

# Food as Fuel: Performance Goals Increase the Consumption of High-Calorie Foods at the Expense of Good Nutrition

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At work, at school, at the gym club, or even at home, consumers often face challenging situations in which they are motivated to perform their best. **This research demonstrates that activating performance goals, whether in cognitive or physical domains, leads to an increase in the consumption of high-calorie foods at the expense of good nutrition.** This effect derives from beliefs that the function of food is to provide energy for the body (food as fuel) coupled with poor nutrition literacy, leading consumers to overgeneralize the instrumental role of calories for performance. Indeed, nutrition experts choose very different foods (lower in calorie, higher in nutritional value) than lay consumers in response to performance goals. Also, performance goals no longer increase calorie intake when emphasizing the hedonic function of food (food for pleasure). **Hence, while consumer research often interprets the overconsumption of pleasurable and unhealthy high-calorie foods as a consequence of hedonic goals and self-control failures, our research suggests that this overconsumption may also be explained by a maladaptive motivation to manage energy intake.**

**Keywords:** lay beliefs, performance, goals, food consumption, health, nutrition

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At work, at school, at the gym club, or even at home, people often face challenging situations in which they are motivated to do their best. “Performing” has become a constant concern for individuals even at an early age (Ehrenberg 1994), and social incentives to be competitive are ubiquitous in modern societies (Kohn 1992). In this research, we investigate the impact of performance goals on behavior, in a particularly important domain for consumers’ health and well-being: food consumption. While foods high in calorie, sugar, and fat are traditionally portrayed as unhealthy indulgences, we posit that they can also be perceived by consumers as energy, or “fuel” for the body, and believed to help achieve performance goals. In seven correlational and experimental studies involving participants from various food cultures (France, the United States, Canada), we show that performance goals (whether in physical or cognitive domains) increase intended or actual intake of high-calorie foods.

Assuredly, food provides energy that can be instrumental for task performance. However, utilizing food as a

means for performance requires specific knowledge in nutrition, namely that “healthy,” nutrient-rich foods may improve body function, while high-calorie, nutrient-poor snack foods are very unlikely to reach that aim; they may even impede performance in addition to their long-term negative impact on health. Yet, most consumers lack nutrition expertise and largely generalize the role of calories for performance (more food calories = more body energy), ignoring nutritional quality. Hence, we demonstrate that while lay consumers select high-calorie snacks at the expense of good nutrition in response to performance goals, nutrition experts select very different foods (lower in calorie, higher in nutrition) in response to the same goals.

Importantly, we also demonstrate that performance goals impact food consumption or selection, especially among consumers who believe that the main function of food is to provide energy for the body. This suggests that the impact of performance goals on consumption is due to the perceived instrumentality of food for performance and is unrelated to hedonic goals. In fact, emphasizing the hedonic function of food in marketing communication (thus making food appear less instrumental for performance) decreases the effect of performance goals on food selection.

From a theoretical perspective, our research contrasts with dominant theories in nutrition and consumer research, according to which the overconsumption of high-calorie, unhealthy foods is mainly a consequence of hedonic goals and self-control failures (Shiv and Fedorikhin 1999; Stroebe et al. 2013). Instead, our findings suggest that unhealthy eating may also result from a maladaptive motivation to manage energy intake. Our findings also extend past research on environmental factors (such as factors signaling resource scarcity) that motivate consumers to seek energy from food (Briers and Laporte 2013; Laran and Salerno 2013). To the best of our knowledge, this research is the first to examine the effect of performance goals—which are pervasive in modern environments—on food consumption.

From a more practical standpoint, our findings bring an important caution against traditional dietary guidelines that invite consumers to modulate their food consumption in response to fluctuating energy needs (USDA 2015). Although these guidelines make perfect sense, they require a certain expertise—that consumers lack—about which foods bring energy to support performance. Our research also suggests that food marketers may take advantage of (and have certainly contributed to) consumers’ generalization of the energetic role of calories, thus increasing the acceptability of high-calorie snacks. Our research should also appeal to policy-makers who design health prevention messages and nutrition education programs.

## CONCEPTUAL BACKGROUND

### Energy Regulation in Today’s Food Environment

Early research on eating behavior has predominantly focused on the concept of homeostatic energy regulation (Mayer and Thomas 1967; Woods et al. 1998). According to this homeostatic model, meal onset and meal termination are triggered by internal, bodily signals indicating energy needs: people feel hungry and start eating when available energy in the body falls to a threshold value, and they feel satiated and stop eating when energy levels are sufficiently replenished.

However, this homeostatic model has struggled to account for the unregulated consumption of excess calories that has led to the obesity crisis over the past 30 years. In today’s eating environment, where people have access to affordable high-calorie foods, eating behavior is hardly determined by internal signals indicating energy needs: it is driven by desire rather than need for calories (Berthoud 2004; Herman and Polivy 1983; Wansink and Chandon 2014). Hence, the overconsumption of high-calorie foods is typically interpreted in terms of self-control failure, whereby hedonic goals (or the anticipated pleasure of eating indulgent foods) inhibit weight control goals (Papies, Stroebe, and Aarts 2007; Shiv and Fedorikhin 1999; Stroebe et al. 2013). This is called the “hedonic” model of food intake.

So, is the concept of energy regulation still relevant in today’s eating environment? We believe that it is. Historically, humans have evolved in environments where food was scarce and the storage of excess calories as fat was essential for survival. Today, consumers still associate calorie intake with survival in harsh environments. Indeed, studies have shown that the presence of cues indicating harshness (e.g., news about economic crisis) increases the desirability of calorie-rich foods (Briers and Laporte 2013; Briers et al. 2006; Laran and Salerno 2013; Swaffield and Roberts 2015). In other words, goals of energy storage are not necessarily triggered by bodily signals but can be activated by environmental cues.

In this research, we further investigate conditions under which consumers can be externally motivated to manage their energy intake. We argue that consumers may be motivated to increase their consumption of calories when they are pursuing performance goals; this motivation can be maladaptive, with adverse consequences for health.

### The Energetic Function of Food: From Scientific Evidence to Lay Beliefs

While consumer research has mostly studied food perceptions in terms of pleasure and health, consumers may also portray food as a source of energy, or “food as fuel.” In an attempt to identify which functions food is believed to fulfill, Fischler and Masson (2008) conducted a series of

qualitative and quantitative studies in different countries, asking participants to generate or select metaphors that best describe the relationship between the human body and food. These studies unveiled heterogeneous perceived bodily functions of food: for instance, the “body as a car” metaphor (the body needs food to move around and function, just like a car needs fuel) reflected an energetic function of food, while the “body as a temple” metaphor (the body needs to be respected and protected in the process of eating) reflected a protective function of food. Still, in most surveyed countries, a majority of participants selected metaphors illustrating the energetic function of food, such as “body as a car” or “body as a factory.”

Assuredly, from a nutritional perspective, food *does* provide energy for the body and food consumption may be modulated in response to fluctuating energy needs, whether in cognitive or physical domains (USDA 2015). However, when the environment signals a higher need for energy, specific knowledge in nutrition is necessary to select the “right” kind of food. Here, it is necessary to distinguish scientific from lay perspectives.

From a scientific perspective, the human body is more complex than a car: while a car needs one type of fuel, the body requires various macronutrients (Frayn and Akanji 2011). In preparation for challenging physical activities—in intensity or endurance—there is a consensus that natural carbohydrates may be effective fuel sources: the consumption of fruits, vegetables, or whole grain (i.e., unprocessed high-carb foods, rich in nutrients, and with a low glycemic index) is generally encouraged (ACSM and ADA 2000; Donaldson, Perry, and Rose 2010; Ivy 1994; Spring, Pingitore, and Schoenfeld 1994; Stellingwerff and Cox 2014). Studies on cognitive performance (e.g., memory, attention, vigilance) have yielded mixed findings about the impact of food intake; still, natural carbohydrates are also generally recommended (Dye, Lluch, and Blundell 2000; Gibson 2007; Gilsenan, de Bruin, and Dye 2009; Hoyland, Dye, and Lawton 2009; Lieberman 2003; Wolraich, Wilson, and White 1995).

Whether it is for physical or cognitive performance, nutrition research recommends avoiding foods that are processed, high in calorie, fat, and refined sugar, and nutrient poor, such as candy, chips, cookies, or chocolate bars. Refined sugar increases food’s glycemic index and causes quick spikes and crashes in blood sugar, with potential negative effects on concentration and performance, while fat can cause gastrointestinal distress and sluggishness (ACSM and ADA 2000; Francis and Stevenson 2011; Lloyd, Green, and Rogers 1994; Spring et al. 1994). Several studies (mostly correlational) also found that consuming processed, high-calorie foods is associated with cognitive impairment (Beilharz, Maniam, and Morris 2015).

To complement this brief literature review, we conducted 16 qualitative interviews of Registered Dietitians

(RDs) in Canada and the United States (see [web Appendix A](#) for interview transcripts). We asked them which foods they would recommend or avoid prior to engaging in challenging cognitive or physical tasks. Although there was some heterogeneity in responses regarding proteins and fibers, the RDs’ responses largely corroborated the recommendations that we found in the nutrition literature. All 16 RDs promptly recommended “healthy,” unprocessed carbohydrates (fruits, vegetables, whole grain) as potentially effective fuel sources, and almost all of them (14 out of 16) suggested avoiding processed foods, high in calories from fat and/or refined sugar. Most RDs provided similar recommendations for cognitive and physical activities.

