Will work less for food

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Will work less for food: Go/No-Go training decreases the reinforcing value of high-caloric food

Katrijn Houben^{a,*}, Janneke C.A.H. Giesen^b

^a Department of Clinical Psychological Science, Faculty of Psychology and Neuroscience, Maastricht University, the Netherlands

^b Department of Audiology and Communication, Adelante, Hoensbroek, the Netherlands

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ABSTRACT

Consistently inhibiting responses to palatable food stimuli increases motor suppression for those stimuli and reduces their hedonic value, suggesting a close link between motor inhibition and food reward. The current study aimed to investigate whether GNG training also reduces the motivational, reinforcing value of palatable, high-calorie food. Participants completed either GNG training for high-calorie food or a control task. This was followed by a Concurrent Schedules Task (CST) to measure the reinforcing value of high-calorie food. As hypothesized, participants in the GNG condition showed reduced high-caloric food reinforcement, as indexed by the number of key presses participants were willing to execute to obtain the food, compared to the control condition. This difference between GNG and control, however, was only significant when the response requirement to obtain high-calorie food was high. These results suggest that GNG training not only reduces hedonic food value but also the motivational, reinforcing value of food.

1. Introduction

In 2016, an estimated 39% of adults worldwide were overweight, of which about 13% were obese (World Health Organization, 2017). As major risk factors for non-communicable diseases like heart disease and stroke, obesity and overweight pose a major threat to global health. The onset and maintenance of obesity and overweight can be ascribed to overeating; that is, consuming more calories than one expends. Despite relatively widespread knowledge of the effects of unhealthy diets, global obesity rates are still on the rise (World Health Organization, 2017), suggesting that many people continue to over-indulge in high-calorie foods against their better judgement. This dilemma is aggravated by our current obesogenic environment, which provides ample temptation through high availability, palatability and relatively low cost of high-caloric food. Within this temptation-laden environment, it has become of paramount importance to inhibit automatic impulses to indulge in palatable, high-caloric foods in favor of conflicting goals (e.g. dieting goals; E.g., Hofmann, Friese, & Strack, 2009).

In line with this idea, weaker food-related inhibitory control is associated with increased hunger and craving for high-caloric foods (Loeber, Grosshans, Herpertz, Kiefer, & Herpertz, 2013; Meule, Lutz, Vögele, & Kübler, 2014), increased food intake (Carbine et al., 2017; Price, Lee, & Higgs, 2016), and elevated levels of BMI (Batterink, Yokum, & Stice, 2010; Houben, Nederkoorn, & Jansen, 2014;

Nederkoorn, Coelho, Guerrieri, Houben, & Jansen, 2012; Price et al., 2016). These findings have fueled interest into the possibility of training food-specific inhibitory control to reduce food craving, food intake, and overweight. One training procedure that has shown promise in this area is based on the Go/No-Go (GNG) task. Specifically, GNG training consistently pairs food-related cues with no-go signals to induce associations between food cues and the engagement of inhibitory control. Research has shown that GNG training reduces the choice and intake for those foods that were consistently paired with inhibition (Veling, Aarts, & Stroebe, 2013a, 2013b; Houben & Jansen, 2011, 2015; Houben, 2011; Lawrence, Verbruggen, Morrison, Adams, & Chambers, 2015; Veling, Aarts, & Papies, 2011; van Koningsbruggen, Veling, Stroebe, & Aarts, 2014) and promotes weight loss (Lawrence, O'Sullivan et al., 2015; Veling, van Koningsbruggen, Aarts, & Stroebe, 2014).

Two potential mechanisms have been proposed to account for GNG training effects, which are not necessarily mutually exclusive. First, consistently withholding responses toward food cues can create an association between these cues and inhibition (Best, Lawrence, Logan, McLaren, & Verbruggen, 2016; Bowditch, Verbruggen, & McLaren, 2016; Houben & Jansen, 2015). Once such associations have been formed, the perception of food cues may evoke simple motor inhibition automatically as a “learned reflex”, triggered by the retrieval of acquired stimulus–stop associations (Verbruggen & Logan, 2008; Verbruggen, Best, Bowditch, Stevens, & McLaren, 2014). Second, there

* Corresponding author.

