behavior. That is because when attention lies elsewhere, cognitive resources for the control of food intake are impaired (Van de Veer et al., 2015), but effortless influences can take place. The use of environmental cues for an improved eating behavior is further a more efficient method than mindfulness interventions, such as mindful attention exercises related to food. These tend to be time costly (Papies, Pronk, Keesman, & Barsalou, 2015).

However, each environment contains its own unique set of cues. Which one of these various environmental cues asserts itself

in real-world settings—for example, in a supermarket, where individuals are exposed to package claims, atmospheric cues, and the palatable products themselves—will also depend on each individual's own goals and motivations (Aarts, 2007; Papies & Aarts, 2010). In the present study, the Giacometti cues were shown to reduce participants' unhealthy food intake when participants liked the chips they tasted. Thus, the cues exerted their influence when the participants were motivated to eat, or in other words, when the goal of eating was active. Environmental cues have been shown to have a greater influence on behavior when relevant goals are active (Forwood et al., 2015; Papies & Hamstra, 2010). Because goals are embedded within associative knowledge structures that contain goal-related content (Aarts, 2007; Papies & Aarts, 2010), environmental cues associatively linked to a goal should influence behavior when the respective goal is active. In the present study, we assume that when individuals liked the chips they tasted, the goal of eating was activated, and because of the associative link between eating and thin figures, the thin sculptures influenced the individuals. Although the goal of eating enjoyment has been shown to inhibit the weight control goal (see goal conflict model of eating, Stroebe, van Koningsbruggen, Papies, & Aarts, 2012), there are some individuals for whom eating-related cues seem to heighten the accessibility of the dieting goal. These individuals seem to have developed facilitative links between eating-related cues and dieting goals due to repeated self-control exertion in the past (Fishbach et al., 2003). It would be interesting to further examine variables such as successfully exerted self-control in follow-up studies. In sum, the present study showed that the Giacometti sculptures reduced unhealthy food intake when individuals were motivated to eat—that is, when a health cue was actually needed.

There are several other important questions not addressed by the present study, as well as a few limitations to the present study. One of the limitations is that the participants did not eat a vast amount of chips. They ate on average about one third of the 20 chips they had received. This can be attributed to the cover story, the chip tasting. Thus, the difference in the consumption volume of chips between primed and unprimed participants amounted only to 3.08 g. To conduct the present study using a cover story that allows participants to eat more might substantiate the obtained results. Participants should have the opportunity to eat for a longer time period, for example, while watching a film. Another limitation lies in the generalizability of the effect of the Giacometti cues and other environmental cues related to food intake. Thus far, to our knowledge, these have been tested only in the laboratory (present study; Brunner & Siegrist, 2012; other cues, e.g., Brunner, 2010) and the field (Stöckli et al., 2016; other cues, e.g., Papies & Hamstra, 2010; Papies et al., 2014; Papies & Veling, 2013). Therefore, it would be interesting to observe the effectiveness of these cues in the home environment. This involves two crucial questions regarding environmental cues. First, there is a lack of evidence regarding how the influence of an environmental cue develops when the cue is applied repeatedly. Habituation processes could either weaken or maintain the cue's effect (see results on repetition priming, e.g., Martens & Gruber, 2012). The second question concerns whether people could use such cues intentionally to facilitate their health or dieting behaviors.

To further explore the application of a cue in the home environment, it would be important to determine which goal or concept the applied cue activates; this matter was not addressed by the present study. The thin sculptures could have activated a health-related goal, or—as we assume—a more specific, weight-related goal or mental concept (Brunner & Siegrist, 2012). The actual underlying goal or concept could be determined using implicit measurement methods, such as a word completion task. Additionally, a laboratory experiment using a between-subjects design to compare the cues' influence on unhealthy and healthy food intake could give further indications of which goal or concept is activated by the Giacometti sculptures. If the cues were to activate a weight-related concept, we would expect them to reduce unhealthy and healthy food intake equally. On the contrary, if the cues were to activate a health-related concept, we would expect them to reduce unhealthy food intake and to promote or, at least, to not decrease healthy food intake. When the purpose of a cue is to activate a broader health goal, the application of sculptures that are not as unnaturally thin as the Giacometti sculptures may be ideal. However, there is contrasting evidence for the appropriateness of using healthy-looking models to influence food intake (Anschutz, Engels, Becker, & van Strien, 2008).

In general, it is important to have a realistic understanding of the impact of environmental cues. As mentioned, an applied cue is one of various cues found in complex, real-world settings. Which of the many cues present affects an individual's behavior depends on many factors, including the individual's mental concepts. Further, it is not known how long the activation of a mental concept by a distinct cue will persist, or on which factors this duration may depend. Finally it is important to note that weight loss is a complex goal that requires different behaviors to be achieved (Papies & Aarts, 2010)—for example, activity-related behaviors in addition to eating-related behaviors.

In sum, the present study showed that thin, human-like sculptures by the artist Alberto Giacometti, when applied as environmental cues, could facilitate dieting by effortlessly reducing motivated eaters' unhealthy food intake. Applying environmental cues that influence food intake effortlessly seems to correspond with the approach of nudging individuals toward self-interested behavior (Thaler & Sunstein, 2009) and with the World Health Organization's approach to facilitating dieting through "making healthy choices easy choices" (World Health Organization, 2015).

Role of funding sources

This research was financially supported by the Swiss National Science Foundation as part of the National Research Program NRP 69 – Healthy Nutrition and Sustainable Food Production (grant 12 no. 145189). The study design was included in the funding proposal. The collection, analysis, and interpretation of the data, in addition to all works contributing to the present manuscript, were done independently of the funding sponsor.

Conflict of interest

All authors declare that they have no conflicts of interest.

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Paper 3

A Nudge in a Healthier Direction:

How Environmental Cues Help

Restrained Eaters Pursue Their Weight-Control Goal

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 goal. *Appetite, 110,* 94–102. doi:10.1016/j.appet.2016.11.037

Submitted in November 2016:
Manuscript 3: A Nudge in the Healthy Direction: How Environmental Cues Help Restrained Eaters Pursue Their Weight-Control Goal, under second revision at Appetite

Appetite 110 (2017) 94–102

Contents lists available at ScienceDirect

Appetite

journal homepage: www.elsevier.com/locate/appet

A nudge in a healthier direction: How environmental cues help restrained eaters pursue their weight-control goal

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ARTICLE INFO

Article history:
Received 5 July 2016
Received in revised form
25 November 2016
Accepted 28 November 2016
Available online 30 November 2016

Keywords:
Environmental cue
Restrained eating
Weight-control goal
Dieting
Nudging

ABSTRACT

Losing weight is a goal for many people, but it is hard to pursue. However, dieting cues in the environment hold promise for improving individuals' eating behavior. For example, exposure to thin, human-like sculptures by the artist Alberto Giacometti has been found to promote healthy snack choices at a vending machine. Whether health- or weight-related processes drive such effects has not yet been determined. However, a detailed understanding of the content-related drivers of environmental cues' effects provides the first indications regarding a cue's possible use. Therefore, two laboratory studies were conducted. They examined the Giacometti sculptures' effects on unhealthy and healthy food intake (Study 1) and on the completion of weight- and health-related fragmented words (Study 2). Study 1 indicated that the sculptures are weight-related by showing that they reduced food intake independent of food healthiness. Furthermore, the "Giacometti effect" was moderated by restrained eating. Restrained eaters, who are known for their weight-control goal, ate less after having been exposed to the thin sculptures. The results of Study 2 pointed in the same direction. Restrained eaters completed more weight-related words after being exposed to the sculptures. Overall, these studies suggest that the thin sculptures are primarily weight-related cues and particularly helpful for restrained eaters. Environmental weight-control cues such as the Giacometti sculptures could act as a counterforce to our obesogenic environment and help restrained eaters pursue their weight-control goal. In this way, they could nudge food decisions in a healthier direction.

We eat what we eat particularly because we like it (Renner, Sproesser, Strohbach, & Schupp, 2012). In our "obesogenic" environment, with its abundance of tasty, high-calorie food, our goal of eating enjoyment gets constantly activated. As a result, we eat too much energy-dense food (Berthoud, 2006; Papies, 2016; Papies, Potjes, Keesman, Schwinghammer, & van Koningsbruggen, 2014; Renner et al., 2012). This contributes to the global obesity epidemic (World Health Organization, 2016). However, just as the obesogenic environment fosters unhealthy eating, the environment can foster healthy eating. For example, dieting cues in a restaurant menu stimulate the choice of low-calorie dishes (Papies & Veling, 2013). Such environmental cues are thought to activate weight-control or health goals (Papies, 2016).

Environmental cues that have repeatedly been found to foster healthy eating are the thin, human-like sculptures by the artist Alberto Giacometti. Exposure to these sculptures made healthy snack choices at a vending machine more likely (Stöckli, Stämpfli, Messner, & Brunner, 2016) and reduced the intake of unhealthy, high-calorie chocolate and chips (Brunner & Siegrist, 2012; Stämpfli & Brunner, 2016). However, it is uncertain which goal primarily drives this "Giacometti effect," as both a health and a weight-control goal are conceivable drivers. This ambiguity reflects the state of the literature on environmental cues. Despite manifold empirical evidence on the effects of environmental cues, the understanding of the specific semantic content activated by a cue is often not revealed (Bargh, 2006; e.g., Papies & Veling, 2013). A detailed understanding of the semantic content activated by a cue and thus driving a cue's effects would be a first indication regarding a cue's possible purpose. Therefore, the goal of the present research was to identify the semantic content that is activated by the Giacometti cue.

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http://dx.doi.org/10.1016/j.appet.2016.11.037
0195-6663/

1. How environmental cues influence behavior

When cues in the environment influence eating behavior, they act as primes. Normally, individuals are not aware of being primed (Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Chartrand, 2005). Primes unconsciously and temporarily activate semantically associated mental content that is then more likely integrated into ongoing mental processes and, more likely, influences behavior (Bargh, 2006; Bargh et al., 2001; Janiszewski & Wyer, 2014; Jones & Estes, 2012).

Goals are a specific type of mental content that can be activated (Aarts, 2007; Janiszewski & Wyer, 2014). Due to their motivating capacity (Custers & Aarts, 2005), goals are important drivers for priming effects (Aarts, 2007). For example, individuals with the goal of visiting a library spoke more quietly after being exposed to a picture of a library, compared to when they only saw the picture but did not have the goal in mind (Aarts & Dijksterhuis, 2003). Thus, regarding the Giacometti cue, it is important to determine not only whether the thin sculptures are primarily associated with weight or health, but also whether individuals have a weight-control or health goal in mind.

As mental content is embedded in an associative network, the activation of mental content spreads to associated contents (Aarts, 2007; Janiszewski & Wyer, 2014; Jones & Estes, 2012). In this way, activated weight-related content could activate health-related content. However, in the specific case of goals, it is difficult to predict how weight-control and health goals would interact with each other. On the one hand, they could facilitate each other when they serve as means to each other's attainment. On the other hand, they could inhibit each other when they are perceived as substitutive for an overarching purpose (Shah, Friedman, & Kruglanski, 2002).

When environmental cues are applied for public policy purposes—to improve public health, for example—priming is termed "nudging." Nudging means guiding people toward the interest of society as well as toward self-interested behavior by arranging the decision-making context (Thaler & Sunstein, 2009). Thus, the important role of personal goals for priming effects fits with the notion of nudging.

2. Environmental dieting cues particularly affect restrained eaters

Given the obesity epidemic (World Health Organization, 2016) and the societal ideal of thinness (van de Veer, van Herpen, & van Trijp, 2015), dieting is a goal for many people. Individuals with a chronic goal of weight control are referred to as "restrained eaters" (Herman & Mack, 1975; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008). Although restrained eating has been conceptualized as an eating behavior independent of individuals' weight (Herman & Mack, 1975; Herman & Polivy, 1980; van Strien, Breteler, & Ouwens, 2002), restrained eating has repeatedly been found to correlate positively with body mass index (Snoek, Engels, van Strien, & Otten, 2013; van Koningsbruggen, Stroebe, & Aarts, 2011).

Paradoxically, restrained eating does not predict weight loss, but rather weight gain (Lowe, Doshi, Katterman, & Feig, 2013). This can be attributed to our obesogenic environment (Papies et al., 2014) in combination with the goal of eating enjoyment, by which restrained eaters are characterized as well (Stroebe et al., 2008; Stroebe, van Koningsbruggen, Papies, & Aarts, 2012). The fragile balance between restrained eaters' conflicting goals of weight control and eating enjoyment (Stroebe et al., 2008, 2012) makes them particularly sensitive to food-related cues (Fedoroff, Polivy, & Herman, 1997, 2003; Hofmann, van Koningsbruggen, Stroebe, Ramanathan, & Aarts, 2010; Papies, Stroebe, & Aarts, 2008; Soetens, Roets, & Raes, 2014), but, promisingly, also to dieting-related cues in the environment (Anschutz, van Strien, & Engels, 2008; Harris, Bargh, & Brownell, 2009; Papies & Hamstra, 2010; Papies & Veling, 2013; Versluis & Papies, 2016). Thus, the influence of the Giacometti sculptures on restrained eaters can provide important insight into whether the cue's effect is driven by a weight-related goal.