While nutrition research suggests that energy largely derives from eating foods with high nutritional quality, rather than from maximizing calorie intake, we contend that lay consumers do not discriminate across sources of calories and largely generalize the role of calories for performance. According to anthropologist Annemarie Mol (2013), in people’s mind, there is a direct quantification of body energy in terms of calories, which may lead to believing that more calories necessarily bring more body energy. Research in food sociology also points out mental associations between high-calorie snack foods and strength (Heisley 1991; Wandel and Roos 2005). Advertising campaigns also build upon the idea that high-calorie snacks like chocolate bars provide energy for the body and the brain and help achieve exceptional performance in sports, at school, or at work (Barthes 1997; Folta et al. 2006; Roberts and Pettigrew 2007). Accordingly, a study showed that, of 62 food products endorsed by athletes in advertising, 79% were calorie-dense and nutrient-poor snacks (Bragg et al. 2013).

In summary, food is a source of energy, but maximizing calorie intake without being selective about nutritional quality will *not* boost performance—it may even be detrimental in the case of highly processed, high-calorie, nutrition-poor foods. Yet, we contend that consumers generalize the role of calories for performance, such that performance goals may have a maladaptive effect on food intake and increase calorie intake at the expense of good nutrition.

## The Current Research: The Impact of Performance Goals on Food Consumption

Performance goals are defined as future-focused mental representations that guide behavior to a competence-related end state (Hulleman et al. 2010). While mastery goals focus on the development of a competence over time through learning or practice, performance goals motivate people to demonstrate physical or cognitive ability and to outperform others (Ames and Archer 1987). While past research has focused on the impact of performance goals on actual task performance (Elliot and Harackiewicz 1996;

Stajkovic, Locke, and Blair 2006), little is known about their impact on consumption, and in particular, food consumption. Somehow related to the concept of performance, research has shown that exposure to messages related to exercising influences food consumption, although the direction of this effect is unclear. Some studies have shown a decrease in calorie intake following exposure to exercising messages, presumably because of activated health goals (van Kleef, Shimizu, and Wansink 2011), while other studies have shown an increase in calorie intake, presumably because thinking about exercising activates reward seeking (Werle, Wansink, and Payne 2011). In any case, these studies have not specifically investigated the role of performance goals.

Our central hypothesis is that performance goals (in physical or cognitive domains) will increase consumption of, or preference for high-calorie foods, even if these foods have poor nutritional quality. This hypothesis follows from anthropological and sociological research suggesting that, in consumers' mind, there is a direct quantification of body energy in terms of calories (Mol 2013) and that processed foods high in calorie, fat, and added sugar are believed to provide strength and energy (Barthes 1997; Folta et al. 2006; Heisley 1991; Roberts and Pettigrew 2007; Wandel and Roos 2005).

**H1:** Performance goals increase consumption of, or preference for, high-calorie, nutrition-poor foods.

While high-calorie, unhealthy foods are typically consumed for their hedonic value (Raghunathan, Naylor, and Hoyer 2006; Shiv and Fedorikhin 1999), our proposed mechanism is *not* related to hedonic goals, but rather to the perceived instrumentality of high-calorie foods for achieving performance goals. To provide the evidence of this mechanism, we rely on Fischler and Masson's (2008) research on heterogeneous beliefs about the predominant function of food. We hypothesize that the effect of performance goals on food consumption should especially occur among consumers believing that the main function of food is to provide energy for the body (energetic function of food), as they should be more likely to construe high-calorie foods as a means to reach performance goals. In contrast, this effect should be mitigated among consumers with other beliefs, such as beliefs that the main function of food is to guarantee good health (protective function of food), or to offer pleasurable sensory experiences (hedonic function of food; Cornil and Chandon 2016b).

**H2a:** The effect of performance goals on food intake or preference occurs especially among individuals for whom the function of food is predominantly energetic (vs. protective or hedonic).

Directly following from hypothesis 2a, we further propose that emphasizing the hedonic function of food in marketing communication should decrease the impact of

performance goals on consumption. This hypothesis is consistent with research showing that activating a goal increases preferences for means—or instruments—related to the goal (Van Osselaer and Janiszewski 2012), and conversely, leads to devalue unrelated means (Brendl, Markman, and Messner 2003). Thus, emphasizing the hedonic function of a food should hinder its energetic function and reduce its perceived instrumentality for performance goals. This hypothesis is also important to further rule out alternative explanations related to hedonic goals.

**H2b:** Emphasizing food's hedonic function in marketing communication decreases the effect of performance goals on food consumption or preference.

Importantly, while it is true that food fulfills energetic functions, utilizing food as a means for achieving performance requires specific knowledge of nutrition. In reality, the nutritional quality of a food is more important than its calorie content: nutrient-rich foods (in particular healthy carbohydrates, such as fruits) may provide energy for performance, while high-calorie, nutrient-poor, processed snack foods may be detrimental for performance—and also for health in the long run. We thus hypothesize that the effect of performance goals on the choice of high-calorie, nutrition-poor foods is moderated (and potentially reversed) by nutrition expertise. This is in line with research showing that nutrition expertise predicts a higher adherence to dietary guidelines (Wardle, Parmenter, and Waller 2000).

**H3:** Nutrition experts (vs. non-experts) select foods lower in calorie and higher in nutritional value in response to performance goals.

## OVERVIEW OF THE STUDIES

We test our hypotheses in seven studies with participants from various countries (France, Canada, the United States) and socioeconomic backgrounds. Two pilot studies showed a correlation between the specific belief that task performance depends on food consumption, and the consumption frequency of high-calorie, nutrition-poor foods. In laboratory experiments, activating performance goals in cognitive (study 1) and physical domains (study 2) led to an increased consumption of high-calorie, nutrition-poor snacks, especially among participants for whom the function of food is predominantly energetic. In subsequent online experiments, performance goals increased the intended consumption of high-calorie, nutrient-poor foods at the expense of lower-calorie, nutrient-rich foods among participants primed to elaborate on the energetic function of food (study 3); this effect was also neutralized when marketing communication emphasizes the hedonic function of food (study 4). We also find that nutrition experts (vs. non-



experts) select foods lower in calorie and higher in nutritional quality in response to performance goals (study 5).

## PILOT STUDY 1

### Method

We recruited 306 French participants (53% females; mean age = 40.04, SD = 16.41) through a panel managed by a market research institute. They completed a food frequency questionnaire (Cade et al. 2004), requiring them to report how often they had consumed each of 21 foods over the last 6 months from 1 (one time or less per week) to 5 (five times or more per week).

We then administered a seven-item scale measuring the specific belief that task performance depends on food consumption (e.g., “Task performance depends a lot on what one has eaten before,” “In order to perform well at a task, it is better to eat well beforehand”; see web appendix B), rated from 1 (strongly disagree) to 7 (strongly agree). This scale was created by our research team; a pretest with 210 participants showed that it was unidimensional and reliable.

We also distributed the Dutch Eating Behavior Questionnaire (van Strien et al. 1986) measuring External Eating (eating in response to pleasant food stimuli), Emotional Eating (eating in response to arousal states such as anger, fear, or anxiety), and Restrained Eating (restrictive control over food intake). We collected self-reported height and weight to compute participants’ body mass index (BMI). BMI was uncorrelated with the scale measuring the belief that performance depends on food consumption; we return to this point in the General Discussion.

### Results

A factor analysis of the 21 foods of the food frequency questionnaire yielded five distinct factors that we labeled *high-calorie Snacks* (e.g., chocolate, cookies, pastry, ice-cream;  $\alpha = .75$ ); *prepared and fast meals* (e.g., pizza, sandwich;  $\alpha = .73$ ); *fruits, veggies, and yogurt* ( $\alpha = .69$ ); *meats, eggs and pasta* ( $\alpha = .64$ ); and *“French” snacks* (cheese, charcuterie, bread;  $\alpha = .57$ ). We created five indexes by averaging the consumption frequency of the foods that loaded each of the five factors. The *high-calorie snacks* factor was the most calorie dense (360 cal. per 100 grams on average), the highest in added sugar (29 grams per 100 grams), and the second highest in saturated fat (7 grams per 100 grams), indicative of poor nutritive quality (see web appendix C for details).

We performed a multivariate linear regression of the five consumption indexes on the scale measuring the belief that performance depends on food consumption ( $\alpha = .84$ ). This belief was the most strongly associated with the consumption frequency of *high-calorie snacks* ( $b = .18$ ,  $t(304) = 3.78$ ,  $p < .001$ ,  $\eta^2_p = .05$ ). The associations between the

belief and the other consumption indexes were weaker and non-significant (*prepared and fast meals*:  $b = .06$ ,  $t(304) = 1.45$ ,  $p = .15$ ; *fruits, veggies, yogurt*:  $b = .09$ ,  $t(304) = 1.28$ ,  $p = .20$ ; *meats, eggs, and pasta*:  $b = .09$ ,  $t(304) = 1.76$ ,  $p = .08$ ; and *“French” snacks*:  $b = .08$ ,  $t(304) = 1.35$ ,  $p = .18$ ). These results were robust when controlling for external, emotional, and restrained eating; in particular, the “food for performance” belief still predicted a higher consumption frequency of *high-calorie snacks* ( $b = .15$ ;  $t(301) = 3.15$ ,  $p = .002$ ,  $\eta^2_p = .03$ ).

## PILOT STUDY 2

The first pilot study showed that in a sample of French participants, the specific belief that task performance depends on food consumption is associated with a higher consumption frequency of foods high in calorie and low in nutritional quality. The second pilot study aims to demonstrate the cross-cultural consistency of this association among US participants.

Arguably, the belief that task performance depends on food consumption derives from more general beliefs about the function of food as an energy source. Hence the second pilot study also aims to provide preliminary correlational evidence supporting our hypotheses that performance goals increase high-calorie consumption—at the expense of good nutrition—among consumers for whom the function of food is predominantly energetic (hypotheses 1 and 2a).

