

**The psychology of desire and implications for healthy hydration**

Esther K. Papies

*Institute of Neuroscience and Psychology, University of Glasgow, UK*

**This article is currently in press at *Annals of Nutrition and Metabolism*.**

**Please address correspondence to:**

Esther K. Papies, [esther.papies@glasgow.ac.uk](mailto:esther.papies@glasgow.ac.uk)

Institute of Neuroscience and Psychology, University of Glasgow

62 Hillhead Street, Glasgow G12 8QB, United Kingdom

Phone: +44 141 330 7293

**Disclosure statement:**

E.K.P. received travel expenses and registration fee from Danone Research to attend the 2019 Hydration for Health Scientific Conference, the European Federation of the Associations of Dietitians 2019 Conference, and the 2020 European and International Congress on Obesity (online).

**Ethics statement:**

This article does not report original research, so ethics approval was not required.

### **Abstract**

This article discusses the cognitive mechanisms underlying the motivation to consume sugar-sweetened beverages (SSBs) and outlines implications for developing healthy hydration habits. While the detrimental health consequences of consuming SSBs are well understood, the psychological processes underlying the motivation to consume them are understudied. To address this gap, the current article applies a grounded cognition theory of desire and motivated behavior, which can be used as a framework to understand and potentially change the motivation for SSBs and healthier alternatives, such as water. The grounded cognition theory of desire argues that people represent foods and drinks through potentially rewarding simulations, or re-experiences, of consuming them. These simulations, in turn, can increase desire and motivated behaviour. In line with this theory, research on eating behaviour shows that people think about attractive food in terms of what it feels like to eat it and in terms of relevant eating situations, and that these simulations predict desire to eat. Similarly, emerging research on SSBs shows that people represent these beverages in terms of the sensory and rewarding experiences of drinking them, more so than water, and especially if they consume them often. These simulations in turn predict desire for sugary drinks and actual consumption. This has implications for attempts to increase healthy hydration: in order to facilitate healthy choices, the immediate pleasure to be gained from consuming a healthy beverage should be emphasized, rather than its long-term benefits. Repeatedly facilitating healthy drinks choices in similar situations can ultimately contribute to the development of healthy hydration habits.

**keywords:** SSB, water, cognitive representations, grounded cognition, desire, habits, motivation, health behavior change

### **The psychology of desire and implications for healthy hydration**

The consumption of sugary drinks, or sugar-sweetened beverages (SSBs) is very common, but is associated with a number of negative health consequences. In the US, for example, at least half of adults, and two-thirds of US children and adolescents consume at least one SSB on a given day [1,2]. In addition to negatively affecting dental health [3], this provides a large amount of sugar and discretionary calories. SSB consumption is correlated with body weight and with weight gain over time, and it contributes to the development of metabolic syndrome and Type II diabetes [e.g., 4–6]. Conversely, interventions that successfully reduce SSB intake typically lead to weight loss or the prevention of weight gain [7–9]. In line with these findings, the Dietary Guidelines for Americans advise to consume beverages with no added sugar [10]. Therefore, it is important to understand what motivates SSB consumption, why people choose SSBs over water, and what can be done to support healthier choices.

Little research so far has addressed the question what drives SSB consumption despite the negative health consequences. Among adolescents, SSB consumption is associated with other health behaviours such watching TV, high fast food consumption, and low fruit consumption [11]. Little is known, however, about the psychological factors underlying these associations. Factors like availability and pricing influence SSB consumption [12–15]. The exposure to soda commercials is associated with increased intake [16], whereas beliefs that drinking SSBs is harmful and contributes to weight gain is associated with decreased intake [17]. Qualitative research and surveys have further shown that adolescents and adults report drinking SSBs for their taste [18], because they quench thirst and make them feel healthy [19], and because of convenience and habits [18,20].