3. The present research: thin, human-like sculptures as an environmental health or weight-related cue

To examine whether the Giacometti effect is driven primarily by weight- or health-related mental content, Study 1 analyzes the sculptures' effects on the consumption volume of unhealthy and healthy foods by applying a between-subjects design. If the sculptures are primarily weight-related, it is hypothesized that being exposed to them will lead to participants' reduced food intake independent of food healthiness. This is because the goal of weight control, and thus calorie reduction, should drive the effect. In this case, no interaction is expected between the cue and food healthiness, but a main effect of the cue on food intake is expected. If the cue is primarily health-related, a health goal should drive the effect. It is hypothesized that in this case, exposure to the sculptures will inhibit the intake of unhealthy foods, but will facilitate the intake of healthy foods, as these are thought to improve one's health. This is because individuals in our sample should be aware of the prevailing insufficient intake of fruits and vegetables, due, for example, to the nationally-known health campaign "5 a day" (Cancer League Switzerland, 2016). They may also know the negative health consequences related to the insufficient intake of fruits and vegetables, such as heart diseases (World Health Organization, 2002, 2004). Thus, an interaction between the cue and food healthiness is expected if the cue is primarily health-related.

Study 2 directly examines the activation of weight- or health-related mental content by means of a word completion task. While the cue's effect on the completion of weight-related words should be facilitated by a weight-control goal, the cue's effect on the completion of health-related words should be facilitated by a health goal. In addition, the correlations of weight- and health-related word completions in the cue and the no-cue conditions are compared to discern the interplay of the potentially activated weight-control or health goals.

4. Study 1: The influence of thin sculptures on unhealthy and healthy food intake

4.1. Method

4.1.1. Participants

Members of a sensory consumer panel and employees and students of a university were invited personally or via e-mail for a food tasting on campus. The tasting objects were not disclosed to ensure that weight-control or health goals did not influence the registrations. Potential participants could choose an appointment on one of seven days between 8:00 a.m. and 18:00 p.m. No appointments were made between 12:00 and 14:00 p.m. in order to circumvent lunchtime influences. Individuals who had participated in a previous study using the Giacometti cue were excluded.

One hundred and thirty-three individuals participated in the study. As they were accustomed, the members of the consumer panel received a compensation of 25 Swiss Francs and the employees and students received a compensation of 10 Swiss Francs. The data of 133 participants were collected. The data of 114 participants were used for the analyses (M_{age} = 31.72 years, SD_{age} = 14.11; 61.95% female). Eighteen participants were excluded

from the analyses because they stated that they had heard of the study before and therefore had an idea about the study's purpose. One participant was excluded because of a missing value for this question.

4.1.2. Design

A 2 (no cue vs. cue) × 2 (unhealthy vs. healthy food) between-subjects design was applied to examine the cue's influence on consumption volume.

4.1.3. Materials and measures

4.1.3.1. Cue. In the cue conditions, the Giacometti cue was applied as a screensaver. The screensaver showed an extract of a photograph depicting three thin figures from Giacometti's sculpture *Piazza*[1], moving in front of a black background (Brunner & Siegrist, 2012; Stämpfli & Brunner, 2016).

4.1.3.2. Food. Each participant was given either 20 chocolates in the unhealthy conditions (M_{weight} = 45.21 g, SD_{weight} = 1.32) or 20 blueberries in the healthy conditions (M_{weight} = 39.02 g, SD_{weight} = 4.68). The chocolates consisted of milk chocolate with a crunchy core. Care was taken to ensure that the blueberries were similar in size to the chocolates.

4.1.3.3. Measures. The dependent variable of this study, *consumption volume*, was captured by weighing the blueberries or chocolates in a small plastic bowl before and after the tasting and calculating the weight difference. To measure whether participants had a weight-control goal, *Restrained eating* (α = .71) was captured with the German version (Dinkel, Berth, Exner, Rief, & Balck, 2005) of the Concern for Dieting subscale of the Revised Restraint Scale (Herman & Polivy, 1980). Comprising six items, this subscale has proven to capture restrained eating better than the entire restraint scale (van Strien et al., 2002). Example items are "How often are you dieting?"; "Do you give too much time and thought to food?"; and "Do you have feelings of guilt after overeating?" These were captured on 7-point Likert scales (1 = I do not agree at all; 7 = I entirely agree). For the purpose of ensuring that we created healthy and unhealthy conditions, the question "In your opinion, how healthy was the product which you have tasted?" was asked at the end of the study, using a 7-point Likert scale (1 = very unhealthy; 7 = very healthy).

To assess participants' *suspicion about the study purpose*, they were asked: "Have you heard about this study and therefore have an idea what the purpose of the study is?" To rate the foods and to answer further questions, participants completed a computer-based questionnaire generated with E-Prime, version 2.0.10.353 (E-Prime 2 Professional).

4.1.4. Procedure

In the cue conditions, participants entered the experimental room while the screensaver with thin, human-like sculptures by the artist Alberto Giacometti, running on the experimenter's laptop computer, was projected on a screen. Participants in the no-cue conditions entered the experimental room when the experimenter's laptop computer was closed. This way, the projection screen was lit in blue.

The experimental room was a computer room with tiers and a high desk in front. The computers used for the data collection were separated by partitions to build cubicles. First, participants were asked to come to the front tier to receive oral instructions from the experimenter. No partitions were installed in this first tier to ensure that all participants could see the screen. The direct exposure to the screen during the instructions took about 30 s. Afterward, participants chose a seat and the experimenter or a study assistant served the food samples for the tasting. Either blueberries or chocolates were served for each group. Then, participants had 5 min to taste and rate the blueberries or chocolates. They were instructed to eat as much as they wanted. After the food samples were distributed, the experimenter switched off the projector. After the tasting, participants completed the questionnaire.

4.2. Results

4.2.1. Manipulation check

The creation of healthy and unhealthy conditions with blueberries or chocolates was successful. Participants rated the food samples to be healthier when they tasted blueberries (M = 5.77, SD = 1.33) than when they tasted chocolates (M = 2.74, SD = 1.25), $t(111) = 12.48$, $p < .001$, $d = 2.35$.

4.2.2. Unspecific "Giacometti effect"

With a two-factor ANOVA, the cue's effect on participants' consumption volume of unhealthy and healthy foods was examined. The analysis revealed that the projected Giacometti screensaver influenced how much food participants ate, $F(1, 110) = 3.96$, $p < .05$, $\eta^2 = .03$. The participants who had been exposed to the projected Giacometti screensaver ate less (M = 17.83 g, SD = 9.68) than the participants who had been exposed to the neutral blue projection screen (M = 21.82 g, SD = 10.81), $t(112) = 2.08$, $p = .04$, $d = 0.39$; see Fig. 1.

Importantly, food healthiness did not influence the Giacometti effect, $F(1, 110) = 0.20$, $p = .66$, $\eta^2 = .00$. Regarding the type of food, the ANOVA revealed a main effect of food healthiness, $F(1, 110) = 11.58$, $p < .001$, $\eta^2 = .09$. Participants ate more of the healthy blueberries (M = 22.82 g, SD = 10.43) than they did of the unhealthy chocolates (M = 16.45 g, SD = 9.29), $t(112) = 3.45$, $p < .001$, $d = 0.65$.

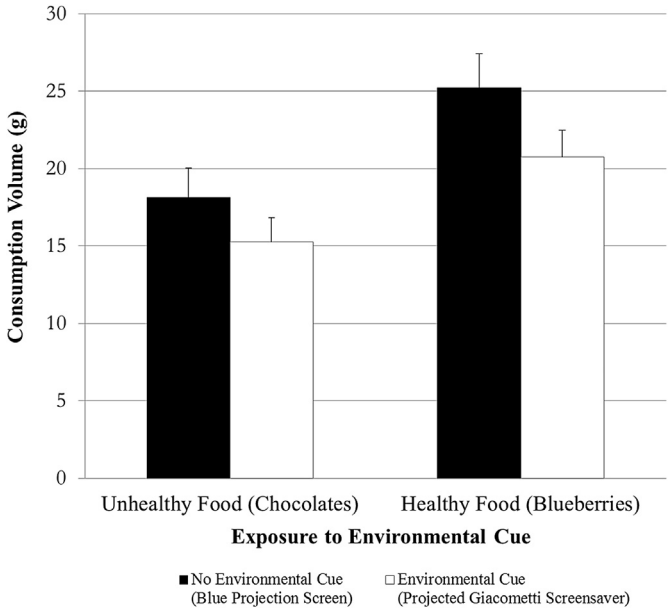

Fig. 1. Mean consumption volume of chocolates and blueberries (in grams) for the four conditions (no cue/cue × unhealthy/healthy food). Participants exposed to a projected screensaver with thin Giacometti sculptures consumed less food than participants exposed to a neutral projection screen. Food healthiness did not alter this effect (error bars represent standard errors).

[1] This sculpture can be found using Google's image search for "Giacometti Piazza".

4.2.3. The influence of the Giacometti sculptures depends on restrained eating

Because food healthiness did not influence the Giacometti effect, food healthiness was omitted in the following analyses. The role that restrained eating plays in the Giacometti effect was analyzed using an ANCOVA that included the cue, restrained eating, and their interaction as independent variables. This analysis revealed that the cue's effect depended on restrained eating, $F(1, 109) = 7.25$, $p = .01$, $\eta^2 = .06$; main effect of the cue, $F(1, 109) = 3.42$, $p = .07$, $\eta^2 = .03$, main effect of restrained eating, $F(1, 109) = 0.16$, $p = .69$, $\eta^2 = .00$. The Johnson-Neyman technique (Hayes, 2013) specified that the projected Giacometti screensaver influenced participants with a restrained eating score upwards of 3.15 on the 7-point scaled moderator variable restrained eating (with a significance level of $\alpha = .05$); see Fig. 2.

4.2.4. Analyses without exclusions

Because of the large number of excluded participants (19), all analyses were repeated without the exclusion of any participants at all. These analyses revealed a marginally significant Giacometti effect, $F(1, 129) = 3.76$, $p = .05$, $\eta^2 = .03$. The participants who had been exposed to the projected Giacometti screensaver ate by tendency less ($M = 17.86$ g, $SD = 9.41$) than the participants who had been exposed to the neutral blue projection screen ($M = 21.10$ g, $SD = 10.58$), $t(131) = 1.87$, $p = .06$, $d = 0.32$. Food healthiness and the cue did not interact, $F(1, 129) = 0.04$, $p = .85$, $\eta^2 = .00$. The main effect of food healthiness remained, $F(1, 129) = 16.12$, $p < .001$, $\eta^2 = .11$. Participants ate more of the healthy blueberries ($M = 22.65$ g, $SD = 10.00$) than they did of the unhealthy chocolates ($M = 16.04$ g, $SD = 9.03$), $t(131) = 4.00$, $p < .001$, $d = 0.69$. Importantly, restrained eating still moderated the Giacometti effect, $F(1, 128) = 7.25$, $p = .01$, $\eta^2 = .05$; main effect of the cue, $F(1, 128) = 3.61$, $p = .06$, $\eta^2 = .03$, main effect of restrained eating, $F(1, 128) = 0.19$, $p = .66$, $\eta^2 = .00$. The projected Giacometti screensaver influenced participants with a restrained eating score upwards of 3.16 (see Hayes, 2013).

4.3. Discussion

The fact that the Giacometti cue's effect was independent of food healthiness in the analyses with and without participant exclusions reveals that the cue is weight-related rather than health-related. While the cue's effect was only marginally significant in the analyses without exclusions, the Giacometti effect was found for restrained eaters in the analyses with and without participant exclusions. This indicates that the Giacometti effect is driven by a weight-control goal.

5. Study 2: The influence of thin sculptures on the completion of weight- and health-related fragmented words

To further analyze the mental content assumed to be activated by the Giacometti cue, Study 2 examined the content-related associations with the cue by means of a word completion task. In addition, the influence of weight- and health-related goals on the cue's effect on word completions was examined by analyzing the influence of restrained eating and general health interest.