### Method

We recruited 321 US participants on Amazon Mechanical Turk (MTurk; 52.3% females, mean age = 34.18, SD = 11.08). For all studies conducted on MTurk and reported in this article, we used the Turkprime platform (Litman, Robinson, and Abberbock 2017) to improve the data collection quality (see web appendix D for specification details).

Participants completed a shorter version of the food frequency questionnaire (only eight foods) and the scale measuring the specific belief that task performance depends on food intake.

Then, we measured participants’ general belief about the energetic function of food with one item inspired by Fischler and Masson’s (2008) research. Participants evaluated how personally relevant (from 1—totally irrelevant to 7—totally relevant) they found the following metaphor describing the human body and its relation to food consumption: “Body as a Car; the body is like a car that needs fuel to function and keep going, just like when I eat.”

We also measured dispositional performance motivation (Elliott and Harackiewicz 1996) with a scale comprised of six items (e.g., “I often have the goal to do better than others”) rated from 1 (strongly disagree) to 5 (strongly agree). Participants reported their height and weight.

## Results

Sixteen participants (5% of all participants) failed an attention check placed in the middle of the survey (two questions about food with an obvious answer, shown in [web appendix E](#)) and were excluded from analysis. The same attention check was used in studies 1–4.

A factor analysis of the eight foods yielded two factors used to create past consumption indexes: *high-calorie snacks* (chocolate/chocolate bars, cookies, candy/confectionery, sweetened breakfast cereals, fruit sauce, ice-cream;  $\alpha = .76$ ) and *fruits and veggies* ( $\alpha = .64$ ).

Consistent with pilot study 1, a multivariate regression showed that the specific belief that performance depends on food consumption predicted a higher consumption frequency of nutrition-poor *high-calorie snacks* ( $b = .17$ ,  $t(303) = 4.01$ ,  $p < .001$ ,  $\eta^2_p = .05$ ) but did not significantly predict consumption of nutrition-rich *fruits and veggies* ( $b = .10$ ,  $t(303) = 1.53$ ,  $p = .13$ ).

To provide correlational support for hypotheses 1 and 2a, we conducted a multivariate regression of *high-calorie snacks* and *fruits and veggies* consumptions on dispositional performance motivation ( $\alpha = .91$ ), the energetic function of food belief (“body as a car” metaphor), and their interaction. These two independent variables were mean-centered and were uncorrelated ( $p = .20$ ). Regarding *high-calorie snacks*, the main effect of the belief was not significant ( $p = .65$ ), but performance motivation predicted a higher consumption frequency ( $b = .12$ ,  $t(301) = 2.36$ ,  $p = .02$ ,  $\eta^2_p = .02$ ), and the interaction effect was significant ( $b = .07$ ,  $t(301) = 2.13$ ,  $p = .03$ ,  $\eta^2_p = .02$ ). [Figure 1](#) illustrates this interaction effect: dispositional performance motivation was positively associated with *high-calorie snacks* consumption, especially among participants who more strongly believe that the main function of food is energetic. Regarding *fruits and veggies*, none of the effects were significant ( $ps > .14$ ).

Note that in line with hypotheses 1 and 2a, the coefficient of the interaction effect of performance motivation and of the food function belief was positive and statistically significant for *high-calorie snacks* and not for *fruits and veggies* (respectively,  $b = .07$ ,  $t(301) = 2.13$ ,  $p = .03$ ;  $b = -.01$ ,  $t(301) = -.14$ ,  $p = .89$ ), although follow-up tests showed that these two coefficients were not statistically significantly different from each other ( $t(301) = 1.35$ ,  $p = .17$ ). In the subsequent studies, we use experimental, rather than correlational methods to further test our hypotheses—in particular, we test whether performance goals and food function beliefs differently impact high-calorie versus nutrition-rich snack consumption in studies 3–5.

## STUDY 1—PERFORMANCE GOALS IN A COGNITIVE DOMAIN

In study 1, we hypothesized an increased consumption of high-calorie, nutrition-poor snacks (M&Ms) after the

activation of performance goals in a cognitive domain (hypothesis 1), especially among participants who believe that the primary function of food is energetic (vs. hedonic or protective; hypothesis 2a). We measured these beliefs by using metaphors uncovered in [Fischler and Masson's \(2008\)](#) research. We also tested an alternative mechanism related to emotional eating: performance goals may trigger stress, potentially leading to indulgent consumption ([Greeno and Wing 1994](#)).

## Method

One hundred forty-six undergraduate students from a Canadian business school participated in this study in exchange for course credit (mean age = 19.87,  $SD = 1.35$ ; 60% females). The study advertisement stipulated that participants should be at least a bit hungry and willing to eat a nut-based snack.

Participants were brought to individual cubicles where we had placed, next to the computer, a laminated document that contained the manipulation of performance goals ([Elliott and Harackiewicz 1996](#)) shown in [web appendix F](#). All documents mentioned that there were two studies: in the first study, participants would eat M&Ms while evaluating a video and, in the second study, they would complete “hidden words” puzzles. There were two between-subject conditions: performance and control. In the performance condition, the document mentioned that the purpose of the second study was to compare students’ puzzle-solving performance and that students would have to demonstrate that they stand out compared with other students. We also indicated that their relative performance would be provided at the end. In the control condition, the document merely mentioned that the purpose of the second study was to collect students’ reactions to puzzles and that information on the percentage of puzzles solved would be provided at the end.

After participants had read the document, the computer-based survey asked them to reframe the purpose of the studies. Then, a laboratory assistant brought a cup of 200 grams of M&Ms for “study 1.” Participants could eat as much as they wanted while watching an 8 minute video about Moscow. When the video was over, the laboratory assistant took the remaining M&Ms and inconspicuously weighed them. Participants answered filler questions about the video.

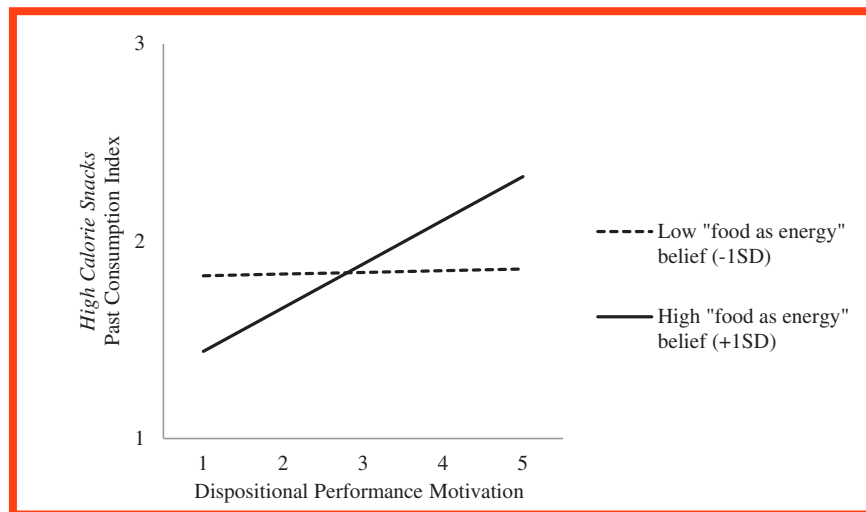
For “study 2,” participants were presented five drawings with six words hidden in each drawing (see [web appendix G](#)). The pictures were presented sequentially for 30 seconds each, during which participants could type the hidden words in textboxes below the picture.

Then, we measured stress with two questions asking participants how nervous, and how worried they felt while completing the puzzles from 1 (not at all) to 7 (extremely).

In the last part of the study, we evaluated participants’ preferred metaphor about the function of food for the body.

FIGURE 1

RELATION BETWEEN DISPOSITIONAL PERFORMANCE MOTIVATION, FOOD AS ENERGY BELIEF, AND PAST CONSUMPTION OF HIGH-CALORIE SNACKS



NOTE.—The association between dispositional performance motivation and high-calorie snacks consumption is estimated at one standard deviation above and below the mean “food as energy” belief score.

They were told that a focus group was asked to find metaphors that best describe the body and its relation to food and that three metaphors emerged: “Body as a car: the car needs fuel to function and keep going, just like when I eat” (energetic function of food); “Body as a temple: the temple is a sacred place that needs to be respected and protected, just like when I eat” (protective function of food); and “Body as a playground: the playground is a place for fun, enjoyment, sensations, and new experiences, just like when I eat” (hedonic function of food). Participants ranked the metaphors, the top-ranked metaphor was the one best describing their own belief about the function of food.

Participants also completed the emotional eating scale (van Strien et al. 1986).

## Results

Three participants refused that the laboratory assistant left M&Ms on the table (no consumption data were collected). Five participants (3.4% of all participants) failed the attention check and were excluded from analysis.

**Manipulation Check.** Participants found marginally significantly more hidden words in the performance (vs. control) condition ( $M = 17.38$ ,  $SD = 4.36$  vs.  $M = 15.74$ ,  $SD = 5.75$ ;  $F(1, 136) = 3.54$ ,  $p = .06$ ; Cohen’s  $d = .32$ ), indicating a successful manipulation of performance goals.

**Food Consumption.** An Analysis of variance (ANOVA) of M&Ms consumption showed that participants ate significantly more M&Ms in the performance (vs.

control) condition ( $M = 40.96$  grams,  $SD = 35.55$  vs.  $M = 30.15$  grams,  $SD = 21.89$ ;  $F(1, 136) = 4.68$ ,  $p = .03$ ;  $d = .37$ ).