E-mail address: K.Houben@maastrichtuniversity.nl (K. Houben).

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is emerging evidence that GNG training causes a devaluation of food stimuli that are consistently paired with no-go cues (e.g., Chen, Veling, Dijksterhuis, & Holland, 2016; Lawrence, O'Sullivan et al., 2015; Lawrence, Verbruggen et al., 2015; Veling, Aarts, & Stroebe, 2013b, 2013a). It has been suggested that the pairing between appetitive food stimuli and inhibition creates a response-conflict, which participants overcome by devaluing the appetitive stimuli (Veling, Holland, & van Knippenberg, 2008; Veling, Lawrence, Chen, van Koningsbruggen, & Holland, 2017). Alternatively, this devaluation effect could also arise from the creation of associative links between the go/no-go associated foods and two mutually inhibitory appetitive/aversive centers (McLaren & Verbruggen, 2015; Verbruggen et al., 2014). More specifically, appetitive, reward-related cues should be associated with activation of motor behavior (approach/go), whereas aversive, punishment-related cues should be associated with inhibition of behavior (avoid/no-go; McLaren & Verbruggen, 2015; Verbruggen et al., 2014). Such associative links between motor responses and reward would explain both the slower responding to no-go associated stimuli and the devaluation of those stimuli.

The present study builds upon this research and aimed to test whether GNG training may also reduce the reinforcing value of food. While most previous studies have focused on self-reported hedonic ratings of food stimuli to demonstrate the devaluation effect (e.g., Chen et al., 2016; Lawrence, O'Sullivan et al., 2015; Lawrence, Verbruggen et al., 2015; Veling et al., 2013b, 2013a), few studies have addressed whether GNG training may also impact the motivational, reinforcing value of no-go assigned appetitive stimuli. One notable exception is the study by Ferrey, Frischen, and Fenske (2012). In this study, GNG training reduced the reinforcing value of erotic images that were previously associated with inhibition. The reinforcing value of a stimulus refers to how strongly the stimulus will motivate behavior, and can be defined in terms of how many responses are made to obtain the stimulus (Epstein & Saelens, 2000). Importantly, higher reinforcing value of food has been associated with increased food intake (e.g., Epstein et al., 2007; Epstein et al., 2015; Temple, Legierski, Giacomelli, Salvy, & Epstein, 2008), overweight (e.g., Giesen, Havermans, Douven, Tekelenburg, & Jansen, 2010; Saelens & Epstein, 1996; Temple et al., 2008), and weight gain (e.g., Carr, Lin, Fletcher, & Epstein, 2014; Epstein, Yokum, Feda, & Stice, 2014; Hill, Saxton, Webber, Blundell, & Wardle, 2009). Moreover, findings suggest that the reinforcing value of food is a stronger predictor of food intake than hedonic ratings of food (Epstein, Carr, Lin, & Fletcher, 2011; Epstein et al., 2015; Temple et al., 2008).

The aim of the present study, therefore, was to examine whether GNG training would decrease the reinforcing value of no-go associated, high-caloric food. Participants were randomly assigned to GNG training or control. In the GNG training condition, images of high-caloric food were consistently paired with a no-go cue while images of low-caloric food were consistently paired with a go cue. In the control condition, images of high- and low-caloric food were presented equally often with the go and no-go cues (i.e., there was no consistent mapping of the food items to go or no-go). Following the training or control task, the reinforcing value of no-go associated high-caloric food relative to go-associated low-caloric food was measured using the Concurrent Schedules Task (CST; Lappalainen & Epstein, 1990). In the CST, participants were provided access to a high-caloric and a low-caloric food product and needed to decide which alternative they wanted to work for. As the task progressed, the response requirement for the high-caloric food option gradually increased (i.e., progressive ratio schedule of reinforcement) while the response requirement for the low-caloric food option remained the same (i.e., fixed reinforcement schedule). The relative reinforcing value of high-caloric food was thus defined as the number of responses that participants were willing to perform to obtain the high-caloric food relative to the low-caloric food alternative (cf. Epstein & Saelens, 2000; Epstein et al., 2007). We hypothesized that participants in the GNG training condition would show reduced reinforcing value

for high-caloric food, as indexed by a reduced number of responses to obtain this food, compared to participants in the control condition.