5.1. Method

5.1.1. Participants

Participants from a campus other than the one where the first study was conducted were recruited in the university building. They were asked to take part in a study in exchange for a

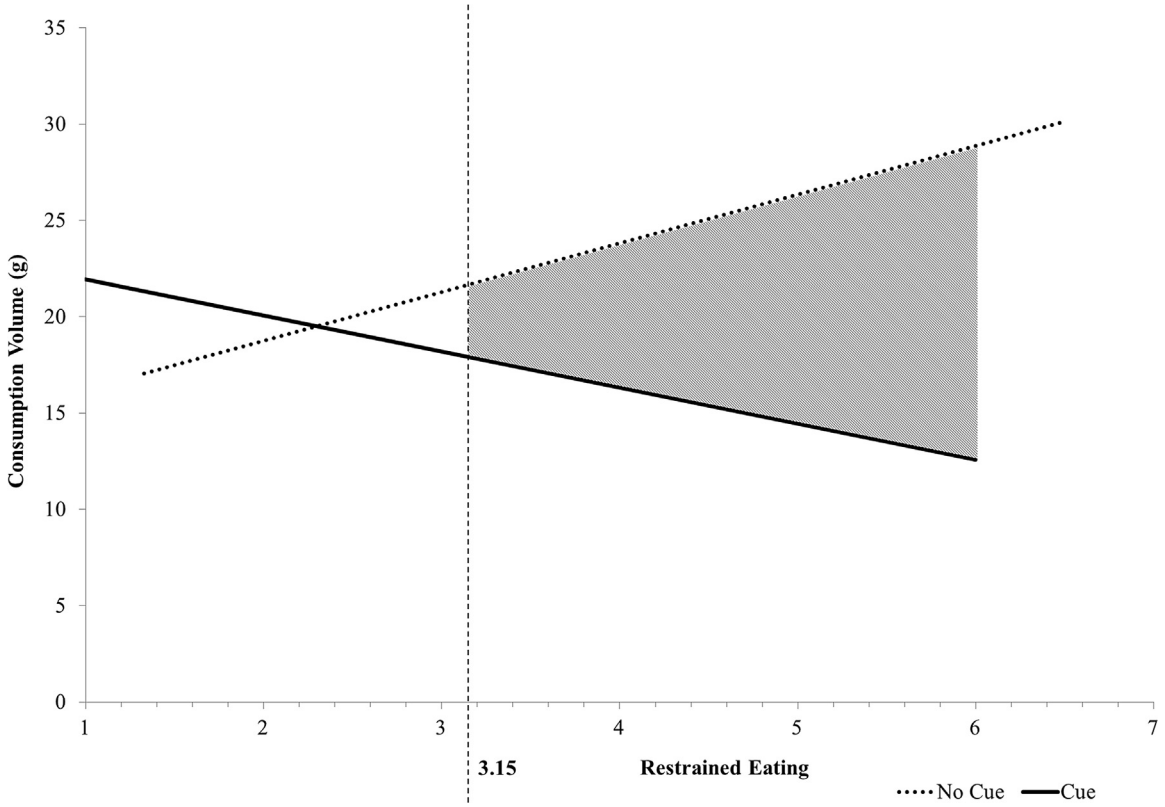

Fig. 2. Chocolate or blueberry consumption as a function of restrained eating and exposure to an environmental cue. Exposure to a projected screensaver with Giacometti sculptures reduced the food intake of participants with a restrained eating score upwards of 3.15.

compensation of 10 Swiss Francs. In accordance with the place of recruitment, the sample consisted almost entirely of students.

Seventy-one individuals took part in the study. The data of 61 participants were used for the analyses (M_{age} = 23.53 years, SD_{age} = 5.07; 63.93% female). One participant was excluded from the analyses because he was assumed to have seen the chocolates directly before the word completion task, and three participants were excluded because their German was insufficient. Another five were excluded because of a breakdown of their computer-based questionnaire. During the restart, these participants could have seen the video file named *Giacometti*. One more participant was excluded because he aborted his participation and therefore did not answer the question regarding whether he had heard of the study before and thus had a suspicion about the study's purpose.

5.1.2. Design

In this study, a one-factorial (no cue vs. cue) between-subjects design was applied to examine the cue's influence on how participants completed fragmented words in a word completion task.

5.1.3. Materials and measures

Fragmented words were created and pretested for their relatedness with weight or health (overview Appendix Table 1). Examples of the weight-related words are *slim*, *dieting*, and *fat*. Examples of the health-related words are *apple*, *balanced*, and *fit*. The dependent variable *mentioning weight* was the number of weight-related words mentioned in the word completion task. The dependent variable *mentioning health* was the number of health-related words mentioned in the word completion task. Very few of the words created by study participants had not been pretested. They were coded as weight- or health-related or neutral. They were also considered if they did not exactly match the gaps given in the fragmented words, since the associations with the sculptures were the focus of interest, not the correct completion of the fragmented words. The coding was done by two independent coders. In cases in which the coding results differed, the two coders reached agreement through discussion.

To examine the role of a weight-control goal in the Giacometti effect, *Restrained eating* (α = .63) was measured. As in Study 1, restrained eating was captured with the Concern for Dieting subscale (Dinkel et al., 2005). To operationalize a health-related goal, *General health interest* (α = .85) was captured. One item was not applied in the data collection because, by relating to cholesterol, it was considered too specific. Example items include the following: “The healthiness of food has little impact on my food choices”; “I always follow a healthy and balanced diet”; and “It is important for me that my daily diet contains a lot of vitamins and minerals” (Roininen, Lähteenmäki, & Tuorila, 1999). Both scales were captured on 7-point Likert scales (1 = I do not agree at all; 7 = I entirely agree). The question used to assess participants' *suspicion about the study purpose* was as follows: “Have you heard about this study and therefore have an idea of what the purpose of the study is?” The computer-based questionnaire was generated with E-Prime, version 2.0.10.353 (E-Prime 2 Professional).

5.1.4. Procedure

The Giacometti cue (see Study 1) was presented as a screensaver directly on participants' computers before they started the computer-based questionnaire. In the no-cue condition, the computers showed a static, white screen.

Participants chose a seat in a cubicle, and the experimenter explained the word completion task. While they were being seated

Table 1

A Pretest Reveals the Words Used to Measure Weight- and Health-Related Words Mentioned, the Dependent Variables of Study 2. N = 117

		“Please indicate how strongly you associate the word *x* with the categories weight and health.” (0 = not at all; 5 = strongly)			“Now you have to tie yourself down: With which of those categories (weight, health, neither) do you associate the following words the most?”			
Words envisaged		M_{weight} (*SD*)	M_{health} (*SD*)	*p*	**Weight**	**Health**	**Neither**	*p*
Weight-related words[a]	eating[b]	4.32 (1.11)	4.23 (1.12)	.31	53	63	1	.40
	slim	4.50 (1.02)	3.54 (1.19)	< .001	101	13	3	< .001
	belly	3.83 (1.19)	2.91 (1.52)	< .001	87	23	7	< .001
	fasting	3.83 (1.27)	3.43 (1.43)	.01	62	47	8	.18
	light	3.64 (1.40)	2.55 (1.50)	< .001	92	13	12	< .001
	skinny	4.13 (1.29)	3.38 (1.51)	< .001	95	19	3	< .001
	kilo	4.71 (0.83)	2.67 (1.52)	< .001	112	1	4	< .001
	sugar	3.97 (1.30)	3.91 (1.28)	.57	60	49	8	.34
	dieting (losing weight)	4.70 (0.80)	3.42 (1.32)	< .001	108	7	2	< .001
	fat	4.74 (0.67)	3.91 (1.33)	< .001	108	8	1	< .001
Health-related words	movement	4.19 (1.13)	4.73 (0.54)	< .001	12	104	1	< .001
	strong	2.75 (1.44)	3.19 (1.35)	< .01	33	64	20	< .01
	orange	1.74 (1.53)	3.27 (1.55)	< .001	10	88	19	< .001
	lively	2.08 (1.66)	3.79 (1.38)	< .001	2	105	10	< .001
	apple	2.38 (1.55)	3.85 (1.32)	< .001	8	98	11	< .001
	active	3.74 (1.34)	4.36 (0.85)	< .001	10	103	4	< .001
	fruits	3.15 (1.34)	4.51 (0.82)	< .001	8	105	4	< .001
	balanced	3.44 (1.36)	4.10 (1.17)	< .001	12	103	2	< .001
	fit	3.79 (1.20)	4.50 (0.81)	< .001	14	102	1	< .001
	well	2.78 (1.70)	3.83 (1.35)	< .001	8	102	7	< .001

Notes:

[a] The words are translated from German except *light*, which is also used in German.

[b] Because *eating* was, in contrast to our expectation, rather assigned to health, it was dropped for the measurement of weight-related words in Study 2.

and receiving oral instructions from the experimenter, participants were exposed to the screensavers for about 30 s. Then, they received the instruction to start the computer-based questionnaire by pressing a certain key on their keyboards. Participants first dealt with the word completion task. The fragmented words were displayed for 30 s in the same randomly ordered sequential selection for each participant. During this time, participants had time to enter the word that first came to mind. After the word completion task, participants completed the questionnaire by answering questions, including the items on restrained eating and general health interest.

5.2. Results

5.2.1. The Giacometti sculptures increased the weight-related word completion of restrained eaters

One-factor ANOVAs revealed no effect of the Giacometti screensaver on the amount of weight-related, $F(1, 59) < 0.01$, $p = .99$, $\eta^2 = .00$, or health-related words mentioned, $F(1, 59) = 0.71$, $p = .40$, $\eta^2 = .01$. However, including restrained eating in an ANCOVA with mentioning weight as the dependent variable revealed an interaction of the screensaver with restrained eating, $F(1, 57) = 5.64$, $p = .02$, $\eta^2 = .09$; main effect of the screensaver, $F(1, 57) = 4.99$, $p = .03$, $\eta^2 = .08$, main effect of restrained eating, $F(1, 57) = 0.58$, $p = .45$, $\eta^2 = .01$. The Johnson-Neyman technique (Hayes, 2013) revealed that the Giacometti screensaver increased the creation of weight-related words in restrained eaters (in participants with a restrained eating score upwards of 4.03; with a significance level of $\alpha = .05$); see Fig. 3. In contrast, restrained eaters did not mention more health-related words after being exposed to the screensaver, compared to individuals low in restrained eating, $F(1, 57) = 0.07$, $p = .79$, $\eta^2 = .00$; main effect of the screensaver, $F(1, 57) < 0.01$, $p = .96$, $\eta^2 = .00$, main effect of restrained eating, $F(1, 57) = 0.57$, $p = .45$, $\eta^2 = .01$.

An ANCOVA including the cue, general health interest, and their interaction as independent variables and the number of health-related words mentioned as dependent variable revealed no interaction of the screensaver with general health interest, $F(1, 57) = 0.51$, $p = .48$, $\eta^2 = .01$; main effect of the screensaver, $F(1, 57) = 0.26$, $p = .61$, $\eta^2 = .00$, main effect of general health interest, $F(1, 57) = 1.75$, $p = .19$, $\eta^2 = .03$.

5.2.2. Correlations of mentioned weight- and health-related words

In order to explore the effect of the activated weight-related content on health-related content, we examined the possible changes in the correlation of mental weight- and health-related content as a consequence of the cue exposure. Bivariate correlation analyses were conducted. They revealed that the participants' mentioning of weight- and health-related words did not correlate, both in participants exposed to the neutral screensaver, $r_{Spearman}(29) = .33$, $p = .08$, and in participants exposed to the Giacometti screensaver, $r_{Spearman}(32) = .11$, $p = .54$. In addition, the association of weight- and health-related words mentioned, measured with the difference of health-mentioning and weight-mentioning, did not differ between the neutral condition ($M = 1.90$, $SD = 1.70$) and the cue condition ($M = 2.28$, $SD = 2.05$), $t(59) = 0.79$, $p = .43$, $d = 0.20$. An ANCOVA analyzing the effects of the cue, restrained eating, and the interaction of cue and restrained eating on the difference of weight- and health-related words mentioned revealed that the association of weight- and health-related words mentioned between the cue and the no-cue condition did not depend on restrained eating, $F(1, 57) = 1.76$, $p = .19$, $\eta^2 = .03$; main effect of the screensaver, $F(1, 57) = 2.08$, $p = .15$, $\eta^2 = .02$, main effect of restrained eating, $F(1, 57) = 1.49$, $p = .23$, $\eta^2 = .03$. These results indicate that weight- and health-related content did not correlate in our sample and that this did not change with either cue exposure or cue exposure and restrained eating.

5.2.3. Analyses without exclusions

No significant results were found when all of the analyses were conducted without any exclusion of participants. One-factor ANOVAs revealed no effect of the screensaver on the number of weight-related, $F(1, 69) = 0.26$, $p = .62$, $\eta 2 = .00$, or health-related words mentioned, $F(1, 69) = 0.52$, $p = .48$, $\eta 2 = .01$. Analyzing the data with an ANCOVA that included restrained eating did not yield any relationships. There was no interaction of the screensaver with restrained eating, $F(1, 66) = 0.08$, $p = .78$, $\eta 2 = .00$, a main effect of the screensaver, $F(1, 66) = 0.01$, $p = .93$, $\eta 2 = .00$, or a main effect of restrained eating, $F(1, 66) = 0.86$, $p = .36$, $\eta 2 = .01$. An ANCOVA including the cue, general health interest, and their interaction as independent variables and the number of health-related words mentioned as dependent variable revealed no interaction of the screensaver with general health interest, $F(1, 66) = .48$, $p = .49$, $\eta^2 = .01$; main effect of the screensaver, $F(1, 66) = .26$, $p = .61$, $\eta^2 = .00$, main effect of general health interest, $F(1, 66) = 1.99$, $p = .16$, $\eta^2 = .03$.