**Moderation by Food Function Metaphors.** Sixty-three participants selected “body as a car” as their preferred metaphor, 44 participants selected “body as a playground,” and 31 participants selected “body as a temple.” A Chi-square test showed that the performance manipulation did not impact the choice of metaphor ( $p = .83$ ). An ANOVA of food consumption with the performance manipulation, the preferred metaphor (a three-level categorical variable), and their interaction as independent variables revealed a significant omnibus interaction effect ( $F(2, 132) = 3.05$ ,  $p = .05$ ,  $\eta^2_p = .04$ ). As shown in figure 2, follow-up contrast analyses revealed that when participants’ preferred metaphor was “body as a car”, performance goals (vs. control) strongly increased the consumption of M&Ms ( $M = 51.77$  grams,  $SD = 45.92$  vs.  $M = 28.39$  grams,  $SD = 22.15$ ;  $t(134) = 3.23$ ,  $p = .002$ ;  $d = .65$ ). When the preferred metaphor was “body as a playground,” or “body as a temple,” there was no significant effect of performance ( $ps > .64$ ).

**Alternative Account (Emotional Eating).** The performance manipulation had no significant impact on stress ( $\alpha = .86$ ,  $p = .70$ ). Also, the impact of performance goal on food consumption was not moderated by the emotional eating score ( $\alpha = .89$ ,  $p = .58$ ).

## Discussion

Performance goals in a cognitive domain led to an increased consumption of a high-calorie, nutrient-poor snack (hypothesis 1). This was especially the case among participants for whom the primary function of food is energetic (body as a car), rather than protective or hedonic (hypothesis 2a). This effect is unlikely to be driven by stress or emotional eating.

## STUDY 2—PERFORMANCE GOALS IN A PHYSICAL DOMAIN

In study 2, we intended to replicate the effects found in study 1 when performance goals are activated in a physical domain. To further demonstrate the maladaptive effect of performance goals on food intake, our food stimulus was “Pringles,” a high-fat snack with poor nutritional value, very much unlikely to improve physical performance.

The physical task was a muscle-strengthening exercise with a hand grip. Past research suggests that male—but not female—college students are particularly keen on demonstrating muscular strength (Dworkin 2001; Kilpatrick, Hebert, and Bartholomew 2005; Salvatore and Marecek 2010). Also, an initial version of this study ( $N = 74$ ) showed that activating muscular performance goals had the expected effects on both actual performance and food intake among male, but not female participants. Hence, in study 2, we only recruited male participants, thus limiting participant recruitment to a population which is likely to be sensitive to the manipulation (Meyvis and Van Osselaer 2017). To reach a reasonably large sample size, but also to test the cross-cultural generalizability of the effect, we recruited participants on two different campuses, in France and in Canada.

## Method

Two hundred five undergraduate male students from a Canadian ( $N = 83$ , mean age = 21.69,  $SD = 2.58$ ) and a French business school ( $N = 122$ , mean age = 19.11,  $SD = 1.91$ ) participated in this study in exchange for a small payment.

Participants were brought to individual cubicles and sat in front of a computer, next to which we had displayed a document containing the manipulation (see [web appendix H](#)). The document mentioned that, in “study 1,” participants would eat Pringles while watching and rating a video and, in “study 2,” they would exercise with a hand-grip strengthener, described as an exercise tool that strengthens hand and forearm muscles. All participants were told that they would have to squeeze and release the handles of the hand grip for 1 minute. There were two between-subject conditions: in the performance condition, the instructions also mentioned that the purpose of the study was to

compare students’ hand-grip performance (measured by the number of squeezes) such that students would have the opportunity to demonstrate that they stand out in terms of physical strength and that relative performance would be provided at the end. In the control condition, the instructions merely mentioned that participants’ reactions would be measured.

Participants were asked to reframe the purpose of the studies. Then, a laboratory assistant brought a cup of 50 grams of Pringles for “study 1” and participants could eat as much as they wanted while watching the same video as in the previous study. When the video was over, the laboratory assistant took the remaining Pringles and inconspicuously weighed them. Participants answered filler questions about the video.

Then, for “study 2,” all participants were brought a hand-grip set at the easiest resistance level (10 kilograms) and were asked to count and report the number of times they squeezed and released the hand grip during a 1 minute countdown. Although asking participants to self-report their performance may lead to overestimations, we wanted to avoid the presence of a laboratory assistant evaluating their performance. Then, we measured stress, preferred metaphor about the function of food for the body, and emotional eating just like in study 1.

## Results

We excluded 17 participants (8.3%) who failed the attention check. Campus location (included as a covariate in all the analyses presented below) never significantly impacted the dependent variables.

**Manipulation Check.** An ANOVA of the number of hand grip squeezes showed that participants squeezed the hand grip significantly more in the performance (vs. control) condition ( $M = 125.91$ ,  $SD = 38.57$  vs.  $M = 112.23$ ,  $SD = 32.01$ ;  $F(1, 185) = 6.58$ ,  $p = .01$ ;  $d = .39$ ).

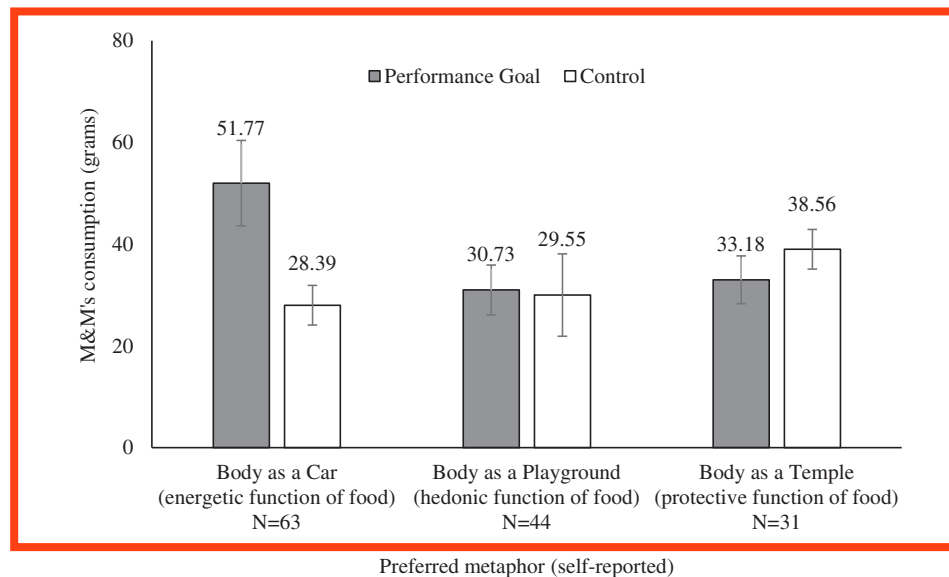
**Food Consumption.** An ANOVA of Pringles consumption revealed that participants ate significantly more in the performance (vs. control) condition ( $M = 29.21$  grams,  $SD = 18.41$  vs.  $M = 23.25$  grams,  $SD = 18.48$ ;  $F(1, 185) = 5.25$ ,  $p = .02$ ;  $d = .32$ ).

**Moderation by Food Function Metaphors.** Ninety-four participants selected “body as a car” as their preferred metaphor, 65 participants selected “body as a playground,” and participants 29 selected “body as a temple.” A Chi-square test showed that the performance manipulation did not impact the choice of metaphor ( $p = .64$ ). An ANOVA of food consumption with the performance manipulation, the preferred metaphor, and their interaction as independent variables revealed a marginally significant omnibus interaction effect ( $F(2, 181) = 2.64$ ,  $p = .07$ ,  $\eta^2_p = .03$ ). As shown in [figure 3](#), follow-up analyses revealed that when participants’ preferred metaphor was “body as a car,”



FIGURE 2

M&amp;M'S CONSUMPTION AS A FUNCTION OF PERFORMANCE GOAL AND FOOD FUNCTION METAPHOR



NOTE.—Error bars represent standard errors in this and all subsequent figures.

activating performance goals (vs. control) significantly increased Pringles consumption ( $M = 31.26$  grams,  $SD = 18.40$  vs.  $M = 19.08$  grams,  $SD = 18.14$ ;  $t(183) = 3.19$ ,  $p = .002$ ;  $d = .66$ ). When the preferred metaphor was “body as a playground” or “body as a temple,” there was no significant effect of the manipulation on consumption ( $ps > .24$ ).

*Alternative Account (Emotional Eating).* The performance manipulation had no effect on stress ( $\alpha = .73$ ,  $p = .33$ ). Also, we did not find any significant interaction effect between the performance manipulation and emotional eating ( $\alpha = .89$ ) on food consumption ( $p = .77$ ).

## Discussion

Performance goals in a physical domain increased consumption of a high-calorie, high-fat, nutrition-poor snack, especially when the primary function of food is believed to be energetic rather than protective or hedonic (hypotheses 1 and 2a). Also, note that in studies 1 and 2, the “body as a car” metaphor (reflecting the energetic function of food) was the most popular metaphor, in line Fischler and Masson (2008). The metaphor reflecting the hedonic function of food only came second—this is a noteworthy observation, given that past research has mostly focused on hedonic explanations for high-calorie food intake.

## STUDY 3—MANIPULATING FOOD FUNCTION

Study 3 investigates how the perceived energetic function of food impacts consumption, (1) by manipulating, rather than measuring, beliefs about food functions, (2) by varying the calorie content and nutritive quality of available foods, and (3) by directly asking participants to choose appropriate foods in scenarios indicating higher or lower energy needs. We did not manipulate performance goals like in the previous and subsequent studies to more directly test how energy needs impact food preferences. Energy needs and performance goals are interconnected within the goal system (Kruglanski et al. 2018), so these constructs should have similar effects on food choice. We hypothesize that when participants elaborate on the energetic function of food (vs. other functions), they will prefer high-calorie, unhealthy foods rather than healthier foods in scenarios where energy is needed.