These findings suggest that contextual factors as well as positive representations of drinks may play a key role in SSB consumption. However, the research so far has not systematically addressed what these representations are and how they lead to increased intake of sugar-sweetened beverages. In other words, how do people think about sugar-sweetened beverages, and how does this lead to the motivation to consume them? How is desire for SSBs triggered? Only once these mechanisms are well understood can we start designing the most effective interventions to facilitate healthier beverage choices.

Here, we introduce a cognitive science perspective to understand people's cognitive representations of SSBs, and to establish which parts of these representations are associated with desire and with SSB consumption. The remainder of this article will first outline the theoretical rationale for studying cognitive representations of foods and drinks. It will then present relevant findings in the domain of foods and alcoholic drinks, and provide an overview of initial findings in the domain of non-alcoholic drinks, before discussing implications for researchers and health practitioners.

### **A grounded cognition approach to desire**

Why study cognitive representations of foods and drinks? The grounded cognition theory of desire [21,22] suggests that people represent foods and drinks by simulating what it's like to consume them, and that such consumption and reward simulations can lead to desire and motivated behavior. Consumption and reward simulations can be understood as mental re-experiences, or re-enactments, of previous consumption episodes. Based on a grounded cognition framework that has been developed in cognitive science [23], the theory argues that any episode of consuming a food or drink is stored in memory as a rich, multifaceted representation containing information about taste and texture, visual appearance, pleasure, and

other immediate consequences of consuming, as well as information about the external context (e.g., other people present, time setting, location), and internal states (e.g., emotions, goals, bodily states). These representations can later be activated by relevant cues, for example by seeing the food or drink (e.g., an image of a drink in an advertisement), by thinking about a consumption context (e.g., meeting friends), or by the emotional state that one typically consumes it in (e.g., feeling tired after a long day at work). Importantly, the remaining, non-present aspects of the representation can then be filled in and simulated, providing a vivid re-experience of consuming the food or drink. This way, merely seeing a picture of a food, such as a piece of cheesecake, can trigger a rich and compelling simulation of what it would be like to eat it, for example experiencing its fresh and sweet taste, its creamy and crumbly texture, the reward from eating it, and the setting one might enjoy it in. Such simulations can be functional for making food-related decisions, since they provide predictions on anticipated pleasure. At the same time, simulating the consumption and reward of consuming unhealthy foods can also lead to unwanted and potentially unhealthy desires [24].

### **Consumption and reward simulations for food**

Recent research in the domain of food and eating behaviour shows that people experience eating simulations in response to cues of attractive foods, and that these simulations lead to desire. These findings lend support for the key hypotheses of the grounded cognition theory of desire. When asked to “list typical features” of a number of highly attractive and a number of neutral foods [25], participants listed words describing the taste, texture, pleasure, and eating situations associated with the food (e.g., crispy, salty, delicious, TV), but especially for the attractive, tempting foods (e.g., crisps). Neutral foods (e.g., rice) were more likely to be described in terms of visual, production, and health features (e.g., white, long, grows in Asia,

healthy; see Figure 1). This suggests that when people think about attractive foods, they spontaneously think about eating them in a relevant eating situation, and about the sensory aspects of these re-experiences.