In addition, no indications of a difference in the association of weight- and health-related words mentioned as a consequence of the cue exposure or the cue exposure and restrained eating were found for the sample without participant exclusions.

5.3. Discussion

The results of the analyses with participant exclusions in Study 2 are in line with the results of Study 1. With restrained eaters' increased mentioning of weight-related words after they were exposed to the thin Giacometti sculptures, Study 2 indicates that the Giacometti cue is weight-related and that the Giacometti effect is driven by a weight-control goal. However, because the activation of mentioning weight-related words by the Giacometti cue for restrained eaters could not be found in the sample without participant exclusions, no firm conclusion should be drawn from these results. In contrast, calculated with and without participant exclusions, the cue had no influence on the mentioning of health-related words, even in individuals with a relatively high general health interest. The results of the correlation analyses indicate that weight- and health-related content did not correlate in our sample.

6. General discussion

The present paper aimed to shed light on the content-related processes underlying priming effects with a distinct environmental cue—thin, human-like sculptures by the artist Alberto Giacometti. This is because content-related cognitive processes mostly have been neglected in existing priming studies using environmental cues (Bargh, 2006). In our studies, the Giacometti sculptures were found to be a weight-related environmental cue that can help restrained eaters in facilitating their dieting by reducing their consumption volume.

6.1. Priming weight is not priming health

A detailed understanding of the specific mental content activated by an environmental cue provides the first indications with respect to a cue's possible use. Such understanding also indicates which individuals could be addressed with a distinct cue—i.e., individuals who have a goal that the cue can activate.

However, when an environmental cue, such as the Giacometti sculptures, has an effect on weight-related content, it is conceivable that health-related content is also activated (Janiszewski & Wyer,

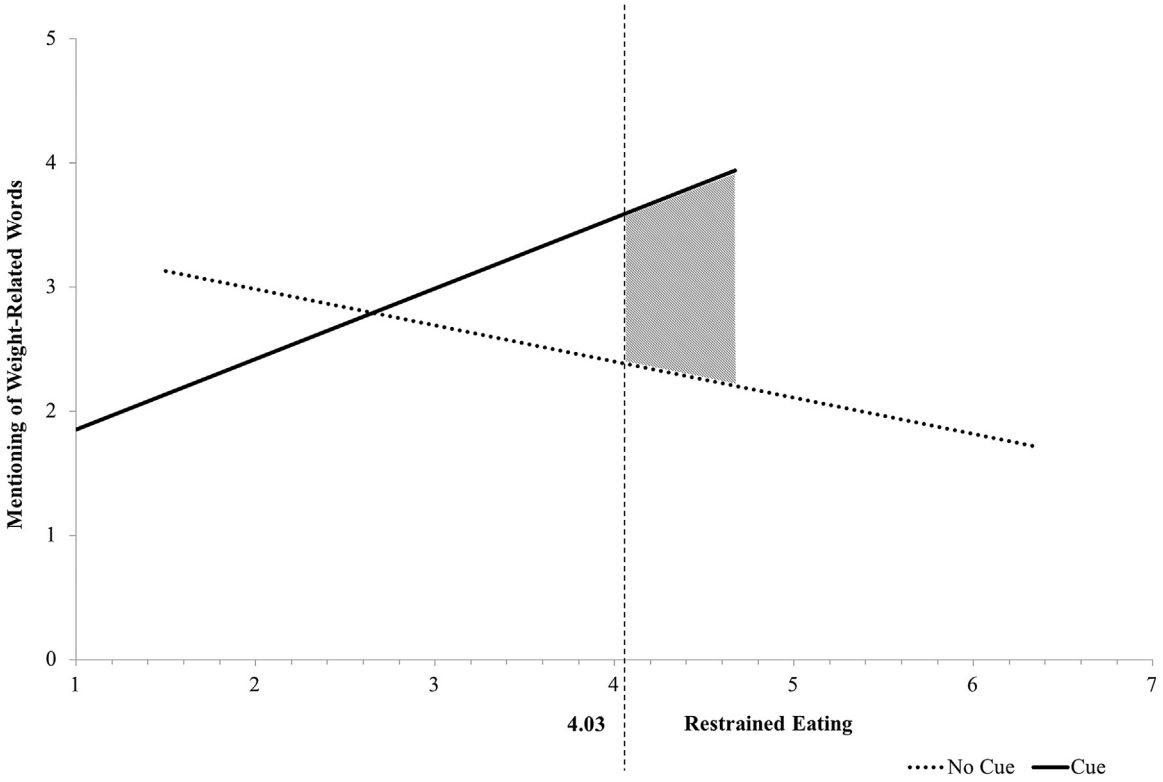

Fig. 3. Mentioning of weight-related words as a function of restrained eating and exposure to an environmental cue. A screensaver with thin, human-like sculptures increased the mentioning of weight-related words in a word completion task in restrained eaters (upwards of a restrained eating score of 4.03).

2014). This is because weight and health are commonly thought to be semantically related. This could not be shown in our sample, however, and health-related content was not activated by the Giacometti sculptures. One potential reason why a relationship could not be determined between weight- and health-related content may be the young age of the participants in Study 2. Health problems caused by weight may not yet be manifest in youth. Nonetheless, being overweight has negative health consequences (World Health Organization, 2002).

6.2. Implications

In regard to the prevailing epidemic of overweight and obesity (World Health Organization, 2016), environmental weight-control cues could play a pivotal role. Primary weight-related cues can be seen as counterparts to the abundance of food and food-related cues in our obesogenic environment (Papies et al., 2014).

An example of applied environmental cues for the promotion of health is the deterrent pictures on cigarette packages, which show the physical consequences of smoking (European Union, 2014). However, studies have found these deterrent pictures to be ineffective (Glock & Kneer, 2009). This indicates that obese figures and the "fear of fat" (Anschutz, Engels, Becker, & van Strien, 2009) would be less effective drivers against eating high-calorie food than cues such as the thin Giacometti sculptures. These sculptures can be seen as motivators, as they emphasize the positive consequences of eating less high-calorie food in order to get closer to the ideal of a thin figure (van de Veer et al., 2015). Results from neural research substantiate that motivation works better than deterrence in the domain of eating. Besides homeostatic regulation, eating is assumed to be controlled by a neural network, which is supposed to consist of a reward pathway and a control pathway (Chen, Papies, & Barsalou, 2016). Interestingly, thinking about the long-term benefits of not eating has been found to increase activity in the inhibitory neural pathway and to reduce activity in the reward pathway more than thinking about the long-term costs of eating (Yokum & Stice, 2013). Evidence from research on reactions to thin and round figures further indicates that thin figures may have more influence on reducing calorie intake than obese figures. For example, dieters ate less when their server was thin than when she was overweight (McFerran, Dahl, Fitzsimons, & Morales, 2010).

With regard to the specific body forms of the Giacometti sculptures, it must be acknowledged that human bodies with figures similar to these sculptures would be seriously underweight. Thus, they would be perceived as less attractive and thus less motivating than figures corresponding to the lower ranges of normal body mass indices (Tovée, Edmonds, & Vuong, 2012; Tovée, Furnham, & Swami, 2007; Weeden & Sabini, 2005). When using human models as environmental cues, using healthier-looking human figures could thus work better than skinny human figures. Supporting evidence for this demonstrates that female television viewers ate less unhealthy food when they watched average-sized or slightly oversized models than they did when exposed to thin models (Anschutz et al., 2009). However, when compared to using human models as environmental cues, the Giacometti sculptures seem to have the advantage of being more generally applicable. Social comparison processes due to characteristics such as clothing or age should be prevented when using artistically simplified human sculptures (Corcoran, Crusius, & Mussweiler, 2011).

6.3. Limitations

Besides the conceivable application of environmental cues for public policy purposes, the question arises whether dieting cues could be used intentionally by individuals for losing weight. If applied intentionally, a cue could be processed more controlled

than when used as a subtle prime. There is evidence that intention could even support a cue's influence, as primes can affect behavior through both automatic and controlled processes (Payne, Brown-Iannuzzi, & Loersch, 2016). Because losing weight is a long-term process, another question that arises is what would happen if cues are applied repeatedly. To our knowledge, there is very little evidence revealing the effects of repeatedly exposing individuals to an environmental weight- or health-related cue (Klesse, Goukens, Geyskens, & de Ruyter, 2012). A constant reactivation of goals and a habituation to the cue with a decreasing effect of the cue (Rankin et al., 2009) are both conceivable.

With a long-term application of environmental weight-control cues, the unintended effects of exposing people to the thin ideal become more important and have to be taken into consideration. Examples of unintended effects are negative affect, increased body dissatisfaction, and disordered eating patterns for vulnerable groups of people, such as vulnerable adolescents (Stice, Spangler, & Agras, 2001) or unsuccessful restrained eaters (Schaumberg, Anderson, Anderson, Reilly, & Gorrell, 2016).

7. Conclusion

In sum, the present research indicates that exposure to thin, human-like sculptures by the artist Alberto Giacometti reduces food intake in restrained eaters and thus that the Giacometti effect is driven by a weight-control goal. Given that restrained eaters are often unsuccessful in dieting, partly because of the obesogenic environment with its abundance of food and food-related cues (Lowe et al., 2013; Papies et al., 2014; Stroebe et al., 2008), weight-control cues in the environment can be seen as helpful counterparts. By helping restrained eaters to pursue their weight-control goal, environmental weight-control cues could act as daily nudges in a healthier direction (Hill, Wyatt, Reed, & Peters, 2003).

Role of funding sources

This research was financially supported by the Swiss National Science Foundation as part of the National Research Program NRP 69— Healthy Nutrition and Sustainable Food Production (grant 12 No. 145189). The study design was partly (Study 1) included in the funding proposal. The collection, analysis, and interpretation of the data, in addition to all work contributing to the present manuscript and journal selected for submission, were done independently of the funding sponsor.

Conflicts of interest

All authors declare that they have no conflicts of interest.

Appendix

Pretest Fragmented Words

To assess whether the Giacometti screensaver activates health- or weight-related mental content, 40 fragmented words were created: 20 that could be completed either by a weight-related or a neutral word and 20 that could be completed either by a health-related or a neutral word. Efforts were made to ensure that the words were not too difficult to complete. A qualitative pretest with 14 individuals (57% female) ensured this and also assessed how often the fragmented words were completed by a weight- or health-related (i.e., semantic category-related) word instead of a neutral word. Ten fragmented words were chosen per semantic category. They were completed with a category-related word between 7% and 57%. With this choice, a sufficient variance was expected in semantic category-related and neutral word completions per fragmented word. The expected weight-related words included, e.g., *slim*, *dieting*, and *fat*. The expected health-related words included, e.g., *apple*, *balanced*, and *fit*.

A second independent pretest was conducted to examine whether the words conceived to represent the weight- and health-related semantic categories can be assigned distinctly to weight or health. One hundred and forty-eight individuals participated in an online questionnaire. The link to this questionnaire was posted in online market places of university websites. The data of everyone who completed the questionnaire (117 participants) were analyzed. In a first step, the participants had to rate how strongly they associated the envisaged weight- and health-related words with both weight and health (0 = not at all; 5 = strongly). They associated all semantic category words with the expected semantic category. All words had a mean rating of higher than 3, which was, with two exceptions, higher than the mean of the competing semantic category. The words *eating* and *sugar*, which were created to represent the weight category, were not associated significantly more strongly with weight than with health (see Table 1). In a second step of this pretest, participants had to decide the category with which they associated each word the most: weight, health, or neither of these categories. Binomial tests revealed that all assignments were made as expected except for the words *eating*, *sugar*, and *fasting*, which were envisaged to represent the weight category. While *sugar* ($p = .34$) and *fasting* ($p = .18$) were rather assigned to weight, *eating* was assigned, in contrast to our expectation, rather to health ($p = .40$; see Table 1). As a consequence, the word *eating* was dropped.

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Manuscript 4

The Art of Losing Weight:

Promising Longitudinal Data

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The Art of Losing Weight: Promising Longitudinal Data

Cues in the environment have proved to reduce individuals' consumption volume and to prompt healthy food choices immediately. However, evidence of environmental cues' influence on eating over a longer period of time or on weight loss is scarce. Therefore, the present longitudinal study applied environmental weight-control cues in the home environment of individuals with a weight-loss goal. We applied a 2 × 2 mixed-subjects design over a six-month duration. Over the course of the six months, participants were exposed to a weight- related Giacometti or a semantically neutral Rothko picture in weight diaries. To examine the so far also unexplored potential for dieters to apply environmental cues intentionally, dieters were either told that the cues had been proven to support weight loss or were not told. This resulted in three experimental conditions related to weight and one control condition. The weight-related conditions were either semantically related to weight (Giacometti-unaware), related by learning (Rothko-aware), or both, semantically and by learning (Giacometti-aware). Results pointed in the direction that the weight-related cues helped with losing weight. By tendency, they helped high-restrained eaters who hold a chronic weight-control goal. Furthermore, results indicated that being aware of a cue's influence may be even more important for activating the weight-loss goal than the mere semantic relatedness of a cue to weight. Results revealed that high-restrained eaters could intentionally apply environmental cues to lose approximately two kilograms in half a year. Thus, weight-control cues, for instance, on a refrigerator's door seem to be able to act as opponents to our "obesogenic" environment by helping to pursue weight-control goals. By this means, dieters can achieve major changes with minimal effort on their part.