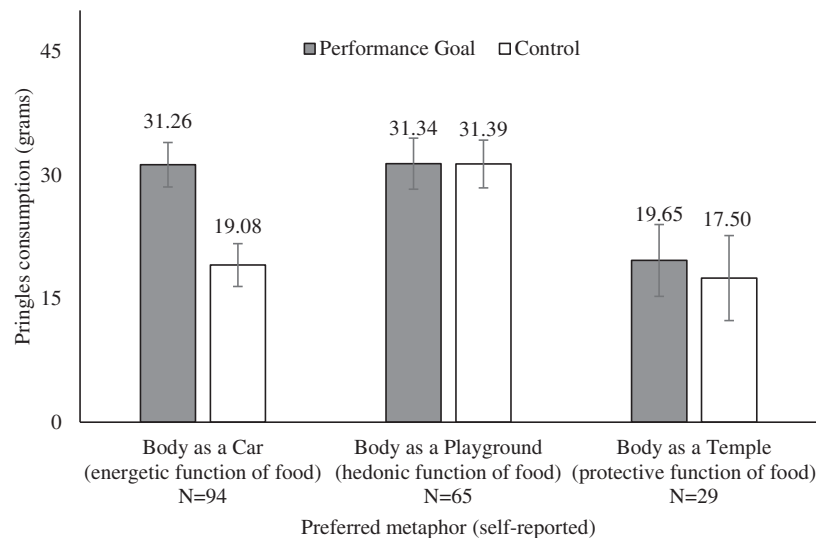
## Method

We assigned 547 MTurkers (mean age = 34.56,  $SD = 11.13$ ; 58% females) to a 3 (food function metaphor: energetic vs. hedonic vs. protective)  $\times$  2 (energy need scenario: high vs. low) between-subject design.

First, participants were told that a focus group was asked to think about the human body and its relation to food and to find one metaphor that best describes the

FIGURE 3

PRINGLES CONSUMPTION AS A FUNCTION OF PERFORMANCE GOAL AND FOOD FUNCTION METAPHOR



function of food for the body. The metaphor reportedly found by the focus group was “body as a car” in the energetic function condition; “body as a playground” in the hedonic condition; and “body as a temple” in the protective condition. We provided the same definitions as in studies 1 and 2 and asked participants to explain in a couple of sentences how the metaphor applies to their own experience of eating.

Then, in the “high-energy need” scenario condition, participants were told to imagine that they were having a busy day at work, at school, or at home with various challenging tasks to accomplish and that, in the middle of the afternoon, they wanted to prepare a snack before getting back to their tasks. In the “low energy need” scenario condition, participants were told to imagine they were spending a relaxing day at home, resting, watching TV, or listening to music and that, in the middle of the afternoon, they wanted to prepare a snack. All participants were asked how likely they would choose each of eight foods varying in calorie content and nutritional quality from 1 (extremely unlikely) to 5 (extremely likely).

As a manipulation check, we asked participants how relevant they found the three body-food metaphors (definitions were provided) from 1 (totally irrelevant) to 7 (totally relevant).

## Results

We excluded 22 participants (4.0%) who failed the attention check.

**Manipulation Check.** Asking participants to elaborate on the “body as a car,” on the “body as a temple,” or on the “body as a playground” metaphor significantly increased the perceived relevance of the respective metaphor ( $p \leq .002$ ), as detailed in [web appendix I](#).

**Intended Food Consumption.** A factor analysis of the eight food items yielded two factors that were used to create two consumption indexes: *high-calorie snacks* (ice-cream, cookie, chocolate bar, and Pringles;  $\alpha = .75$ ) and *nutrition-rich snacks* (fruit, vegetable snack, yogurt, and nuts;  $\alpha = .55$ ). Hence the first (second) factor corresponded to the foods disapproved (approved) by RDs in situations requiring energy. We use these two consumption indexes in the analyses below; detailed analyses (for each of the eight foods) are provided in [web appendix I](#).

We first conducted a 2 (snack type: high calorie vs. nutrition rich)  $\times$  3 (food function metaphor: energetic vs. hedonic vs. protective)  $\times$  2 (energy need scenario: high vs. low) mixed ANOVA on intended consumption, with the first factor within subject and the other two between subject. We found several significant effects: the main effect of snack type ( $F(1, 519) = 183.14, p < .001, \eta^2_p = .15$ ), the snack type  $\times$  scenario interaction ( $F(1, 519) = 4.23, p = .04, \eta^2_p = .01$ ), the scenario  $\times$  metaphor interaction ( $F(2, 519) = 5.21, p = .006, \eta^2_p = .01$ ), and the snack type  $\times$  scenario  $\times$  metaphor three-way interaction ( $F(2, 519) = 3.43, p = .03, \eta^2_p = .01$ ). The other effects were non-significant ( $p > .10$ ). The between-subject manipulations thus had different effects on high-calorie versus nutrition-rich snacks, which we analyze separately below.

An ANOVA of the *high-calorie snacks* index revealed no main effects of scenario and metaphor ( $ps > .17$ ), but a significant interaction effect ( $F(2, 519) = 7.04, p = .001, \eta^2_p = .03$ ). As shown in figure 4, follow-up analyses revealed that participants asked to elaborate on the energetic function of food reported a higher intended consumption of high-calorie, nutrition-poor snacks in the high (vs. low) energy need condition ( $M = 2.90, SD = 1.00$  vs.  $M = 2.55, SD = .99; t(519) = 2.27, p = .02, d = .35$ ). Also, in the “high-energy need” condition only, participants asked to elaborate on the energetic function of food (vs. other two functions) reported the highest intended consumption of high-calorie, nutrition-poor snacks ( $M = 2.90, SD = 1.00$  vs.  $M = 2.45, SD = .95; t(519) = 3.30, p = .001, d = .46$ ). Interestingly, participants reported *lower* intended consumption of high-calorie snacks in the high (vs. low) energy needs scenario after elaborating on the hedonic ( $M = 2.50, SD = .92$  vs.  $M = 2.90, SD = 1.06; t(519) = 2.69, p = .007, d = .40$ ) and protective ( $M = 2.40, SD = .98$  vs.  $M = 2.68, SD = .99; t(519) = 1.90, p = .06, d = .28$ ) food functions.

An ANOVA of the *nutrition-rich snacks* index revealed a marginally significant main effect of scenario ( $F(1, 519) = 2.81, p = .09, \eta^2_p = .005$ ), but no main effect of metaphor ( $p = .35$ ) and no interaction effect ( $p = .87$ ). Despite the absence of interaction effect, we checked the effect of energy needs on the intended consumption of nutrition-rich snacks among participants primed to elaborate on the energetic function of food and failed to find a significant effect ( $p = .19$ ).

## Discussion

Study 3 provides additional evidence of the maladaptive effect of portraying food as a source of energy. In situations requiring energy, consumers *should* opt for nutritious carbohydrates, such as fruits, and avoid high-calorie, nutrition-poor snacks, yet they do the opposite: in situations indicating a higher need for energy, elaborating on the energetic function of food prompts participants to prefer high-calorie, nutrition-poor snacks (hypothesis 2a).

Interestingly, we found opposite effects among participants asked to elaborate on the other functions of food. In particular, after elaborating on the hedonic function of food, participants intended to consume fewer high-calorie snacks in the high (vs. low) energy needs scenario. This might be because consumers are more likely to consume pleasurable (high-calorie) foods in relaxing (low energy) situations. Another potential explanation is that, in the high-energy need scenario, participants were told to imagine being “busy”: past research has shown that a busy mindset promotes less indulgent consumption (Kim, Wadhwa, and Chattopadhyay 2019).

Note that in study 3, we contend that the scenario manipulation increased perceived energy needs and that the

metaphor manipulation influenced the perceived function of food. One alternative possibility is that both manipulations impacted energy needs and that endorsing the “body as a car” metaphor increased anticipated energy needs. Thus, we ran a post-test in which 296 MTurkers who passed the attention check (mean age = 35.95,  $SD = 11.53$ ; 66% females) were assigned to the same 3 (food function metaphor: energetic vs. hedonic vs. protective)  $\times$  2 (energy need scenario: high vs. low) between-subject design. We measured perceived energy needs by asking participants: “Compared to a regular day, how much energy do you think you need on that day?” from 1 (Much less energy) to 7 (Much more energy). An ANOVA of perceived energy needs, with the two manipulated factors and their interaction as independent variables revealed a strong main effect of energy need scenario ( $F(1, 290) = 346.80, p < .001, \eta^2_p = .54$ ), but no main effect of food function metaphor ( $p = .40$ ) nor interaction effect ( $p = .35$ ). Overall, the results of study 3 and of the post-test suggest that endorsing the “body as a car” metaphor increases the perceived energetic function of high-calorie foods but does not increase perceived energy needs.

## STUDY 4—MANIPULATING FOOD POSITIONING

In study 4, we return to our investigation of the effect of performance goals on food choices with a similar paradigm as in study 1 adapted for an online context. We manipulated performance goals in a cognitive domain and measured hypothetical choice between foods varying in calorie and nutritional quality: there were high-calorie foods containing refined sugar and fat and lower-calorie foods mostly containing natural carbohydrates (natural sugar). Hence the higher-calorie foods were objectively worse fuel sources.

In studies 1 and 2, we found that among participants who believe that the primary function of food is hedonic, performance goals have no impact on food consumption. Study 4 further investigates this effect by manipulating food positioning. We hypothesize that, when marketing emphasizes the hedonic function of food, performance goals no longer increase the preference for high-calorie foods (hypothesis 2b). We also tested moderating effects by beliefs that performance depends on food consumption, by emotional eating, and by nutrition knowledge.