2. Method

2.1. Participants

A total of 86 female undergraduate students were recruited via flyers in Maastricht University buildings and via an online platform for psychology students. During this study, participants had to respond to high- and low-caloric food products that were selected based on a rating and ranking task as described below. To ensure equal liking for the high- and low-caloric foods, the highest rated high- and low-caloric foods were selected that were rated within one point of each other (on an 11-point liking Likert scale). Participants were included only if their matched high- and low-caloric food were both rated higher than or equal to 5. In total, 83 from the 86 participants met this inclusion criterion. In addition, one participant did not follow the instructions for the GNG task and three participants did not fill out the questionnaires. Data from these four participants were excluded from the analysis, leading to a final sample of 79 participants (mean age = 22.81 years, $SD = 4.83$). Of the final sample, 10% of participants were overweight (mean BMI = 22.18, $SD = 2.32$, range = 17.87–28.92).

2.2. Materials & measures

Rating and ranking. Participants were served a tray containing bite sized portions of a variety of eight foods, including four high-caloric snacks and four low-caloric food items. The high-caloric snacks included chocolate M&M's (479 kcal/100 gr), cocktail snacks (578 kcal/100 gr), mini chocolate chip cookies (497 kcal/100 gr) and paprika flavored potato crisps (531 kcal/100 gr). The low-caloric foods consisted of baby carrots (35 kcal/100 gr), cherry tomatoes (31 kcal/100 gr), white grapes (57 kcal/100 gr) and whole grain crackers (381 kcal/100 gr). The foods were not arranged in any particular order on the tray and at no point was reference made to the categories 'healthy' and 'unhealthy' foods. Participants were requested to sample each of the foods and to rate their palatability on an 11-point Likert scale (0 = 'not at all tasty', 10 = 'extremely tasty'). Participants also ranked the food items from most palatable (1) to least palatable (8).

Go/No-Go (GNG) Task. During the GNG task, participants were presented with pictures on the computer screen and were instructed to press the space bar when the picture was presented within a blue frame (i.e., go cue) and to refrain from responding when the picture was presented within a gray frame (i.e., no-go cue). The stimuli were pictures of the same eight foods that were used during the tasting and rating task. During each trial, the picture was presented first and a blue or gray frame appeared around the picture 100 ms after picture onset. The frame remained visible together with the picture for the remainder of the trial. Each trial lasted 1000 ms. A green circle was displayed after a correct (non)response (500 ms), and a red cross after an incorrect (non)response (500 ms). The inter-trial interval was 500 ms. The GNG task consisted of one block of 160 trials. Participants were randomly assigned to one of two conditions. In the training condition ($n = 38$), pictures of high-caloric snack food were consistently paired with the no-go cue whereas pictures of low-caloric foods were consistently paired with the go cue. In the control condition ($n = 35$), pictures of high- and low-caloric food were presented with both the go cue and the no-go cue equally often.

Concurrent Schedules Task (CST). Participants performed the CST with their favorite low-caloric food and their favorite high-caloric snack, provided that the difference in subjective liking between these two food items was less than or equal to 1 point as described above. Participants were instead informed that the computer would randomly choose two of the eight foods that they had previously sampled. It was then explained that they would have to work (by clicking the mouse) to

earn points for either of the two foods presented and that they could choose which food they wanted to earn points for at any given time.

The task consisted of 5 schedules during which participants had to earn a combined 20 points before proceeding to the next schedule. During each trial, the pictures of the two food items were presented side by side on the computer screen and participants were instructed to choose which food to earn points for by clicking the corresponding mouse button (i.e., click the right mouse button for the food shown on the right and click the left mouse button for the food presented on the left). The response assignment of high- and low-caloric food was counterbalanced. Points were not awarded for every mouse click but instead this was based on a fixed ratio for each schedule. Feedback was given after every mouse click to inform participants whether they had earned a point or not.