Keywords: environmental cues; dieting; awareness; restrained eating; longitudinal study

The Art of Losing Weight: Promising Longitudinal Data

Our "obesogenic" environment (Papies, Potjes, Keesman, Schwinghammer, & van Koningsbruggen, 2014), with its abundance of tempting food, leads us to over 200 unnoticed food decisions a day (Wansink & Sobal, 2007). This is reflected in today's obesity epidemic (World Health Organization, 2016). However, similarly as food cues prime eating, weight-control cues in the environment can prime dieting. For instance, dieting-related meal descriptions in a restaurant menu increase low-calorie food choices (Papies & Veling, 2013). Furthermore, human-like thin sculptures by the artist Alberto Giacometti have repeatedly been proven to reduce the amount of food consumed (Brunner & Siegrist, 2012; Stämpfli & Brunner, 2016) and have promoted healthy food choices at a food vending machine (Stöckli, Stämpfli, Messner, & Brunner, 2016).

Environmental weight-control cues are thought to influence at the moment of "wrong" eating decisions by activating individuals' weight-control goals outside of their awareness (Papies, 2016; Stroebe, van Koningsbruggen, Papies, & Aarts, 2012). Empirical evidence has revealed the immediate effects of weight-control cues, especially their influence on the amount consumed and food choices (Papies, 2016; Wansink & Chandon, 2014). Individuals with a chronic goal of weight control, referred to as restrained eaters (Herman & Mack, 1975; Stroebe, Mensink, Aarts, Schut, & Kruglanski, 2008), have been shown to be particularly sensitive to weight-control-related environmental cues (Anschutz, van Strien, & Engels, 2008; Harris, Bargh, & Brownell, 2009; Papies & Hamstra, 2010; Papies & Veling, 2013; Versluis & Papies, 2016). However, losing weight is a longer-term process, and evidence regarding environmental cues' influence on weight loss in the long term is scarce. To the best of our knowledge, there is only one such study. However, this study analyzed weight loss for a period of two weeks only (Klesse, Goukens, Geyskens, & de Ruyter, 2012). The present study contributes to closing this research gap by exposing dieters daily to environmental weight-control cues over the course of six months. By applying the cues in the home environment, the present study also addresses the ecological validity of environmental weight-control cues.

Two crucial issues underlie this research design. First, it is, as of yet, unclear how an environmental cue's effect develops with repeated application. A decrease in the cue's influence on individuals' behavior over time could occur due to habituation (Rankin et al., 2009; Silvestrini &

Gendolla, 2011). However, because of the numerous environmental cues in individuals' daily lives, we anticipate dishabituation processes with re-increased responses to the original cue (Ferrari, Bradley, Codispoti, & Lang, 2015; Rankin et al., 2009). Thus, we assume that the weight-control cue will activate and constantly re-activate participants' weight-control goals. Second, because cues are thought to influence individuals outside of their conscious awareness (Bargh, 2006; Bargh, Gollwitzer, Lee-Chai, Barndollar, & Trötschel, 2001; Chartrand, 2005), an important issue is whether dieters can intentionally apply the cues once they are aware of their effects. We hypothesize that the awareness of a cue's effect enhances its effect, like a knot in a handkerchief, as a reminder on one's goal.

Method

Participants

The question "Are you still on your way to your ideal weight?" was asked to search for participants willing to take part in a six-month diary study. They were recruited by a postal dispatch of approximately 20,000 flyers, by publishing the flyer on the university homepage, via e-mail, and by placing advertisements in free newspapers. Those interested could register online for the study. Only individuals with an indicated BMI of higher than 22 were admitted. The participants were then divided among the planned initial appointments for the study by sex, BMI, and the time of day of the appointment. As incentive, individual data of a body analysis scale from before and after the study were offered, as well as the edited developments of the recorded data from participants' diaries. At the initial appointment, 167 individuals participated. A total of 116 participants (M_{age} = 48.70 years, SD_{age} = 14.15; M_{BMI} = 28.23 kg/m^2, SD_{BMI} = 4.02 kg/m^2; 68.1% female) completed the study. There was no relation between the dropout rate and the conditions (see Design section): Rothko-unaware (n = 15, 35.7%), Rothko-aware (n = 14, 34.1%), Giacometti-unware (n = 11, 26.8%), Giacometti-aware (n = 11, 25.6%), $\chi^2(3) = 1.55$, $p = .672$. One diary was not included in the analyses because it was returned approximately one month after the final appointment.

Design

A 2 (cue: semantically neutral Rothko picture vs. semantically weight-related Giacometti picture) × 2 (awareness of the cue's influence: unaware vs. aware) mixed-subjects design was applied to examine the cues' effects over time. Cue and awareness served as the between-subjects factors,

and time served as the within-subjects factor. That is, participants were divided into one of the four conditions "Rothko-unaware", "Rothko-aware", "Giacometti-unaware", and "Giacometti-aware," and participants' measures were captured repeatedly over time.

Materials and Measures

Cue. The weight-related cue was a photograph depicting Alberto Giacometti's sculpture *Piazza*, showing thin, human-like sculptures (Brunner & Siegrist, 2012; Stämpfli & Brunner, 2016). This photograph was printed on the diaries' covers and was used as the background of the tables for the data entry on each page. In addition, a single Giacometti sculpture was printed on each page, including the diaries' spines. See Appendix, Fig. A1. The semantically neutral cue was a picture of the Rothko-painting *No 203 1954*, showing a blue- and rose-colored field. It was printed on the diaries' covers, as the background of the tables for data entry, on each page, and on the diaries' spines. See Appendix, Fig. A2.

Awareness of the cue's influence. In the awareness conditions, the diaries had the title *Giacometti Losing Weight Diary* or *Rothko Losing Weight Diary*. On the introduction page, it was stated that the thin sculptures or the Rothko paintings had been proven to support weight loss, to lead to a healthier diet, and to reduce the amount of consumed food. See Appendix, Fig. A3. In the no awareness conditions, the diaries had the title *Diet Diary*. See Appendix, Fig. A4.

Diaries and stickers. The diaries had an introduction page explaining how to do the data entry to participants. The following pages contained tables for data entry. At the end of the diaries, a page that provided space for the participants' notes was included. In addition to the diaries, six stickers with either the Giacometti or the Rothko picture were given to participants, masked as reminders for study participation.

Measures. The bodyweight scale used to measure participants for their incentive was a Tanita BC-545. Each day, participants had to note the basis for this study's main dependent variables, their bodyweight, in kg, to two decimal places if possible. In addition, light physical activity (a little out of breath) and physical activity (strong sweating) were captured, in minutes. In addition, fruit and vegetable consumption was captured, in portions. As dependent variables, the data differences from the last and the first four weeks of the study were calculated.

Further, *restrained eating* ($\alpha = .64$) was captured with the German version (Dinkel, Berth, Exner, Rief, & Balck, 2005) of the Concern for Dieting subscale of the Revised Restraint Scale (Herman & Polivy, 1980). This subscale consists of six items and has been shown to capture restrained eating better than the entire restraint scale does (van Strien, Breteler, & Ouwens, 2002). Example items are "How often are you dieting?," "Do you give too much time and thought to food?," and "Do you have feelings of guilt after overeating?" These items were reformulated (first person view) and captured on 7-point Likert scales (1 = I do not agree at all to 7 = I entirely agree).

Procedure. During the final two weeks of November 2015, participants attended the initial appointment at the university campus. Only individuals assigned to the same condition participated in each appointment. Participants first read and signed the informed consent form. They were advised that they should only participate if they felt psychologically and physically able. They were also informed that the researchers were not medical professionals or nutrition counselors. Therefore, they were informed that it was their responsibility to decide whether to seek medical guidance. In addition, the researchers stated that they would not support weight loss below the normal weight and that participants had the right to end their participation at any time without having to give a reason. See Appendix, Fig. A5. The participants then answered the questionnaire, which was used to assess restrained eating. Afterward, participants received their diaries and were instructed, always by the same instructor, on how to record their data each day. After having the chance to ask questions, participants were weighed individually with the body analysis scale. They were then discharged. The research team provided a study e-mail address which participants could contact in case they had any questions during the study. The study started in the first week of December 2015 and ran for 26 weeks until the end of May 2016. In June, participants attended the final appointment. In the final appointment, participants were again weighed and then debriefed.

Results

Weight-Related Conditions vs. Control Condition: Restrained Eaters by Tendency Lost Weight Applying Weight-Related Cues

To first compare the Rothko-unaware control condition to the conditions related to weight, Rothko-aware, Giacometti-unaware, and Giacometti-aware, we analyzed the effect of the four conditions (as four levels of one variable) on the difference in weight change of the last and the first

four weeks of the study. An ANCOVA containing the variables condition, restrained eating, and their interactions revealed by tendency an interaction of condition with restrained eating, $N = 110$, $F(3, 26.72) = 2.44$, $p = .069$, $\eta^2 = .06$.[1] Despite the only marginal significant effect, we did a median split for restrained eating at the value of 3.60, and conducted ANOVAs for low- and high-restrained eaters. A one-factor ANOVA with the independent variable condition for low restrained eaters revealed no effect of condition, $n = 58$, $F(3, 15.86) = 1.23$, $p = .308$, $\eta^2 = .06$. By contrast, a one-factor ANOVA with the independent variable condition for high-restrained eaters revealed an effect by tendency of condition on weight change, $n = 52$, $F(3, 21.87) = 2.69$, $p = .057$, $\eta^2 = .14$. Despite the only marginal significant effect, we conducted a custom hypothesis test for high-restrained eaters, comparing the Rothko-unaware control condition to the average of the three conditions related to weight, Giacometti-unaware, Rothko-aware, and Giacometti-aware. This test revealed that high-restrained eaters lost more weight in the conditions related to weight ($M = -1.71$ kilograms, $SD = 3.08$), than in the control condition ($M = 0.67$ kilograms, $SD = 1.92$), $F(1, 48) = 7.59$, $p = .008$, $d = 0.93$, see Fig. 1.[2]

[1] There was no effect of condition, $F(3, 22.26) = 2.03$, $p = .114$, $\eta^2 = .05$, or of restrained eating, $F(1, 24.94) = 2.27$, $p = .135$, $\eta^2 = .02$.

[2] In contrast, low restrained eaters' weight did not change as a result of the conditions, $F(1, 54) = 2.31$, $p = .135$.

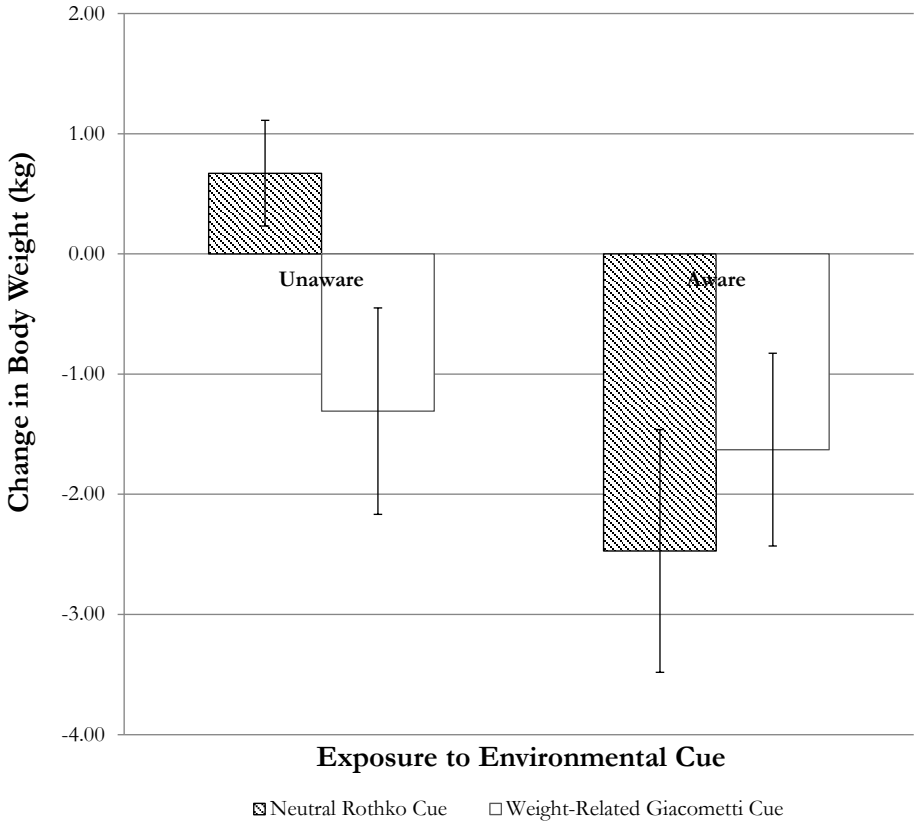

Figure 1. Mean change in bodyweight (in kilograms) for high-restrained eaters (upper half of the median split, $n = 52$) for the four conditions (no cue/cue × unaware/aware of the cue's influence). High-restrained eaters in the weight-related conditions lost more weight than did high-restrained eaters in the Rothko-unaware control condition (error bars represent standard errors).