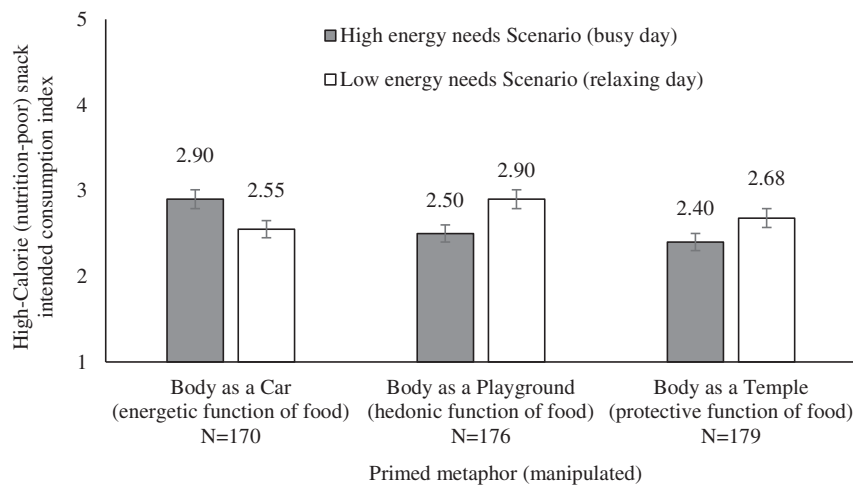
## Method

We assigned 499 MTurkers (mean age = 33.70,  $SD = 11.73$ ; 50% females) to a 2 (goal: performance vs. control)  $\times$  2 (positioning: hedonic vs. control) between-subject design.

All participants first read a webpage that contained the performance goal manipulation (see web appendix F). The

FIGURE 4

HIGH-CALORIE SNACK INTENDED CONSUMPTION AS A FUNCTION OF ENERGY NEEDS AND FOOD FUNCTION METAPHOR



webpage mentioned that there were two studies: the first one about food preferences and the second one about “hidden words” puzzles. In the performance goal condition, the webpage also mentioned that participants would have the opportunity to demonstrate outstanding puzzle-solving abilities compared with other workers. We also mentioned that those who stand out may be recontacted for a follow-up paid study and that the number of hidden words found and performance relative to other MTurkers would be provided at the end. In the control goal condition, the webpage mentioned that the purpose of the study was to measure MTurkers’ reactions to hidden words puzzles and that participants may be recontacted regardless of their performance.

Next, for “study 1,” participants were told to imagine that they could eat 100 grams of snacks now. There were six available foods, for which we provided photos and the amount of calorie, fat, and sugar per 100 grams (see [web appendix J](#)). Three foods (chocolate-covered blueberries, chocolate-covered raisins, chocolate-covered cranberries) ostensibly contained 450 calories, 20 grams fat, and 65 grams sugar per 100 grams. The other three foods (dried blueberries, raisins, dried cranberries) contained 300 calories, 0 gram fat, and 65 grams sugar per 100 grams. Hence, the former (vs. latter) three foods were visibly higher in calories and fat, but not in sugar. The nutrition data were approximations designed to simplify the task but not to deceive participants (see the exact nutrition data in [web appendix J](#)). Although this was not specified, the dried fruits had better nutritive quality (e.g., natural sugar) than the chocolate-covered dried fruits (e.g., refined sugar). We

manipulated a tagline on top of the photos. In the “control positioning” condition, the tagline was “A vast selection of snacks.” In the “hedonic positioning” condition, the tagline was “A vast selection of snacks to suit your pleasure” (“to suit your pleasure” was written in bold and larger fonts). Participants could select any quantity of any food, as long as the total was 100 grams.

Then, for “study 2,” we presented four drawings with hidden words (see [web appendix G](#)), for 40 seconds each. Participants could type the hidden words in textboxes below the picture.

We measured the specific belief that food provides fuel for performance (same scale as in the pilot study), as well as stress during the task and emotional eating (like in studies 1 and 2). We also attempted to measure nutrition knowledge with a brief scale containing 20 statements that needed to be identified as true or false, such as “Oily fish contain healthier fats than red meat” ([Dickson-Spillmann, Siegrist, and Keller 2011](#)).

## Results

We excluded 26 participants (5.2% of all participants) who failed the attention check.

**Manipulation Check.** An ANOVA of the number of correct words found (our measure of cognitive performance), with the performance manipulation, the hedonic positioning manipulation, and their interaction as independent variables revealed a main effect of performance (vs. control) goal on cognitive performance ( $F(1, 469) = 7.04$ ,



$p = .008$ ;  $M = 14.81$  words,  $SD = 4.76$  vs.  $M = 13.62$ ,  $SD = 4.90$ ;  $d = .25$ ). No other effect was significant ( $ps > .17$ ).

**Intended Food Consumption.** We summed up the intended consumption of the three high-calorie foods. Given that the quantity of food that participants could choose was fixed (100 grams), if a participant intended to consume  $x$  grams of high-calorie foods, this also meant that they intended to consume  $(100 - x)$  grams of lower-calorie, nutritive foods. An ANOVA of this measure with the two manipulated factors and their interaction as independent variables revealed no significant main effects ( $ps > .13$ ), but a significant interaction ( $F(1, 469) = 5.24$ ,  $p = .02$ ,  $\eta^2_p = .01$ ). As shown in figure 5, contrast analyses showed that without hedonic positioning, the performance goal manipulation (vs. control) increased the intended consumption of high-calorie foods ( $M = 63.87$  grams,  $SD = 33.53$  vs.  $M = 51.35$  grams,  $SD = 36.93$ ;  $t(469) = 2.69$ ,  $p = .007$ ;  $d = .35$ ) and thus decreased the intended consumption of low-calorie, nutritive foods. However, in the hedonic positioning condition, the effect of the performance goal manipulation (vs. control) was not significant ( $M = 53.59$  grams,  $SD = 35.51$  vs.  $M = 56.08$  grams,  $SD = 36.41$ ;  $p = .59$ ).

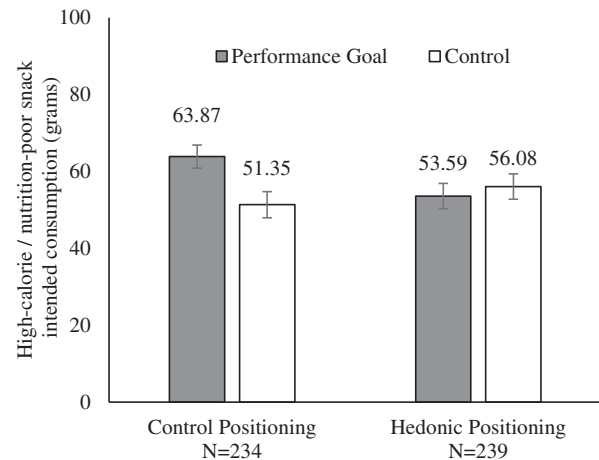
**Moderation by Belief That Performance Depends on Food Consumption.** An ANOVA of the intended consumption of high-calorie snacks with both manipulations, the measured belief that performance depends on food consumption ( $\alpha = .83$ ) and all interactions as independent variables yielded a significant three-way interaction ( $F(1, 465) = 6.10$ ,  $p = .01$ ,  $\eta^2_p = .01$ ). Follow-up analyses showed that performance goals increased intended calorie consumption especially among participants believing that performance depends on food consumption, provided the hedonic function of food was *not* emphasized: indeed, the impact of performance goals on high-calorie consumption was moderated by the belief in the “control positioning” condition ( $F(1, 230) = 9.33$ ,  $p = .003$ ,  $\eta^2_p = .04$ ), but not in the “hedonic positioning” condition ( $p = .56$ ). We provide more detailed analyses in web appendix K.

**Alternative Account (Emotional Eating).** The manipulations had no significant effects on stress ( $\alpha = .93$ ,  $ps > .37$ ). Also, an ANOVA of high-calorie snacks consumption, with both manipulations, emotional eating ( $\alpha = .95$ ), and all interactions as independent variables showed that emotional eating moderated none of the manipulated factors ( $ps > .31$ ).

**Moderation by Nutrition Literacy.** An ANOVA of high-calorie snacks consumption, with both manipulations, nutrition literacy, and all interactions as independent variables showed that the nutrition literacy score moderated none of the manipulated factors ( $ps > .25$ ).

FIGURE 5

HIGH-CALORIE (VS. LOW-CALORIE) SNACK INTENDED CONSUMPTION AS A FUNCTION OF PERFORMANCE GOAL AND MARKETING POSITIONING



NOTE.—Intended consumption of lower-calorie/nutrition-rich snacks (in grams) is 100 minus intended consumption of high-calorie/nutrition-poor snacks.

## Discussion

In study 4, we found that activating performance goals in a cognitive domain increased preference for high-calorie foods over lower-calorie, healthier foods, where the difference in calorie stemmed from fat (hypothesis 1). This provides additional evidence of the maladaptive effect of performance goals. Furthermore, this effect was stronger among participants who more firmly believe that performance depends on food consumption and was no longer significant when emphasizing the hedonic function of the food through marketing positioning (hypothesis 2b), suggesting that emphasizing this hedonic function hindered the impact of energetic beliefs about food.

We failed to find a moderation effect by nutrition literacy (hypothesis 3). This may be due to an insufficient number of nutrition experts on MTurk, or to the difficulty to reliably estimate nutrition expertise with a short scale covering a limited area of nutrition knowledge, as pointed out by past research. In fact, one of the most widely used nutrition knowledge questionnaires comprises 110 multiple-choice questions (Parmenter and Wardle 1999); in contrast the questionnaire we used in study 4 contained only 20 true/false questions.