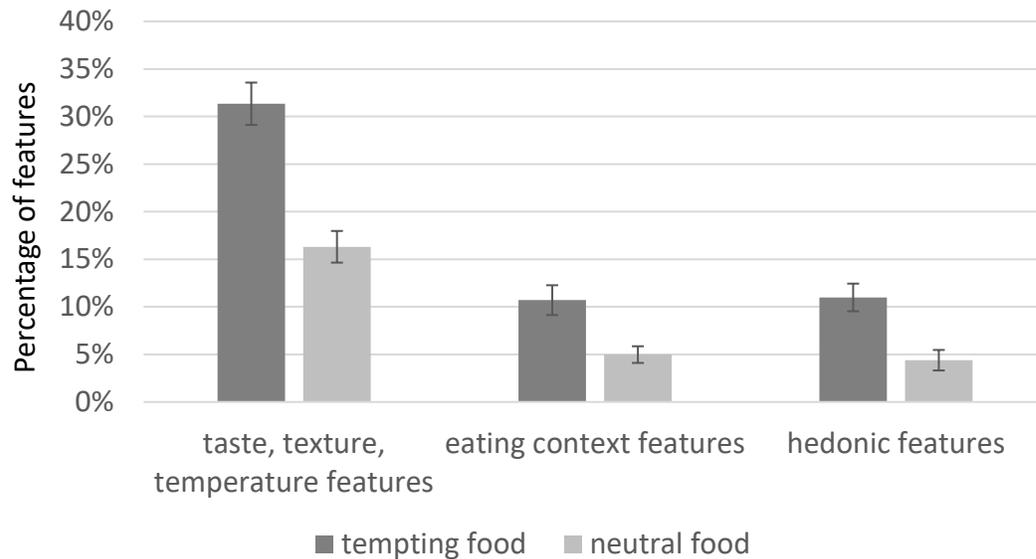


Figure 1: Percentage of eating simulation features out of all features listed for four tempting foods (e.g., crisps, cookies) and four neutral foods (e.g., rice, ). Participants listed a higher percentage of taste (e.g., salty), texture (e.g., crunchy), and temperature features (e.g., warm), eating context features (e.g., Friday, TV), and hedonic features (e.g., delicious) for the tempting compared to the neutral foods. This figure is based on Papies (2013) and reproduced under a Creative Commons Attribution license.

Research on salivary responses to foods corroborates these patterns with different methods, and further shows that eating simulations increase salivation, which may reflect the desire to eat a food. Keesman and colleagues [26] instructed participants in one condition to merely look at a food, and participants in the other condition to vividly simulate eating the food in front of them. For all participants, the amount of saliva produced, as well as self-reported eating simulations were measured. Participants produced more salivation and reported stronger

eating simulations in response to the attractive food (crisps) than compared to the neutral food (bread with cheese). In addition, participants salivated more when instructed to simulate eating the food, and this effect was particularly pronounced when the food was attractive. This suggests that eating simulations can increase desire, especially for attractive food.

Recent work also suggests that increasing eating simulations through highly scaleable means, such as food labels and descriptions, can increase a food's attractiveness. Labeling healthy foods with words that refer to sensory characteristics (e.g., sweet, tangy) increased taste expectations and healthy choices, compared to labeling the same foods with health features [e.g., vitamin-rich, protein-packed; ,27,28]. These effects seem to be driven by increased eating simulations, as was shown in experiments manipulating the labels for meat-based and plant-based foods [29]. Here, food descriptions that contained words referring to sensory, hedonic, or eating context features increased eating simulations and perceived attractiveness of both plant-based and meat-based foods, compared to food descriptions that listed ingredients and visual features [29]. The effects of these simulation-based labels on food attractiveness was mediated by eating simulations ("I imagine what the food would taste and feel like"). Thus, food labels can be designed such that they trigger eating simulations, even for relatively unknown foods, which in turn can increase the attractiveness of a food.

Similar findings have been reported for other scaleable cues that increase consumption simulations. Showing images of a food, for example, in such a way that they facilitate eating simulations (e.g., showing yoghurt or pie with the spoon or fork ready to be picked up by one's dominant hand) has been found to increase desire through increased consumption simulations [30]. Similarly, showing a food (e.g., soup) in a matching eating context (e.g., kitchen) compared to a non-matching context (e.g., cinema) has been found to increase desire and

expected liking through consumption simulations [Papies, van Stekelenburg, Smeets, Zandstra, & Dijksterhuis, unpublished data; see also 31].

### **Consumption and reward simulations for drinks**

What can this approach tell us about why people consume sugary drinks? Research on the desire for drinks has produced initial findings that are consistent with the effects of simulations on desire for foods. As in the domain of food, the general pattern of findings suggests that drinks are represented through consumption and reward simulations, and that these predict desire. Keesman and colleagues [32], for example, again using the feature listing method, found that alcoholic drinks are heavily represented in terms of drinking simulations, and especially in terms of the social context of drinking. The tendency to think about alcohol in terms of social drinking situations was further associated with alcohol cravings, with having intrusive alcohol thoughts in daily life, with finding alcohol highly tempting, and with choosing a voucher for an alcoholic drink over a voucher for a non-alcoholic drink as an additional reward for the study. The same study also assessed representations of sugar-sweetened beverages, and found that these, too, were heavily represented in terms of consumption simulations, especially sensory features (e.g., sweet, cold, sparkling), and more so than water.