In the first schedule the reinforcement ratio for high- and low-caloric food were both set at FR2 (fixed ratio of 2), meaning that a point was earned with every two responses on the same key. This FR2 reinforcement schedule remained the same for the low-caloric food throughout the task. However, the response requirement for the high-caloric food doubled with every schedule: To earn 1 high-caloric snack point, participants had to click the corresponding mouse button four times in schedule 2, eight times in schedule 3, sixteen times in schedule 4 and 32 times in schedule 5. Participants were informed that it would progressively become more difficult to earn points for one of the two foods. They were also told that for every 10 points they earned they would be served 10 gr of the corresponding food, which they would have to eat at the end of the task. This served the purpose of minimizing the influence of socially desirable responding. Additionally, participants were informed that the task would end when they had earned a combined 100 points.

Craving. Food craving was measured using three questions. On 100 mm Visual Analogue Scales, participants indicated how much hunger they experienced at that moment (0 = 'not hungry'; 100 = 'very hungry'), how strongly they desired to eat something at that moment (0 = 'no desire'; 100 = 'strong desire') and how strongly they experienced craving for food at that moment (0 = 'no craving'; 100 = 'strong craving'). Responses were averaged across the three questions to attain one overall craving score.

Dietary Restraint. Dietary restraint was measured using the revised Restraint Scale (RS; [Herman & Polivy, 1980](#)). The RS is a self-report questionnaire consisting of 10 items that measure dieting concern/intentions and weight fluctuations. Higher scores indicate an increased intention to restrict food intake.

BMI. Participants' weight and height were measured in the lab and used to calculate BMI (kg/m^2 ; BMI).

2.3. Procedure

Upon arrival participants were asked to read and sign the informed consent. Next, participants rated their current hunger and desire and they were presented with a tray of eight foods to be tasted before completing the rating and ranking task. Participants next performed the GNG task. While participants completed the GNG task, the experimenter went to a separate room to examine the food ratings and select the two foods to be used in the CST. When participants had completed the GNG task, the experimenter returned to the test room to start the CST. Afterwards, participants filled out the RS and they exchanged the points they had earned for the foods and ate the food accordingly. When they were finished, participants' weight and height were measured to calculate BMI. Participants were given the option of a €7.50 voucher or 1 participation credit as remuneration for their participation in the study.

2.4. Statistical analyses

To test whether GNG training reduced the reinforcing value for

Table 1

Characteristics of participants in the training ($n = 41$) and control condition ($n = 38$). Means (M) and standard deviations (SD) are shown together with significance tests for the difference between the two conditions.

	M (SD)		t-tests
	Training	Control	
BMI	22.26 (2.45)	22.09 (2.21)	$t(77) = -.31, p = .76$
Dietary restraint	12.59 (4.85)	14.89 (5.73)	$t(77) = 1.94, p = .06$
Craving	4.40 (2.25)	5.55 (2.27)	$t(77) = 2.26, p < .05$
High-calorie food rating	8.32 (.99)	8.40 (1.00)	$t(77) = .35, p = .73$
Low-calorie food rating	8.07 (1.10)	8.24 (.97)	$t(77) = .70, p = .49$

Note. BMI = Body Mass Index. High-caloric food rating and low-caloric food rating refer to the hedonic ratings of the high- and low-caloric food items that were selected for the Concurrent Schedules Task (CST).

high-caloric food, we performed a 5 (schedule: FR2, FR4, FR8, FR16, FR32) $\times$ 2 (condition: training versus control) analysis of variance (ANOVA) with repeated measures for the factor schedule and with condition as a between-subjects factor. The dependent variable was the number of responses for high-caloric food in each reinforcement schedule. A significant interaction between schedule and condition was further examined by testing for differences between training and control in the five different reinforcement schedules. Across the five schedules, there were 13 cases in which the number of responses for high-caloric food was more than 3 standard deviations above the mean. These influential cases were winsorized by setting their value to the nearest maximum value within three standard deviations from the mean.