## STUDY 5—THE ROLE OF NUTRITION EXPERTISE

In this final study, we aim to find the evidence of moderation by nutrition expertise (hypothesis 3). Instead of

measuring nutrition expertise with a questionnaire, we identified nutrition expertise based on participants' college degree (e.g., B.A. in nutrition) and employment (e.g., RDs, nutrition coaches). To recruit a sufficient number of such experts, our study was advertised on Facebook and targeted toward individuals with an academic background, an employment, or a strong interest in nutrition.

## Method

We advertised our study via Facebook Ads ("Help academic researchers better understand nutrition. Participate in a 5 minute, anonymous survey, and get a chance to win a \$50 Amazon voucher"). Facebook Ads allowed us to determine an audience: we selected the United States and Canada as geographic areas; clinical dietitian/clinical nutritionist/nutrition consultant as field of study or as job titles; and clinical nutrition/human nutrition as interests. Note that this targeting method does not guarantee the recruitment of only nutrition experts, but rather the recruitment of participants with high involvement in nutrition and heterogeneity in actual expertise, as detailed in the Results section. Clicking on the Facebook post directly led to a study hosted on Qualtrics. Participants were allowed to participate only once based on their IP address. Participants who failed an attention check placed at the beginning of the study were automatically excluded (no data were collected). A total of 417 participants (mean age = 36.35, SD = 11.18; 97% females) completed the study. The high percentage of female participants is likely due to ad targeting.

First, we manipulated performance goals like in study 4 (a page indicating that "study 1" was about food preferences and "study 2" about word puzzles), although in the performance condition, instead of telling participants that they would be recontacted for follow-up paid studies depending on their performance, we told them that their chance of winning the \$50 voucher would depend on their puzzle performance.

In "study 1," participants were told to imagine that they could eat snacks now and were shown the same six food items as in study 4 with the same nutrition information. The items were presented as three pairs of food options containing a chocolate version and a dried fruit version: chocolate-covered raisins versus raisins; chocolate-covered blueberries versus dried blueberries; and chocolate-covered cranberries versus dried cranberries. For each pair, we asked participants which version they would prefer on 5-point scales ranging from 1 = "I'd much prefer the chocolate-covered version" to 5 = "I'd much prefer the no chocolate (dried fruit) version." In "study 2," participants completed three hidden word puzzles.

Then, we measured participants' preferred food function metaphor, like in studies 1 and 2.

After measuring participants' education level, we asked them whether they received any post-secondary education

related to "nutrition or dietetics," or to "human biology"—if so, we asked them the name of their degree, and to list relevant courses. We also asked them whether their current or past employment was related to "nutrition or dietetics," or to "human biology"—if so, we asked them what their position was.

We measured nutrition involvement with a five-item scale (Chandon and Wansink 2007).

One out of 15 participants was anonymously given a code to redeem a \$50 Amazon voucher, and one out of eight participants who found all hidden words was given the code.

## Results

*Nutrition Expertise.* Two coders were provided a file with the education and employment information of each participant and were asked to individually identify three levels of academic/professional expertise in nutrition. Disagreements were resolved by discussion. Level 1 participants ( $N = 270$ ) had no academic/professional expertise. Level 2 participants ( $N = 86$ ) had a limited expertise: they attended some introductory courses but had no degree in nutrition, and/or some nutrition knowledge is necessary but not fundamental for their job (e.g., nurse, fitness coach). Level 3 participants ( $N = 61$ ) had a high expertise: most of them had a bachelor's degree in nutrition and were RDs; there were also some doctors of medicine and non-registered nutrition coaches with academic credentials. Participants' overall education level and nutrition involvement were both fairly high across all three levels of nutrition expertise (median education was a bachelor's degree, and mean nutrition involvement was above 4 on a 1–5 scale across all three levels), although level-3 experts were slightly more educated and more involved in nutrition. We provide more detail in [web appendix L](#).

*Manipulation Check.* We performed an ANOVA of the number of correct words, with the performance manipulation, nutrition expertise (coded as a continuous variable), and their interaction as independent variables. The only significant effect was a main effect of performance goals indicating that participants found significantly more words in the performance (vs. control) condition ( $M = 9.41$ ,  $SD = 3.97$  vs.  $M = 8.61$ ,  $SD = 4.24$ ;  $F(1, 413) = 4.07$ ,  $p = .04$ ,  $d = .19$ ).

*Food Preference and Moderation by Nutrition Expertise.* We created an index of high-calorie (over lower-calorie, more nutritious) food preferences by averaging and reverse-coding the answers to the three food questions ( $\alpha = .75$ ). This index ranged from 1 (meaning that the participant would "much prefer the dried fruit version" in all three pairs of snacks) to 5 (meaning that the participant would "much prefer the chocolate-covered version" in all three pairs). An ANOVA of this measure with

performance goal, expertise, and their interaction as independent variables yielded an insignificant effect of performance ( $p = .53$ ), but a significant main effect of expertise ( $F(1, 413) = 5.32, p = .02, \eta^2_p = .01$ ) and, more importantly, a significant interaction effect ( $F(1, 413) = 9.30, p = .002, \eta^2_p = .02$ ). As shown in figure 6, among nonexperts (level 1), performance goals (vs. control) increased preference for high-calorie over lower-calorie, nutritious foods ( $M = 3.29, SD = 1.16$  vs.  $M = 2.90, SD = 1.37; t(411) = 2.55, p = .01; d = .31$ ). Among people with limited expertise (level 2), the effect of performance goals was insignificant ( $p = .82$ ). Among experts (level 3), performance goals (vs. control) decreased preference for high-calorie over lower-calorie, nutritious foods ( $M = 2.28, SD = 1.07$  vs.  $M = 3.01, SD = 1.17; t(411) = 2.27, p = .02; d = .65$ ). The same analyses controlling for nutrition involvement ( $\alpha = .87$ ) and overall education level yielded similar results.

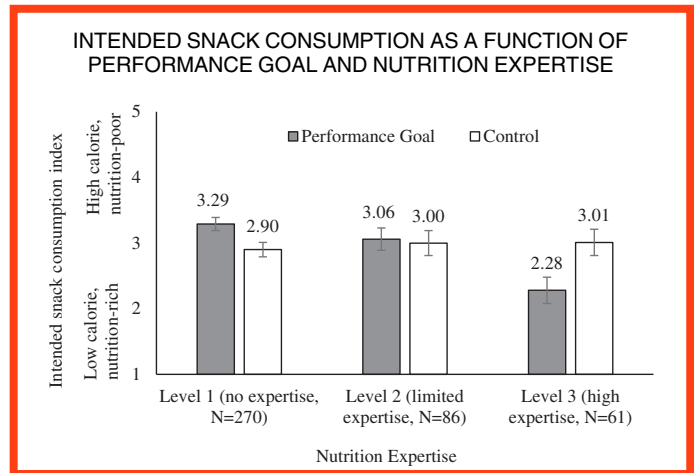
**Moderation by Food Function Metaphors.** Chi-square tests showed that the choice of metaphor was unaffected by the performance manipulation ( $p = .25$ ) and unrelated to nutrition expertise ( $p = .26$ ). The “body as a car” metaphor (energetic function of food) was the most popular metaphor in all three categories of expertise (46% nonexperts, 57% level-2 experts, and 39% level-3 experts chose the energetic metaphor). This shows that considering food primarily as a source of energy is not necessarily a mistake—what is potentially a mistake is what foods are chosen as sources of energy.

Indeed, an ANOVA of the food preference index with the performance manipulation, the preferred body metaphor, nutrition expertise, and all interactions as independent variables revealed a marginally significant three-way interaction effect ( $F(2, 405) = 2.42, p = .09, \eta^2_p = .01$ ), suggesting that the different perceived functions of food have divergent consequences on food preference depending on nutrition expertise. Consistent with previous studies, among the 123 nonexperts (level 1) whose preferred metaphor was “body as a car,” activating performance goals (vs. control) increased preference for high-calorie over lower-calorie, nutrition-rich snacks ( $M = 3.41, SD = 1.07$  vs.  $M = 2.90, SD = 1.36; F(1, 121) = 5.36, p = .02; d = .42$ ); the effect was not significant among nonexperts selecting other metaphors ( $ps > .17$ ). In contrast, among the 24 experts (level 3) whose preferred metaphor was “body as a car,” activating performance goals (vs. control) had the opposite effect ( $M = 2.05, SD = .99$  vs.  $M = 3.00, SD = 1.13$ ; we do not provide tests of significance given the small sample size). We provide more details in web appendix L.

## Discussion

In study 5, we provide evidence that nutrition expertise moderates the effect of performance goals on food

FIGURE 6



preference (hypothesis 3). While nonexperts preferred high-calorie over lower-calorie, nutrition-rich snacks in response to performance goals, nutrition experts (such as RDs and medical doctors) made the opposite choices. It is also noteworthy that the “body as a car” metaphor (energetic function of food) was the most popular metaphor across all levels of expertise, suggesting that portraying food as a source of energy is not an error—although doing so needs to be associated with nutrition expertise in order for people to make the right food choices in response to performance goals.

## GENERAL DISCUSSION

### Theoretical Contributions

We demonstrate that performance goals increase calorie consumption at the expense of good nutrition. Two pilot correlational studies in France and in the United States showed that the belief that performance depends on food consumption is associated with a higher consumption frequency of high-calorie, nutrition-poor foods. Subsequent experimental studies showed that performance goals in cognitive (study 1) and physical domains (study 2) have a causal effect on the consumption of high-calorie, nutrition-poor snacks. We provide evidence of the mechanism by showing that this effect is particularly strong among participants who believe that the primary function of food is energetic, rather than hedonic or protective, whether this belief was measured (studies 1, 2, and 5) or manipulated (study 3). Accordingly, we also find that emphasizing the hedonic function of food in marketing communication mitigates the effect of performance goals on food intake (study 4). Across all studies, participants’ food choices or consumption in response to performance goals were clearly maladaptive and reflected poor nutrition knowledge. In

particular, participants preferred high-calorie, nutrition-poor processed snacks over lower-calorie, nutrition-rich foods (studies 3–5). This is the opposite of what nutrition experts, such as RDs, would recommend (qualitative interviews reported in the conceptual development) or even choose for themselves (study 5).