In recent, unpublished work, we have focused on gaining a more detailed understanding of these representations of SSBs and water [Papies, Claassen, Ruzs, & Best, unpublished data]. Across several experiments, we found that participants represent SSBs (cola, orange soda) more in terms of consumption and reward simulations than both bottled water and tap water. When describing cola, for example, participants listed words like *cold*, *sweet*, *bubbly*, *nice*, and *delicious*, while they described water in terms of *boring*, *convenient*, *clean*, and *available*. Notably, features describing positive immediate bodily consequences (e.g., *thirst-quenching*)

were more pronounced for water than for sugary drinks. Participants' consumption and reward simulations were associated with the frequency of consuming the drinks in their daily lives, they in turn predicted the desire to drink, and they predicted actual intake when participants were thirsty. The associations of consumption simulations with consumption frequency, desire, and intake were stronger for sugar-sweetened beverages than for water. Notably, consumption and reward simulations predicted desire and intake more than thirst. Furthermore, participants listed very few long-term health consequences for the various drinks (e.g., healthy, unhealthy, high in sugar). Thus, while most participants are probably aware that water is healthier than SSBs, this was not very salient when they freely and spontaneously described the drinks.

These initial findings suggest that when describing beverages, participants simulated drinking them based on their previous consumption experiences, and these simulations predicted desire and intake, especially for sugary drinks. This interpretation is also consistent with neuro-imaging research among adolescents, which shows that tasting cola, as well as merely anticipating tasting it, activated gustatory and reward regions [33]. These neuro-imaging findings thus also suggest that when anticipating the drink, participants spontaneously simulate the taste and pleasure of drinking it.

### **Implications for healthy hydration**

What are the implications of these findings for healthy hydration? How people think about drinks influences their drinking behaviour, and these representations in turn are heavily influenced by previous consumption experiences. Thus, people who frequently consume sugary drinks heavily represent them in terms of how good they taste and feel, which feeds into their desire to consume them again. However, experiences are not the only influence on cognitive representations. Research in the domain of food has shown how language and images can be

used to trigger rewarding consumption simulations even for relatively healthy foods such as yoghurt, vegetable dishes, and fully plant-based meals. Thus, scaleable health communications and advertising can potentially be used to change the cognitive processes influencing desire. Crucially, however, desire is increased by increasing expectations of short-term reward, rather than by focusing on long-term health consequences. Applying this principle to hydration, increasing healthy hydration choices is likely to work better by making healthy drinks seem more rewarding in the moment, compared to emphasizing their purity or long-term health benefits.

Studying cognitive representations also reveals which kinds of product features can be used to boost short-term reward or desire. For some food products [25], for example, rewarding situational cues are very salient (e.g., evening, sofa, TV). For alcoholic drinks, social context cues (Friday, fun, friends) predict desire on a variety of measures [32]. For sugar-sweetened beverages, we found that taste and texture features were more salient in participants' representations than their thirst-quenching properties, whereas the reverse was true for water. In other words, the perceived reward of a drink can come from all kinds of features, not only its taste. Carefully studying cognitive representations of drinks among a specific target group will be helpful for deciding which features to emphasize in order to increase the attractiveness of healthy drinks.

Can this approach be used to create healthier hydration habits? Changing cognitive representations of drinks through external cues, such as in advertising, may increase the chances that people consider healthy alternatives when choosing a drink. To the degree that this leads to a consumption episode that is experienced as pleasant, more rewarding representations of healthy drinks will be consolidated in memory. As a result, rewarding consumption simulations may be

triggered when again encountering the drink later, which in turn will increase the chances of repeated healthy choices. This is crucial to habit formation.