To analyze the conditions' effects on weight over time in more detail, we conducted a repeated measures ANCOVA with condition, restrained eating, and time as independent variables and "monthly" averages of weight as dependent variables. Six points in time were analyzed. Because the length of the study was 26 weeks, time points 3 and 4 contained the data for five weeks; the other four time points each contained data for four weeks. Because sphericity was violated, the Greenhouse-Geisser correction was applied, Mauchly's $W = .004$, $p < .001$, $\varepsilon_{\text{Greenhouse-Geisser}} = .299$. Similar to the results in the ANOVA with weight difference as the dependent variable, the repeated measures analysis showed condition to interact by tendency with restrained eating and time, $N =$

107, $F(4.48, 147.91) = 1.96$, $p = .096$. See Fig.2 for the temporal developments per condition for low- and high-restrained eaters.

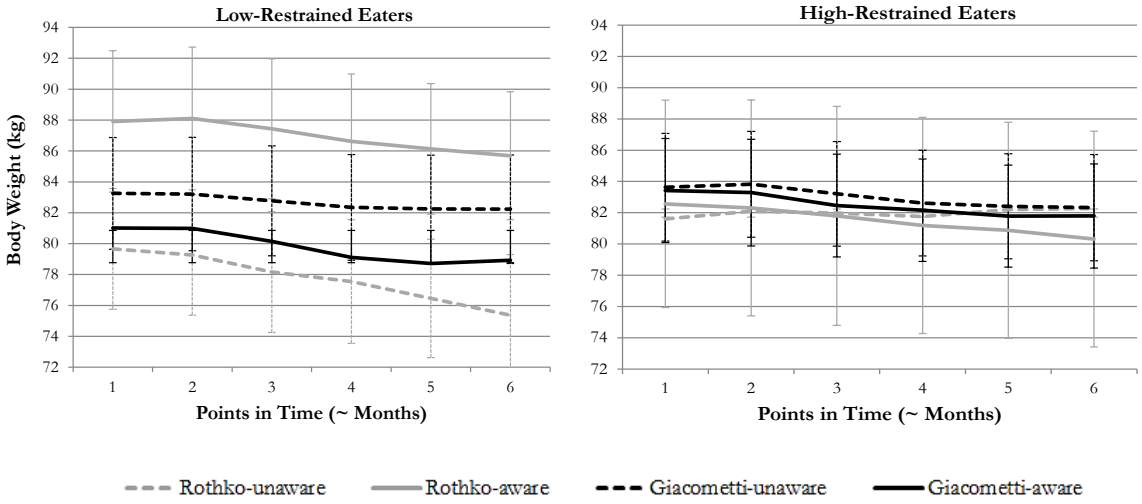

Figure 2. Mean change in bodyweight (in kilograms) for low- and high-restrained eaters (lower and upper half of the median split) for the four conditions (no cue/cue × unaware/aware of the cue's influence). Condition interacted by tendency with restrained eating and time (error bars represent standard errors).

However, separate repeated measures ANOVAs for low- and high-restrained eaters (median split) did not reveal interactions of condition and time. For low restrained eaters, $n = 56$, $W = .003$, $p < .001$, $\varepsilon_{\text{Greenhouse-Geisser}} = .297$, there was no interaction of condition and time, $F(4.46, 77.28) = 1.27$, $p = .289$, $\eta_p^2 = .07$. The same proved to be the case for high-restrained eaters, $n = 51$, $W = .003$, $p < .001$, $\varepsilon_{\text{Greenhouse-Geisser}} = .302$, $F(4.53, 70.92) = 1.72$, $p = .148$, $\eta_p^2 = .10$.[3]

Despite the only marginally significant three-way interaction and the non-significant repeated measures ANOVAs for low- and high-restrained eaters, we ran further analyses based on the results from the custom hypothesis test for high-restrained eaters with weight differences. We examined the contrast of the Rothko-unaware control condition and the mean effect of the weight-related conditions, Giacometti-unaware, Rothko-aware, and Giacometti-aware for high-restrained eaters.

[3] There were only effects of time: for low restrained eaters, $F(1.49, 77.28) = 21.33$, $p < .001$, $\eta_p^2 = .29$; for high-restrained eaters, $F(1.51, 70.92) = 7.58$, $p = .003$, $\eta_p^2 = .14$.

Helmert contrasts did not show the control condition to differ from the weight-related conditions with regards to the averaged weight over time, $p = .939$. In addition, we examined the simple effects of time within conditions for high-restrained eaters, $n = 51$. As sphericity was violated, $W = .003$, $p < .001$, we relied on the multivariate tests (O'Brien & Kaiser, 1985). Overall, they did not reveal weight changes because of conditions; Giacometti-unaware, $F = 1.57$, $p < .188$, Rothko-aware, $F = 1.45$, $p < .213$, Giacometti-aware, $F = 1.54$, $p < .197$, Rothko-unaware control condition, $F = 2.06$, $p < .089$.[4]

In sum, these analyses revealed by tendency an interaction of condition, restrained eating, and time. The results of the analyses with differences as dependent variable indicate that, by tendency, weight-related cues—whether semantically related (Giacometti-unaware), related by learning (Rothko-aware), or both (Giacometti-aware)—help high-restrained eaters to lose weight.

Cue × Awareness: Restrained Eaters Could Apply Cues Intentionally to Lose Weight

Since the results of the previous analyses were ambiguous, we analyzed the data further, replacing the independent variable condition with the cue and awareness variables in accordance with the 2 × 2 design of our study. A full model ANCOVA, which included cue, awareness, restrained eating, and all interactions as independent variables and the difference in weight change of the last and the first four weeks of the study as the dependent variable, $N = 110$, revealed a three-way interaction between cue, awareness, and restrained eating, $F(1, 102) = 6.10$, $p = .015$, $\eta^2 = .05$.[5] To examine the effects of cue and awareness for low- and high-restrained eaters, we conducted separate ANOVAs. The ANOVA for low restrained eaters, $n = 58$, did not reveal any effects.[6] By contrast, the ANOVA for high-restrained eaters, $n = 52$, revealed awareness to have influenced participants' weight loss, $F(1, 48) = 4.60$, $p = .037$, $\eta^2 = .08$. Restrained eaters who had been told about the cue's influence lost more weight ($M = -1.95$ kilograms, $SD = 3.04$) than did restrained eaters who had not been told ($M = -0.32$ kilograms, $SD = 2.78$), $t(50) = 2.01$, $p = .050$, $d = 0.56$. See Fig.1. Furthermore,

[4] By contrast, the non-decisive univariate tests would have substantiated the pattern found in the custom hypothesis test. In the univariate tests, high-restrained eaters' weight changed as a result of the conditions related to weight, Giacometti-unaware, $F(5, 235) = 3.44$, $p = .005$, Rothko-aware, $n = 51$, $F(5, 235) = 3.58$, $p = .004$, and Giacometti-aware, $F(5, 235) = 4.62$, $p < .001$, but not as a result of the Rothko-unaware control condition, $F(5, 235) = .56$, $p = .728$.

[5] Furthermore, the analysis revealed an interaction of cue and awareness, $F(1, 102) = 5.47$, $p = .021$, $\eta^2 = .05$; no main effect of cue, $F(1, 102) = 0.75$, $p = .390$, $\eta^2 = .01$, no main effect of awareness, $F(1, 102) = 0.74$, $p = .393$, $\eta^2 = .01$, no main effect of restrained eating, $F(1, 102) = 2.27$, $p = .135$, $\eta^2 = .02$, no interaction of cue and restrained eating, $F(1, 102) = 0.59$, $p = .444$, $\eta^2 = .01$, and no interaction of awareness and restrained eating, $F(1, 102) = 1.80$, $p = .183$, $\eta^2 = .02$.

[6] There was no main effect of cue, $F(1, 54) = 1.79$, $p = .186$, $\eta^2 = .03$, no main effect of awareness, $F(1, 54) = .01$, $p = .925$, $\eta^2 = .00$, and no interaction of cue and awareness, $F(1, 54) = 2.30$, $p = .135$, $\eta^2 = .004$.

there was no main effect of cue, $F(1, 48) = 0.50$, $p = .485$, $\eta^2 = .01$, and an interaction by tendency of cue and awareness, $F(1, 48) = 3.05$, $p = .087$, $\eta^2 = .05$.

To substantiate the found effect of awareness, we conducted a repeated measures ANCOVA with cue, awareness, restrained eating, and time as independent variables and "monthly" averages of weight as dependent variables, $N = 107$. As in the repeated measures analysis with condition, time points 3 and 4 contained the data for five weeks; the other four time points each contained data for four weeks. Because sphericity was violated, the Greenhouse-Geisser correction was applied, $W = .004$, $p < .001$, $\varepsilon_{\text{Greenhouse-Geisser}} = .299$. Tests of within-subjects effects reflected the result of the full model ANCOVA on the difference in weight change by revealing a four-way interaction of cue, awareness, restrained eating, and time, $F(1.49, 147.91) = 4.62$, $p = .019$, $\eta_p^2 = .04$. See Fig. 2. However, separate repeated measures ANOVAs for low- and high-restrained eaters (median split) revealed no effects except of time.[7] There was no interaction of cue, awareness, and time for low restrained eaters, $n = 56$, $W = .003$, $p < .001$, $\varepsilon_{\text{Greenhouse-Geisser}} = .297$, $F(1.49, 77.28) = 1.88$, $p = .169$, $\eta_p^2 = .04$, or for high-restrained eaters, $n = 51$, $W = .003$, $p < .001$, $\varepsilon_{\text{Greenhouse-Geisser}} = .302$, $F(1.51, 70.92) = 1.70$, $p = .196$, $\eta_p^2 = .04$.

In sum, the analyses with cue × awareness as independent variables revealed an interaction of cue, awareness, restrained eating, and time in the ANOVA with differences and in the repeated measures ANOVA. The analysis with differences revealed awareness to support high-restrained eaters in pursuing their weight-control goal.

Mixed Models Substantiate Interaction of Cue, Awareness, Restrained Eating, and Time

To substantiate these results by examining the data in more detail, we applied a mixed-model approach (Gelman & Hill, 2007). With regards to time, we focused in modeling on three issues: which temporal resolution to choose for the daily recorded weight data, how to model the temporal autocorrelation within participants' weight data, and whether a nonlinear time effect was needed or whether a linear time effect would be sufficient for our data. First, with regards to the temporal resolution of the data, weekly averages in a model, including the independent variables cue,

[7] Low restrained eaters, $F(1.49, 77.28) = 21.33$, $p < .001$, $\eta^2 = .29$, high-restrained eaters, $F(1.51, 70.92) = 7.58$, $p = .003$, $\eta^2 = .14$.

awareness, time, and their interactions, were shown to be very highly correlated.[8] Therefore, we chose "monthly" data. Second, we compared models, with and without restrained eating, for temporal autocorrelation, using AR(1), MA(1), and ARMA(1,1). However, none of these fitted the data better than simple random intercept models did (i.e., models in which only the intercept is allowed to vary between subjects). Therefore, we chose the random intercept models. Third, to assess whether a nonlinear time effect was needed, models with time as a factor, which allow nonlinear time effects, were compared to models with time as a numeric variable (with and without restrained eating). The likelihood ratio tests revealed that the more complex models that allowed nonlinear time effects did not fit the data better; without restrained eating, $LR = 8.99$, $p = .704$, or with restrained eating, $LR = 12.43$, $p = .999$. Thus, over the observed time period, there was no need for a nonlinear time pattern. In sum, simple random intercept models were chosen. We analyzed monthly averages, did not consider temporal autocorrelation, and used models which only allowed for linear time effects.