At baseline, there were no significant differences between the training condition and the control condition with respect to BMI, or the palatability ratings for the low- and high caloric food items that were used in the CST (see [Table 1](#)). However, in the control condition, craving was significantly higher relative to the training condition while dietary restraint was marginally significantly higher. The main analysis was therefore also repeated with restraint and craving entered as covariates in the model. BMI was added as an additional covariate as previous research has shown that increased BMI is associated with increased food reinforcement ([Giesen et al., 2010](#); [Saelens & Epstein, 1996](#); [Temple et al., 2008](#)).

3. Results

Accuracy in the GNG task was overall high, with no significant difference between the training condition ($M = 0.99, SD = 0.01$) and the control condition ($M = 0.99, SD = 0.01$), $F(1, 77) = 0.72, p = .40, \eta_p^2 = 0.01$. There was also no significant difference between the training condition ($M = 506.54, SD = 42.80$) and the control condition ($M = 519.30, SD = 38.85$) in response latencies during go trials, $F(1, 77) = 1.92, p = .17, \eta_p^2 = 0.02$.

The schedule $\times$ condition ANOVA showed a significant main effect of schedule, $F(2.12, 163.31) = 11.13, p < .001, \eta_p^2 = 0.13$, but no significant main effect of condition, $F(1, 77) = 1.46, p = .23, \eta_p^2 = 0.02$. In addition, the interaction between schedule and condition was significant, $F(2.12, 163.31) = 3.17, p = .04, \eta_p^2 = 0.04$. As shown in [Fig. 1](#), this interaction indicates that participants in the training condition responded less for high-caloric food as the reinforcement schedules progressed, compared to participants in the control condition. When BMI, restraint and craving were entered in the analyses as covariates, the schedule $\times$ condition interaction was marginally significant, $F(2.07, 153.13) = 2.79, p = .06, \eta_p^2 = 0.04$. Further, the effect of BMI was significant, $F(1, 74) = 6.31, p = .01, \eta_p^2 = 0.08$, indicating that a higher BMI was associated with increased food reinforcement. Restraint, $F(1, 74) = 2.68, p = .11, \eta_p^2 = 0.04$, and craving, $F(1, 74) = 2.51, p = .12, \eta_p^2 = 0.03$, did not significantly predict food

Fig. 1. Mean number of responses for high-caloric food per schedule for each condition. FR refers to fixed ratio of reinforcement and the accompanying numbers indicate the number of responses required to obtain a single-snack point.

reinforcement. The main effects of schedule and condition and their interaction terms with the covariates did not reach significance (all $F < 2.20$).

Post hoc tests showed a significant difference between the training and control condition in responding for high-caloric food only in the final schedule FR32, $F(1,77) = 4.99$, $p = .03$, $\eta_p^2 = 0.06$, but not in any of the other schedules (all $F < 1$). When BMI, restraint and craving were entered as covariates in the analyses, the results were the same with condition being a significant factor in FR32, $F(1,74) = 4.38$, $p = .04$, $\eta_p^2 = 0.06$, but not in the other schedules (all $F < 1$). Overall, the covariates mainly predicted high-caloric food reinforcement in the first schedules, but not in the later schedules. Specifically, BMI predicted increased responding for high-caloric foods in FR2, $F(1,74) = 4.13$, $p < .05$, $\eta_p^2 = 0.05$, FR4, $F(1,74) = 8.20$, $p = .01$, $\eta_p^2 = 0.10$, FR8, $F(1,74) = 11.19$, $p = .001$, $\eta_p^2 = 0.13$, and FR16, $F(1,74) = 6.17$, $p = .02$, $\eta_p^2 = 0.08$, but not in FR32 ($F < 1$). Restraint was associated with decreased high-caloric food reinforcement in FR4, $F(1,74) = 7.61$, $p = .01$, $\eta_p^2 = 0.09$, and in FR8, $F(1,74) = 5.08$, $p = .03$, $\eta_p^2 = 0.06$, but not in FR2, FR16 or FR32 (all $F < 1.5$). Finally, craving was a marginally significant predictor of increased food reinforcement in FR2, $F(1,74) = 3.74$, $p = .06$, $\eta_p^2 = 0.05$, a significant predictor in FR4, $F(1,74) = 4.96$, $p = .03$, $\eta_p^2 = 0.06$, and in FR8, $F(1,74) = 5.28$, $p = .02$, $\eta_p^2 = 0.07$, but not significant in FR16 or FR32 (all $F < 1$).