It is important to note, however, that drinking behaviour is highly susceptible to habit formation, not only because it is performed with high frequency, but also because it is performed in a relatively stable context [34], i.e., in very similar situations across each day [35]. Therefore, to make healthy hydration choices habitual, and to effectively counter unhealthy habits, interventions should try to trigger healthy choices with high frequency in several, stable contexts [e.g., always when waking up; at every office lunch; with every cup of coffee; ,35]. Once healthy drinks choices have become habitual through frequent repetition in stable contexts, the emerging habits may also reduce the temptation of sugar-sweetened beverages and therefore make healthier behaviour less effortful in the long-term [35,36].

### **Funding Sources**

The writing of this article was supported by ESRC Research Grant ES/R005419/1.

### **Acknowledgements**

The author is grateful to Maisy Best, Dorottya Rusz, and Lawrence W. Barsalou for useful discussions of the topics of this article.

### **References**

- 1 Rosinger A, Herrick K, Gahche J, Park S. Sugar-sweetened Beverage Consumption Among U.S. Youth, 2011-2014. *NCHS Data Brief*. 2017 Jan;(271):1–8.
- 2 Bleich SN, Vercammen KA, Koma JW, Li Z. Trends in Beverage Consumption Among Children and Adults, 2003-2014. *Obesity*. 2018;26(2):432–41.
- 3 Hasselkvist A, Johansson A, Johansson A-K. Association between soft drink consumption, oral health and some lifestyle factors in Swedish adolescents. *Acta Odontol Scand*. 2014 Nov;72(8):1039–46.
- 4 Cantoral A, Téllez-Rojo MM, Ettinger AS, Hu H, Hernández-Ávila M, Peterson K. Early introduction and cumulative consumption of sugar-sweetened beverages during the pre-school period and risk of obesity at 8–14 years of age. *Pediatr Obes*. 2016;11(1):68–74.
- 5 Pan A, Malik VS, Hao T, Willett WC, Mozaffarian D, Hu FB. Changes in water and beverage intake and long-term weight changes: results from three prospective cohort studies. *Int J Obes*. 2013 Oct;37(10):1378–85.
- 6 Deshpande G, Mapanga RF, Essop MF. Frequent Sugar-Sweetened Beverage Consumption and the Onset of Cardiometabolic Diseases: Cause for Concern? *J Endocr Soc*. 2017 Nov;1(11):1372–85.
- 7 Chen L, Appel LJ, Loria C, Lin P-H, Champagne CM, Elmer PJ, et al. Reduction in consumption of sugar-sweetened beverages is associated with weight loss: the PREMIER trial. *Am J Clin Nutr*. 2009 May;89(5):1299–306.
- 8 Duffey KJ, Poti J. Modeling the Effect of Replacing Sugar-Sweetened Beverage Consumption with Water on Energy Intake, HBI Score, and Obesity Prevalence. *Nutrients*. 2016 Jul;8(7):395.
- 9 Tate DF, Turner-McGrievy G, Lyons E, Stevens J, Erickson K, Polzien K, et al. Replacing caloric beverages with water or diet beverages for weight loss in adults: main results of the Choose Healthy Options Consciously Everyday (CHOICE) randomized clinical trial. *Am J Clin Nutr*. 2012 Mar;95(3):555–63.