Such a model with the independent variables cue, awareness, time, and their interactions revealed an interaction of awareness with time, $F(1, 585) = 11.60$, $p < .001$[9]. Participants who had been told about the cue's influence lost more weight over time than participants who had not been told. This result indicates that being informed of environmental cues effectiveness on losing weight can be applied intentionally. The additional weight loss per day for participants in the awareness conditions, compared to subjects in the no awareness conditions, was 0.007 kilograms, or approximately 200 grams per month.[10] However, this result must be interpreted with caution.[11] The Shapiro Wilk tests indicated that the random intercept model was insufficient regarding the normal

[8] In an ARMA(1,1) model with cue, awareness, and time, the AR coefficient was estimated as $\hat{\varphi} = 0.999$. In an AR(1) model with cue, awareness, restrained eating, and time, the AR coefficient was also estimated as $\hat{\varphi} = 0.999$.
[9] We looked at the model without the insignificant three-way interaction, $F(1, 584) = 0.27$, $p = .600$.
[10] Furthermore, the analysis revealed no interaction of cue and time, $F(1, 585) = 0.04$, $p = .842$, an interaction of cue and awareness, $F(1, 150) = 4.73$, $p = .031$, an effect of time, $F(1, 585) = 18.83$, $p < .001$, an effect of awareness, $F(1, 150) = 5.39$, $p = .022$, and no effect of cue, $F(1, 150) = 2.72$, $p = .101$.
[11] When just adding random slopes to this model, which allows for different courses of weight change per subject and which fitted the data better, $LR = 489.19$, $p < .001$, an interaction of awareness and time was revealed only by tendency, $F(1, 585) = 3.11$, $p = .079$. Furthermore, the analysis revealed no interaction of cue and time, $F(1, 585) = 0.21$, $p = .644$, an interaction of cue and awareness, $F(1, 150) = 4.49$, $p = .036$, an effect by tendency of time, $F(1, 585) = 3.72$, $p = .054$, an effect of awareness, $F(1, 150) = 5.04$, $p = .026$, and no effect of cue, $F(1, 150) = 2.52$, $p = .114$. However, the Shapiro Wilk tests indicated that the random intercept and slopes model was insufficient regarding the normal distribution of the random effects, $W = .89$, $p < .001$, and the fixed effects, $W = .94$, $p > .001$.

distribution of the random effects, $W = .97$, $p = .002$, and of the fixed effects, $W = .92$, $p = <.001$. A random intercept model with the independent variables cue, awareness, restrained eating, time, and their interactions revealed a four-way interaction of these variables, $F(1, 580) = 22.55$, $p < .001$.[12, 13] However, this model was also insufficient regarding the normal distribution of the random effects, $W = .97$, $p = .004$, and of the fixed effects, $W = .93$, $p > .001$.

In summary, mixed-model analyses indicated awareness to help with losing weight in a model without restrained eating. Including restrained eating, the mixed-model analyses revealed a four-way interaction of cue, awareness, restrained eating, and time. However, in both cases, the normal distributions of the random and fixed effects were violated.

Overall, results were ambiguous. However, they pointed in the direction that the weight-related cues—whether semantically related, related by learning, or both, semantically and by learning—helped with losing weight. By tendency, they helped high-restrained eaters who hold a chronic weight-control goal (Mensink et al., 2008). Furthermore, results indicated that the awareness of a cue's influence may be even more important for activating the goal of losing weight than the mere semantic relatedness of a cue with weight loss.

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[12] Furthermore, the analysis revealed an interaction of awareness, restrained eating, and time, $F(1, 580) = 18.37$, $p < .001$, an interaction of cue, restrained eating, and time, $F(1, 580) = 16.50$, $p < .001$, an interaction of cue, awareness, and time, $F(1, 580) = 20.05$, $p < .001$, no interaction of cue, awareness, and restrained eating, $F(1, 146) = 0.68$, $p = .412$, an interaction of restrained eating and time, $F(1, 580) = 21.37$, $p < .001$, an interaction of awareness and time, $F(1, 580) = 11.73$, $p < .001$, an interaction of cue and time, $F(1, 580) = 14.51$, $p < .001$, no interaction of awareness and restrained eating, $F(1, 146) = 0.12$, $p = .732$, no interaction of cue and restrained eating, $F(1, 146) = 0.01$, $p = .917$, no interaction of cue and awareness, $F(1, 146) = 0.04$, $p = .842$, an effect of time, $F(1, 580) = 28.70$, $p < .001$, no effect of restrained eating, $F(1, 146) = 0.01$, $p = .922$, no effect of awareness, $F(1, 146) = 0.11$, $p = .737$, and no effect of cue, $F(1, 146) = 0.33$, $p = .566$.

[13] The respective random intercept and slopes model also revealed this four-way interaction, $F(1, 580) = 4.85$, $p = .028$, and the random intercept and slopes model fitted the data better than the random intercept model, $LR = 466.84$, $p < .001$. However, the model was insufficient regarding the normal distribution of the random effects, $W = .97$, $p = .003$, and of the fixed effects, $W = .94$, $p < .001$. Furthermore, this analysis revealed an interaction by tendency of awareness, restrained eating, and time, $F(1, 580) = 3.92$, $p = .048$, an interaction by tendency of cue, restrained eating, and time, $F(1, 580) = 3.12$, $p = .078$, an interaction of cue, awareness, and time, $F(1, 580) = 4.11$, $p = .043$, no interaction of cue, awareness, and restrained eating, $F(1, 146) = 0.61$, $p = .434$, an interaction of restrained eating and time, $F(1, 580) = 4.77$, $p = .029$, no interaction of awareness and time, $F(1, 580) = 2.24$, $p = .135$, no interaction of cue and time, $F(1, 580) = 2.38$, $p = .123$, no interaction of awareness and restrained eating, $F(1, 146) = 0.10$, $p = .754$, no interaction of cue and restrained eating, $F(1, 146) = 0.01$, $p = .903$, no interaction of cue and awareness, $F(1, 146) = 0.03$, $p = .859$, an effect of time, $F(1, 580) = 6.20$, $p = .013$, no effect of restrained eating, $F(1, 146) = 0.01$, $p = .941$, no effect of awareness, $F(1, 146) = 0.12$, $p = .728$, and no effect of cue, $F(1, 146) = 0.34$, $p = .559$.

Discussion

The present longitudinal study is, to the best of our knowledge, the first study to point in the direction that external cues can lead to weight loss in the long run. For example, the results indicated that environmental cues can be applied intentionally to lose weight by individuals with a weight-control goal. In relation to the issue of whether environmental cues can affect individuals over a longer time period or whether habituation takes place, these results point in the direction of an activation and constant re-activation of mental concepts. There was no evidence for habituation effects.

Weight-Control Primes or Reminders?

By evidencing that the environmental cues affected high-restrained eaters—individuals with strongly anchored weight-related mental concepts in mind (Herman & Mack, 1975; Stroebe et al., 2008)—the present results substantiated the assumed working mechanism of environmental cues. The cues act as primes and activate existing mental concepts outside of individuals' awareness (Bargh et al., 2001; Chartrand, 2005). However, the present results also reveal that the intentional application of environmental cues helps with losing weight. Thus, environmental cues seem to work both, out of awareness as weight-control primes and over a more conscious way as weight-control reminders. In all, we assume that environmental cues do not work merely through conscious processing. Rather, we presume that in complex, real-world settings, a consciously perceived weight-control reminder helps to initiate the unconscious processes. These then operate in cognitively high-demanding environments (Bargh & Chartrand, 2000; Papies et al., 2014).

The Small Big Change

As the longitudinal study reveals, by intentionally applying environmental cues, high-restrained eaters with their chronic weight-control goal managed to lose approximately 2 kilograms of their weight in half a year. Adults gain on average 0.5 to 1 kilograms per year (Hutfless et. al., 2013). For a typical male, gaining an extra kilogram a year comes from eating 24 calories too much per day (Seeley & Woods, 2003). This is equivalent to about one piece of chocolate from a chocolate bar for dessert each day. When weight-control cues can influence in such tempting situations, in opposition to our "obesogenic" environment (Papies et al., 2014), they can help in preventing obesity (Hill, Wyatt, Reed, & Peters, 2003). For example, dieters can simply pin a picture reminding them

about their weight-control goal on the door of their refrigerator. In this way, dieters can successfully pursue their weight-control or health goals with little effort on their part.

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Appendix Manuscript 4

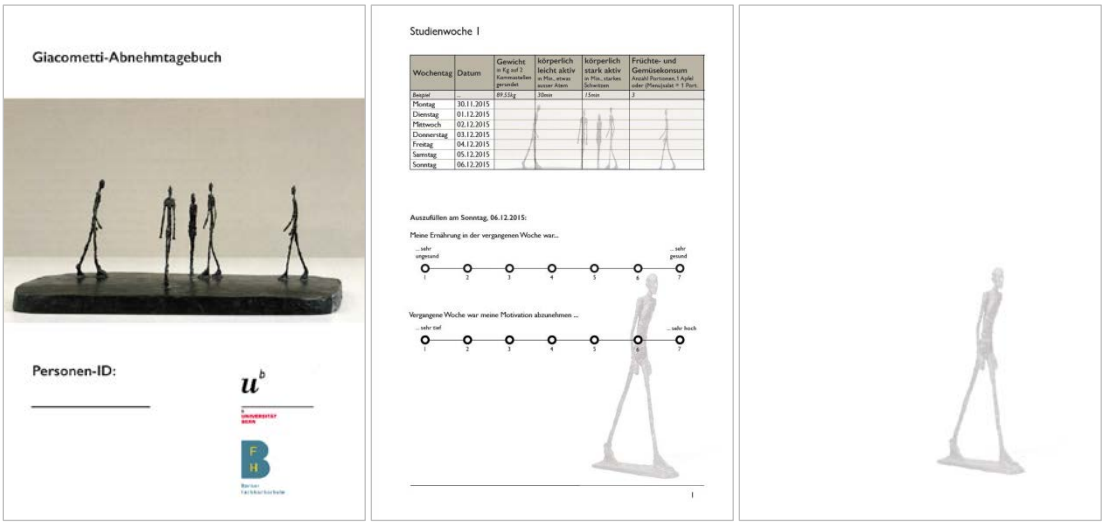


Figure A1. Weight-related Giacometti cue on a diary's cover, as background of a weekly table for data entry, and on the diary's spine (condition Giacometti aware).

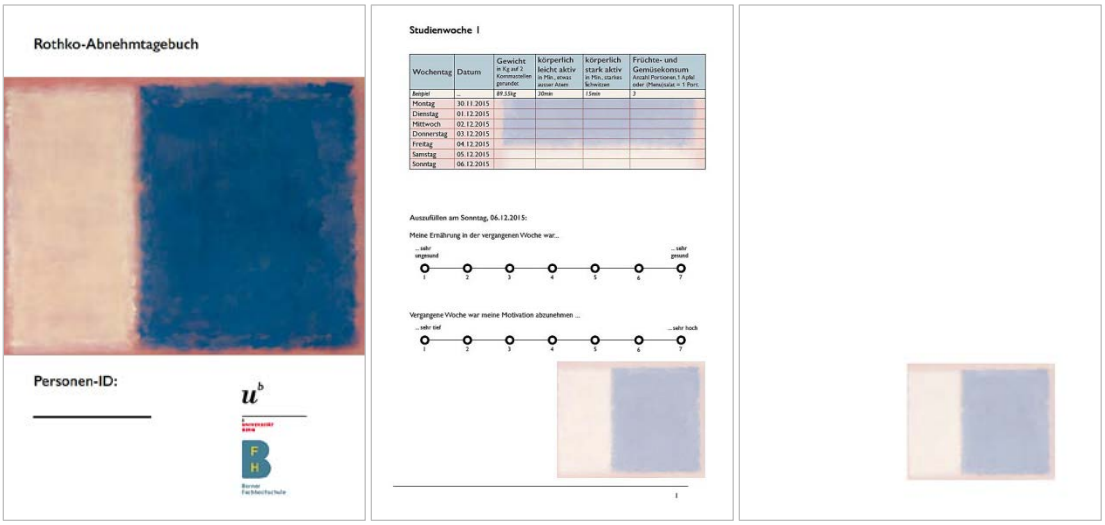


Figure A2. Semantically neutral Rothko cue on a diary's cover, as background of a weekly table for data entry, and on the diary's spine (condition Rothko-aware).