From a theoretical perspective, in food research, the overconsumption of high-calorie, unhealthy foods is typically explained by hedonic goals and self-control failures (Papies et al. 2007; Stroebe et al. 2013). Our research brings an important nuance to this predominant hedonic model. Indeed, many consumers think that the primary function of food is to provide energy (Fischler and Masson 2008), although nutrition knowledge about what constitutes food energy is scarce. Hence, we show that the consumption of high-calorie foods may also result from a maladaptive motivation to manage energy intake, unrelated to hedonic goals. Our findings are in line with emerging research suggesting that eating pleasure is not necessarily the enemy of healthy eating (Cornil and Chandon 2016a, 2016b), and echo early research on eating behavior, which focused on energy needs activated by internal signals of energy depletion, such as hunger (Mayer and Thomas 1967). However, in our research, energy needs are triggered by external factors—performance goals—rather than internal signals. This is an important finding, given the ubiquitous social incentives to perform in modern societies (Kohn 1992).

Our research also contributes to the understanding of lay nutrition. Nutrition science recommends opting for “healthy” foods (in particular nutrition-rich natural carbohydrates) and avoiding high-calorie, processed snack foods in preparation for challenging mental or physical tasks. Yet, lay consumers do exactly the opposite, with detrimental consequences for health.

We rule out one important alternative explanation related to emotional eating, defined as the tendency to eat rewarding high-calorie foods as a way to suppress or cope with negative emotions such as stress (Greeno and Wing 1994; van Strien et al. 1986). It is possible that performance goals activated negative emotions such as stress or anxiety among some participants, leading to the consumption of high-calorie foods. However in studies 1, 2, and 4, we found no significant difference in stress levels across participants assigned to a performance condition and those assigned to a control condition and found that emotional eating did not significantly moderate the effect of performance goals on food consumption.

## Limitations and Implications for Future Research

*Justification for Self-Control Failure.* Our research shows that consumers increase calorie intake in response to performance goals because high-calorie foods are construed as “fuel” for the body. This is in line with

sociological research pointing at a lay nutrition belief that body energy is directly quantifiable in terms of calories (Mol 2013); this notion is supported by the way many high-calorie snacks are marketed: foods that provide strength and energy. Hence our explanation contrasts with the self-control failure account, according to which consumers eat high-calorie foods when hedonic goals override weight control goals. Given that the foods chosen by consumers to support performance (high-calorie foods) are also highly palatable (Drewnowski and Greenwood 1983) and perceived as pleasurable (Raghunathan et al. 2006), can our findings be somehow reconciled with the self-control failure account?

One possibility is that “food as fuel” beliefs (which moderated the impact of performance on calorie intake across all our studies) may be reinforced through rationalization processes as a way to justify repeated self-control failures. That is, people eat pleasurable foods and then justify it by thinking of those pleasurable foods as fuel for their body. If it were the case, then food as fuel beliefs should correlate with measures of self-control failure, and also with other beliefs that are typically used to justify indulgent consumption. This is what we tested in an additional correlational study, where 100 MTurk participants completed a series of questionnaires presented in random order. We measured the perceived relevance of the “body as a car,” “body as a temple,” and “body as a playground” metaphors from 1 (totally irrelevant) to 7 (totally relevant), as well as the specific belief that task performance depends on food consumption (like in the pilot studies). We also distributed the Eating Self-Control scale (Haws, Davis, and Dholakia 2016) measuring agreement with 10 items such as “I am good at resisting tempting food.” We finally measured five food-related Compensatory Health Beliefs (Knäuper et al. 2004) that are typically interpreted as justifications over self-control failures, such as “Eating whatever one wants in the evening is OK if one did not eat during the entire day.” We found that the food as fuel beliefs (whether the specific belief that task performance depends on food, or the endorsement of the “body as a car” metaphor) were uncorrelated with Eating Self-Control ( $ps > .20$ ) and with food-related Compensatory Health Beliefs ( $ps > .19$ ). On the other hand, we found significant correlations between the perceived relevance of the other metaphors and the measures of Eating Self-Control and Compensatory Health Beliefs (see web appendix M for details).

While food as fuel beliefs and their impact on consumption seem unrelated to hedonic goals, self-control failures, and attempts to justify these failures, future research should nonetheless further explore how these beliefs are formed and reinforced. One possibility is that these beliefs are manifestations of evolutionary needs, as explained in the paragraph below.



*Life History Theory.* Previous research showed that environmental cues indicating resource scarcity motivate consumers to “store” calories (Briers and Laporte 2013; Briers et al. 2006; Laran and Salerno 2013). In a similar manner, we demonstrate that environmental cues related to performance goals motivate consumers to ingest calories. While we propose a mechanism based on lay beliefs, research on the effect of resource scarcity on food consumption has relied on life history theory: humans have evolved in environments where food was scarce and the storage of excess calories as fat was essential for survival in prevision for future food shortages (Hill et al. 2016; Kardum, Gračanin, and Hudek-Knežević 2008). Yet, these two mechanisms are not mutually exclusive. Indeed, beliefs reflect “proximate” explanations for eating behavior, which include culture, incentives, or learning (Griskevicius, Cantú, and Vugt 2012). An evolutionary perspective contends that proximate explanations may be grounded in “ultimate,” evolutionary explanations. It is thus possible that food as fuel beliefs are manifestations of evolutionary needs to ingest calories in preparation for exhausting tasks. Then, this evolutionary function becomes maladaptive in today’s food environment characterized by easy access to nutrient-poor foods.

*Impact on Body Weight.* Our research suggests that in response to performance goals, consumers ingest calories that they eventually will not burn, failing to reach energy balance. This should lead to weight gain over time. Yet in the pilot studies, participants’ BMI was uncorrelated with the specific belief that performance depends on food consumption. Also in pilot study 2, the interaction effect between performance motivation and the endorsement of the “body as a car” metaphor—which predicted past calorie consumption—did not predict BMI. This might be due to the difficulty to find correlations between self-reported BMI and trait measures in cross-sectional data (Meule and Bleichert 2016), although some past studies did find the evidence of correlations between food-related lay beliefs (e.g., the tasty = unhealthy intuition) and BMI (Cooremans, Geuens, and Pandelaere 2017; Mai and Hoffmann 2015; McFerran and Mukhopadhyay 2013). Research has tended to favor longitudinal studies, where the relationship between BMI (or weight fluctuations) and trait measures is assessed within-subject and over time (Keller, Hartmann, and Siegrist 2016). This could be explored in future research.

*Expectancy Effects on Performance.* In our research, the main dependent variable was food consumption, while actual performance was treated as a manipulation check. We do not investigate how actual food consumption impacts performance—this has been extensively researched in the nutrition literature. Nonetheless in study 1 (where we measured actual food consumption), we found

an intriguing effect. Despite nutrition research suggesting that the ingestion of high-calorie, unhealthy snacks is unlikely to boost cognitive performance, we found that M&Ms consumption was positively related to cognitive performance, seemingly via expectancy (or “placebo”) effects (Plassmann and Wager 2014). Indeed, the effect of performance goals on actual performance was mediated by M&Ms consumption, conditional upon participants believing the function of food to be predominantly energetic. However, we could not replicate this effect in study 2. We provide detailed analyses in [web appendix N](#).

## Implications for Managers and Policy-Makers

From a marketing standpoint, our findings provide theoretical validation for marketers’ tendency to use performance cues on the packaging and advertising of snack foods high in calories, fat, and sugar (Barthes 1997; Bragg et al. 2013; Folta et al. 2006; Roberts and Pettigrew 2007). This was the case for early advertising of chocolate products: Kit Kat Chocolate bars were claimed to “give you longer endurance, staying power (...) and energy to make a good job of whatever you’re doing” in a 1940 campaign (Nestlé 2014) and Cadbury Chocolate claimed to “build up brain and muscle that no housewife ought to be without it” in a 1904 campaign (Brenner et al. 2000). Although more subtle, performance positioning is still used in today’s advertising for snack products: for instance, a recent ad implicitly associates the consumption of Nutella with school performance (see [web appendix O](#) and [P](#)).

While the impact of misleading health claims on food products has been largely investigated and regulated (Chandon and Wansink 2012; Wansink and Chandon 2006), future research should also investigate the impact of “performance claims” as part of the positioning of high-calorie foods. Legislators should also pay a closer attention to these potentially misleading claims. In addition, as increasing performance has been the dominant choice of education policy (Kohn 1992), children may be at-risk (Rovner et al. 2011). Policy-makers should thus focus on advertising that target children and their parents but also find solutions to educate consumers about the “right” choices of food as a source of energy.

## DATA COLLECTION INFORMATION

The first author managed the data collection of pilot study 2 using Amazon Mechanical Turk (MTurk) panel in March 2019, study 1 at Sauder Business School behavioral laboratory in October 2017, study 2 (Canadian participants) at Sauder Business School behavioral laboratory in October 2018, study 3 using MTurk in May 2019, study 4 using MTurk in May 2018, and study 5 with participants recruited via a Facebook ad in July and August 2019. The second author managed the data collection of pilot study 1

using an online panel owned by a market research company in February 2014. The second and third authors jointly managed the data collection of study 2 (French participants) at the NEOMA Business School behavioral laboratory in October 2018 and post-test of study 3 using MTurk in November 2019. The data were analyzed jointly by the first and second authors.

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