- 10 McGuire S. Scientific Report of the 2015 Dietary Guidelines Advisory Committee. Washington, DC: US Departments of Agriculture and Health and Human Services, 2015. *Adv Nutr.* 2016 Jan;7(1):202–4.
- 11 Scully M, Morley B, Niven P, Crawford D, Pratt IS, Wakefield M. Factors associated with high consumption of soft drinks among Australian secondary-school students. *Public Health Nutr.* 2017 Sep;20(13):2340–8.
- 12 Rauzon S, Randel-Schreiber H, Kuo E, Schwartz P, Reed AL, Thompson HR. The association between sugar-sweetened beverage availability in school vending machines and school staff sugar-sweetened beverage consumption. *Prev Med Rep.* 2020 Sep;19:101128.
- 13 Teng AM, Jones AC, Mizdrak A, Signal L, Genç M, Wilson N. Impact of sugar-sweetened beverage taxes on purchases and dietary intake: Systematic review and meta-analysis. *Obes Rev Off J Int Assoc Study Obes.* 2019;20(9):1187–204.
- 14 Bogart LM, Elliott MN, Ober AJ, Klein DJ, Hawes-Dawson J, Cowgill BO, et al. Home Sweet Home: Parent and Home Environmental Factors in Adolescent Consumption of Sugar-Sweetened Beverages. *Acad Pediatr.* 2017 Jul;17(5):529–36.
- 15 Ennis K, Holt A, Cheater S. Sugar-sweetened beverages: availability and purchasing behaviour within the school fringe. *Int J Health Promot Educ.* 2014 Sep;52(5):300–12.
- 16 Koordeman R, Anschutz DJ, van Baaren RB, Engels RCME. Exposure to soda commercials affects sugar-sweetened soda consumption in young women. An observational experimental study. *Appetite.* 2010 Jun;54(3):619–22.
- 17 Zoellner J, Estabrooks PA, Davy BM, Chen Y-C (Yvonne), You W. Exploring the Theory of Planned Behavior to Explain Sugar-sweetened Beverage Consumption. *J Nutr Educ Behav.* 2012 Mar;44(2):172–7.
- 18 Zoellner J, Krzeski E, Harden S, Cook E, Allen K, Estabrooks PA. Qualitative Application of the Theory of Planned Behavior to Understand Beverage Consumption Behaviors among Adults. *J Acad Nutr Diet.* 2012 Nov;112(11):1774–84.
- 19 Kassem NO, Lee JW. Understanding Soft Drink Consumption Among Male Adolescents Using the Theory of Planned Behavior. *J Behav Med.* 2004 Jun;27(3):273–96.
- 20 Tak NI, Te Velde SJ, Oenema A, Van der Horst K, Timperio A, Crawford D, et al. The association between home environmental variables and soft drink consumption among adolescents. Exploration of mediation by individual cognitions and habit strength. *Appetite.* 2011 Apr;56(2):503–10.
- 21 Papies EK, Best M, Gelibter E, Barsalou LW. The Role of Simulations in Consumer Experiences and Behavior: Insights from the Grounded Cognition Theory of Desire. *J Assoc Consum Res.* 2017 Sep;2(4):402–18.

- 22 Papies EK, Barsalou LW. Grounding Desire and Motivated Behavior: A theoretical framework and review of empirical evidence. *The Psychology of Desire*. New York, NY, US: Guilford Press; 2015; pp 36–60.
- 23 Barsalou LW. Simulation, situated conceptualization, and prediction. *Philos Trans R Soc B Biol Sci*. 2009 May;364(1521):1281–9.
- 24 Papies EK, Barsalou LW, Ruzs D. Understanding desire for food and drink: A grounded cognition approach. *Curr Dir Psychol Sci*. 2020;(in press). DOI: 10.31219/osf.io/478qy
- 25 Papies EK. Tempting food words activate eating simulations. *Front Psychol*. 2013;4:838.
- 26 Keesman M, Aarts H, Vermeent S, Häfner M, Papies EK. Consumption Simulations Induce Salivation to Food Cues. *PLOS ONE*. 2016 Nov;11(11):e0165449.
- 27 Turnwald BP, Boles DZ, Crum AJ. Association Between Indulgent Descriptions and Vegetable Consumption: Twisted Carrots and Dynamite Beets. *JAMA Intern Med*. 2017 Aug;177(8):1216–8.
- 28 Turnwald BP, Crum AJ. Smart food policy for healthy food labeling: Leading with taste, not healthiness, to shift consumption and enjoyment of healthy foods. *Prev Med*. 2019 Feb;119:7–13.
- 29 Papies EK, Johannes N, Daneva T, Semyte G, Kauhanen L-L. Using consumption and reward simulations to increase the appeal of plant-based foods. *Appetite*. 2020 Dec;155:104812.
- 30 Elder RS, Krishna A. The “Visual Depiction Effect” in Advertising: Facilitating Embodied Mental Simulation through Product Orientation. *J Consum Res*. 2012 Apr;38(6):988–1003.
- 31 Hildebrand D, Harding RD, Hadi R. Culturally Contingent Cravings: How Holistic Thinking Influences Consumer Responses to Food Appeals. *J Consum Psychol*. 2019;29(1):39–59.
- 32 Keesman M, Aarts H, Ostafin BD, Verwei S, Häfner M, Papies EK. Alcohol representations are socially situated: An investigation of beverage representations by using a property generation task. *Appetite*. 2018 Jan;120:654–65.
- 33 Burger KS, Stice E. Neural responsivity during soft drink intake, anticipation, and advertisement exposure in habitually consuming youth. *Obesity*. 2014 Feb;22(2):441–50.
- 34 Ouellette JA, Wood W. Habit and intention in everyday life: The multiple processes by which past behavior predicts future behavior. *Psychol Bull*. 1998 Jul;124(1):54–74.
- 35 Rodger A, Wehbe L, Papies EK. “I know it’s just pouring it from the tap, but it’s not easy”: Motivational processes that underlie water drinking. *Rev*. 2020 Available from: <https://psyarxiv.com/grndz>