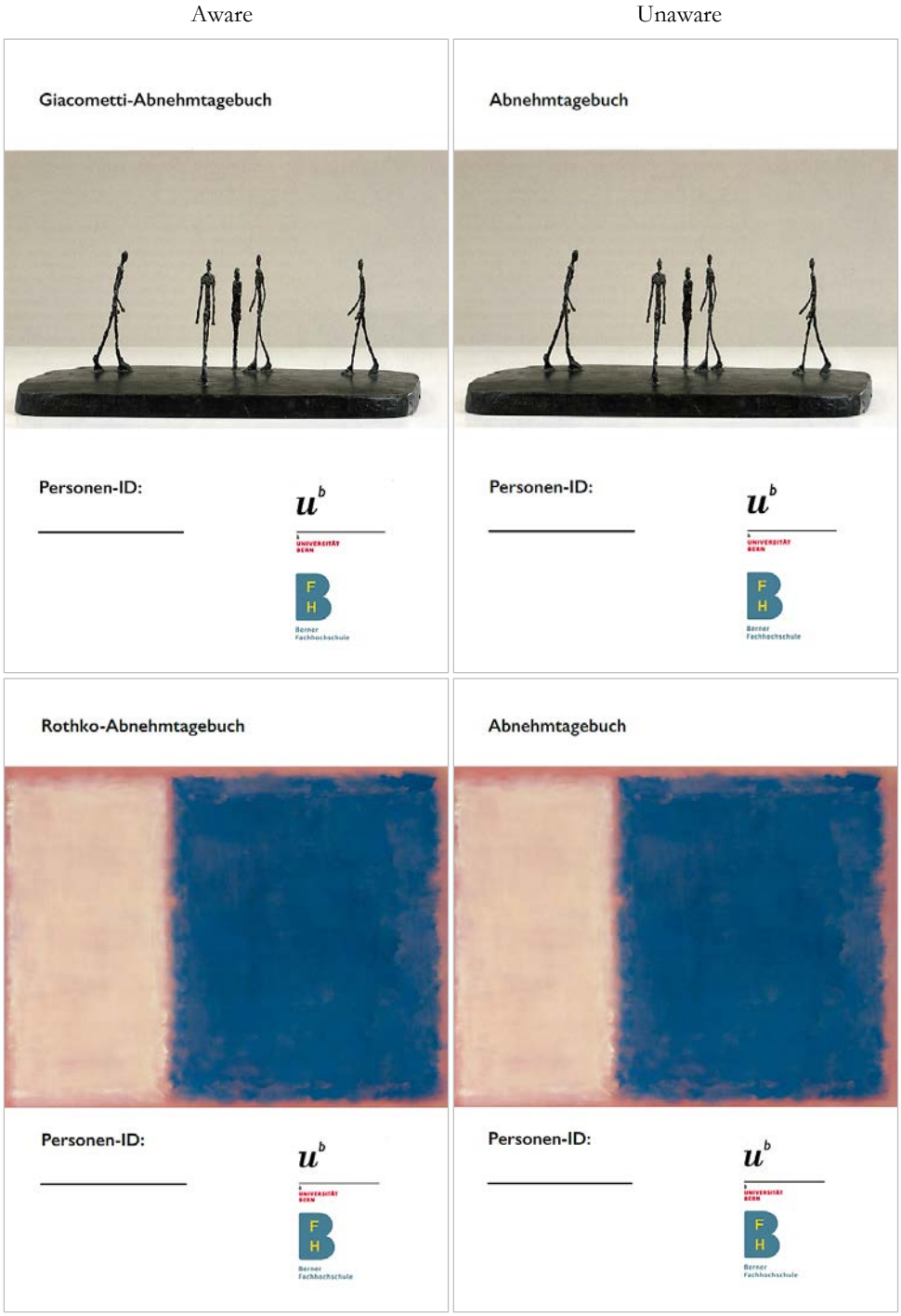


Figure A3. Differences in study materials between awareness and no awareness conditions' cover pages.

Aware

Unaware

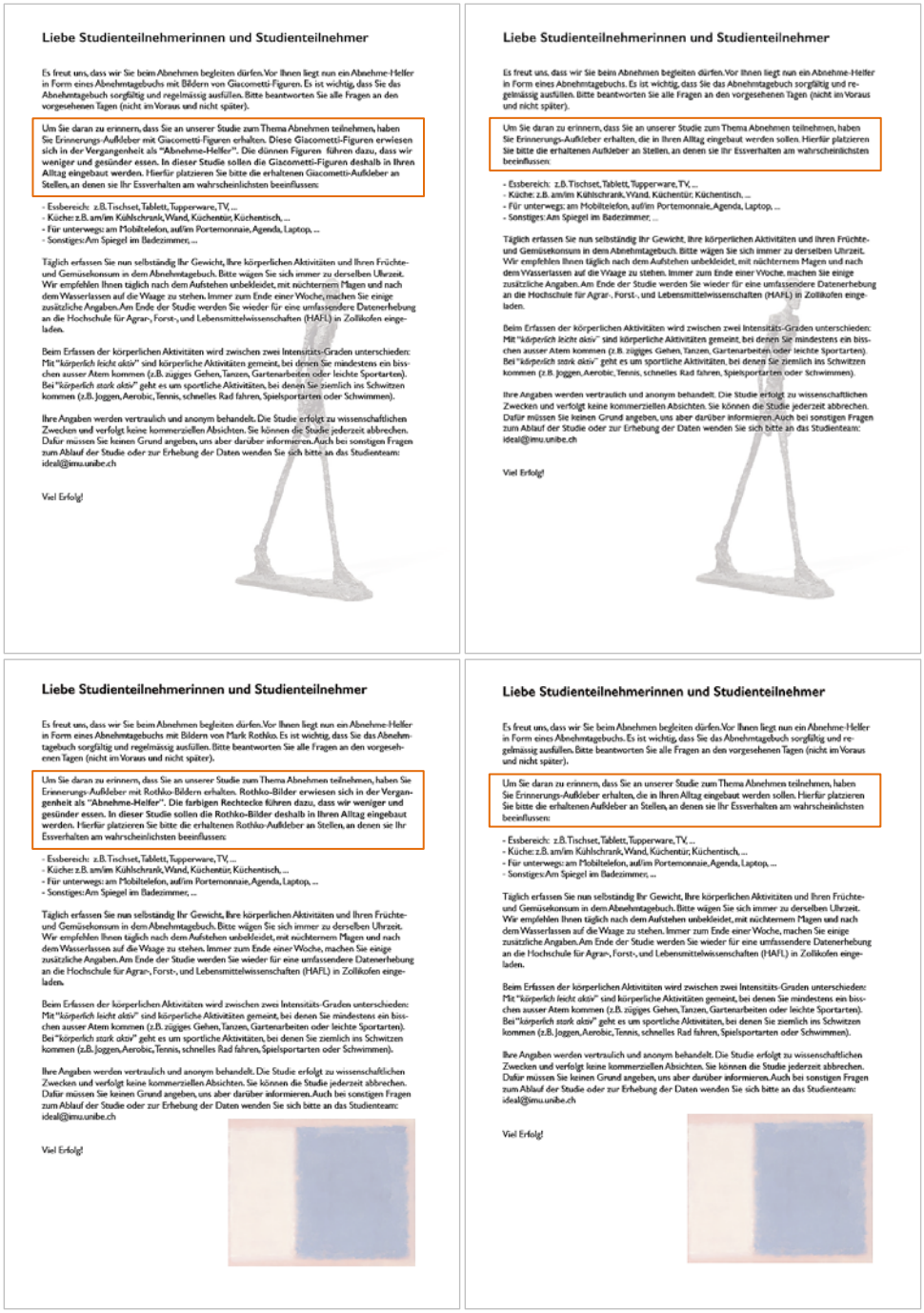


Figure A4. Differences in study materials between awareness and no awareness conditions' introduction pages.

Berner Fachhochschule

UNIVERSITÄT BERN

Einverständniserklärung zur Abnehme-Langzeitstudie IDEAL

Vielen Dank für Ihre Teilnahme an dieser Studie!

Unabhängig davon, wie diese Studie aussieht, sind wir verpflichtet, von unseren Teilnehmer/innen eine Einverständniserklärung in der vorliegenden Art einzuholen.

Zu Beginn und zum Ende der Studie werden Sie an der Berner Fachhochschule HAFL mit einer Analysewaage gewogen (dafür müssen Sie sich barfuss auf die Waage stellen). Zudem wird für diese Studie Ihre Grösse gemessen und Sie füllen an beiden Terminen einen kurzen Fragebogen mit Fragen zu Ihrer Person aus und machen eine Lückenwörter-Aufgabe.

Für die Studie werden Sie während eines halben Jahres jeden Tag bei sich zu Hause selbstständig Ihr Gewicht notieren sowie Ihre körperliche Aktivität und Ihren Früchte- und Gemüsekonsum erfassen. Wöchentlich werden Sie 2 zusätzliche Fragen beantworten. Ihre Aufzeichnungen werden anfangs Studie einmal eingeholt (über E-Mail oder Postweg) sowie zu einem oder zwei späteren Zeitpunkt(en) innerhalb der Studiendauer. Ihre Angaben werden vertraulich und anonym behandelt. Die Daten werden ausschließlich zu Forschungszwecken verwendet.

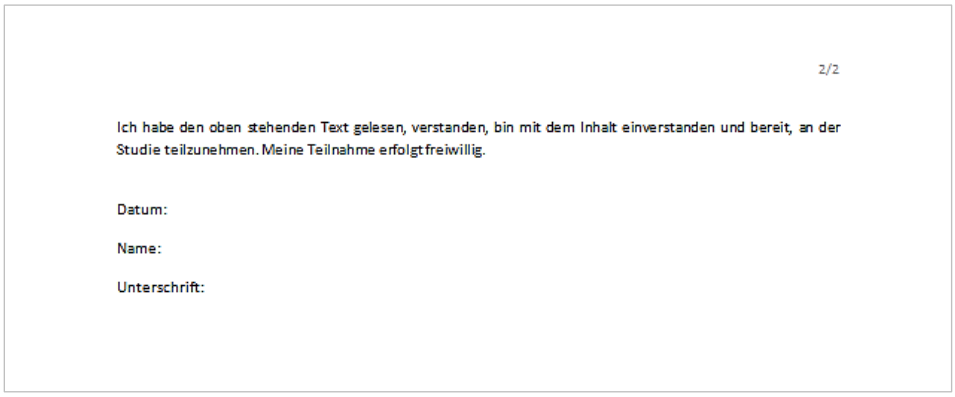
Unsere Dienstleistung beschränkt sich auf die Körperanalyse mit einer Analysewaage zu Beginn und zum Ende der Studie (Körpergewicht, Körperfettanteil, Grundumsatz, Muskelmasse, ...) sowie das Angebot einer Übersicht über den Verlauf des Körpergewichtes während der Studie in Form eines Schlussberichtes. Weitere Dienstleistungen erbringen wir nicht.

Wichtig: Wir beobachten Ihre Gewichtsentwicklung, Ihren Früchte- und Gemüsekonsum sowie Ihre Aktivität während der Studie, sind aber keine Mediziner oder Ernährungsberater. Wir ersetzen keine medizinische Betreuung für das Abnehmen und bieten keine Ernährungsberatung an. Grundsätzlich sollten Abnehmprozesse immer ärztlich begleitet werden. Die Abschätzung darüber, Kontakt zu einem Arzt aufzunehmen, liegt in Ihrer Verantwortung. Nehmen Sie nur an der Studie teil, wenn Sie sich physisch und psychisch dazu in der Lage fühlen. Nehmen Sie nicht teil, wenn medizinische Gründe dagegen sprechen. Wenn Sie im Verlauf der Studie merken, dass die Studie Sie physisch oder psychisch beeinträchtigt oder Sie Fragen haben, melden Sie sich bei uns: ideal@imu.unibe.ch (Aline Stämpfli; Sabrina Stöckli). Sie können die Studie jederzeit abbrechen, ohne Angabe eines Grundes und ohne dass Ihnen ein Nachteil entsteht. Sämtliche Ansprüche, die sich aus physischen oder psychischen Folgen der Studie ergeben, sind ausgeschlossen. Eine Gewichtsreduktion unter das Normalgewicht empfehlen und unterstützen wir nicht. Wir übernehmen keine Garantie dafür, dass Sie während der Studie abnehmen werden.

Bitte tauschen Sie sich nicht mit anderen Teilnehmenden über diese Studie aus. Wir möchten Sie bitten, die Studie sorgfältig durchzuführen.

Wenn Sie Details über die Studie erfahren möchten, geben wir Ihnen nach Abschluss der Studie gerne Auskunft.

Studienverantwortlich: Team IDEAL: Aline Stämpfli und Sabrina Stöckli (Doktorandinnen Universität Bern)
Berner Fachhochschule, Hochschule für Agrar-, Forst- und Lebensmittelwissenschaften HAFL, Food Science & Management
Universität Bern, Institut für Marketing und Unternehmensführung, Abteilung Konsumentenverhalten



2/2

Ich habe den oben stehenden Text gelesen, verstanden, bin mit dem Inhalt einverstanden und bereit, an der Studie teilzunehmen. Meine Teilnahme erfolgt freiwillig.

Datum:

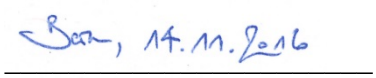
Name:

Unterschrift:

Figure A5. Informed consent form.

Selbständigkeitserklärung

Ich erkläre hiermit, dass ich diese Arbeit selbständig verfasst und keine anderen als die angegebenen Quellen benutzt habe. Alle Koautorenschaften sowie alle Stellen, die wörtlich oder sinngemäss aus Quellen entnommen wurden, habe ich als solche gekennzeichnet. Mir ist bekannt, dass andernfalls der Senat gemäss Artikel 36 Absatz 1 Buchstabe o des Gesetzes vom 5. September 1996 über die Universität zum Entzug des aufgrund dieser Arbeit verliehenen Titels berechtigt ist.



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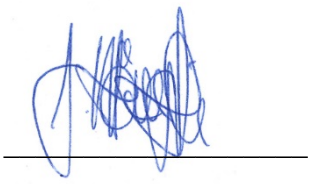

Aline E. Stämpfli