- 36 Galla BM, Duckworth AL. More than resisting temptation: Beneficial habits mediate the relationship between self-control and positive life outcomes. *J Pers Soc Psychol.* 2015 Sep;109(3):508–25.

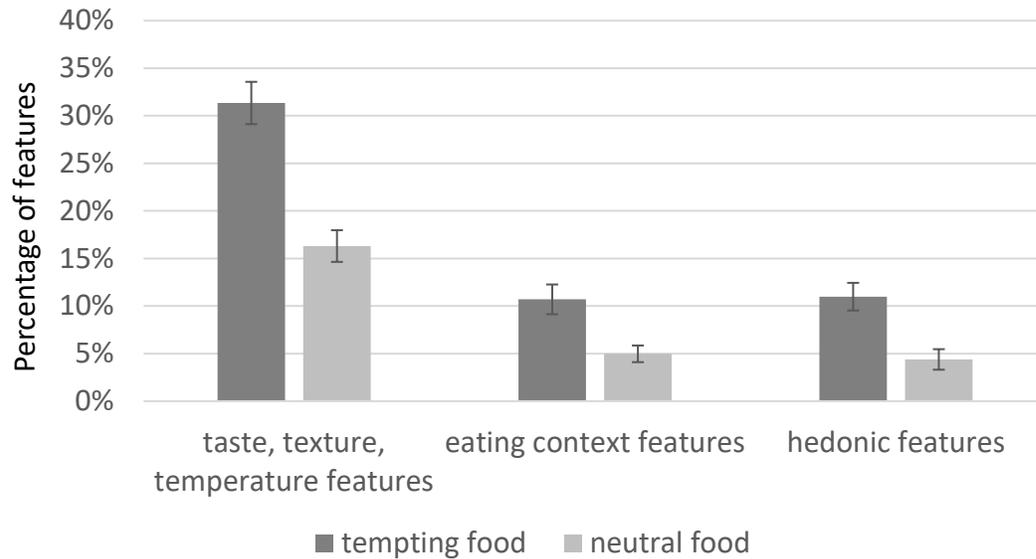


Figure 1: Percentage of eating simulation features out of all features listed for four tempting foods (e.g., crisps, cookies) and four neutral foods (e.g., rice, ). Participants listed a higher percentage of taste (e.g., salty), texture (e.g., crunchy), and temperature features (e.g., warm), eating context features (e.g., Friday, TV), and hedonic features (e.g., delicious) for the tempting compared to the neutral foods. This figure is based on Papies (2013) and reproduced under a Creative Commons Attribution license.