4. Discussion

GNG training that pairs food stimuli with inhibition has been found to reduce food intake (Veling et al., 2013a, 2013b, 2011; Houben & Jansen, 2011, 2015; Houben, 2011; Lawrence, Verbruggen et al., 2015; van Koningsbruggen et al., 2014) and induce weight loss (Lawrence, O'Sullivan et al., 2015; Veling et al., 2014). The underlying rationale is that the consistent and repeated pairing of food stimuli with no-go cues induces automatic inhibition of responses toward those stimuli (e.g., Best et al., 2016; Bowditch et al., 2016; Houben & Jansen, 2015; Verbruggen & Logan, 2008; Verbruggen et al., 2014) as well as a devaluation in the hedonic value of the no-go associated food stimuli (e.g., Chen et al., 2016; Veling et al., 2008, 2013a, 2013b, 2017). The aim of this study was to extend these findings by examining whether GNG training also decreases the motivational, reinforcing value of no-go associated food stimuli. Participants were assigned to a GNG training condition that consistently paired high-caloric food with response inhibition (i.e., no-go) or to a control condition. Food reinforcement was measured using a CST which required participants to perform a response to earn either high- or low-caloric food. The CST used a progressive ratio schedule so that the high-caloric food items gradually

became more difficult to earn (i.e., required more responses) while the reinforcement ratio for low-caloric food remained the same throughout the task. As expected, participants in the GNG training condition exerted less effort to obtain high-caloric food compared to participants in the control condition, indicating a reduction in the reinforcing, motivational value of high-caloric food following GNG training.

Differences in food reinforcement were, however, only found in the final reinforcement schedule. More specifically, when the response requirement for high-caloric food was equal to that of low-caloric food, participants in both conditions exerted equal amounts of effort to obtain the high-caloric food. As the response requirement for high-caloric food was exponentially increased relative to the response requirement of low-caloric food, the GNG condition started to show reduced responding to the high-caloric food item while the control condition was more persistent in their efforts to obtain high-caloric food (this difference was only significant in the last schedule; FR32). These findings therefore indicate that participants in the GNG condition did not simply inhibit their responses for high-caloric food more relative to control. Only as the behavioral cost for high-caloric food increased relative to the cost for low-caloric food, participants in the GNG training condition showed reduced responding relative to control. These findings thus seem to indicate a devaluation effect rather than a simple motor inhibition effect. If trained no-go foods were associated with automatic motor inhibition one might expect fewer mouse-clicks to these foods already in the very first block of the CST in the trained group compared to control. The current results (with no main effect of group and no effect early on in the CST) thus tentatively argue against a simple motor inhibition account of GNG training effects. Instead, these findings seem to indicate reduced reinforcing value for high-caloric food following GNG training. On the basis of behavioral choice theory, excessive food intake can be reduced, either by decreasing the reinforcing value of unhealthy, high-caloric food or by increasing the reinforcing value of competing alternatives (Epstein & Saelens, 2000; Goldfield & Epstein, 2002). Research in this area mostly aimed at increasing the behavioral cost to obtain unhealthy food while making healthier alternatives more easily available (e.g., Giesen et al., 2010; Goldfield & Epstein, 2002). The present findings show that GNG training can perhaps offer an alternative approach by directly manipulating the reinforcing value of unhealthy, high-caloric food.

These findings are in line with other studies that have shown a devaluation of no-go associated food stimuli. Previous studies have mostly focused on self-reported hedonic food ratings, which were found to be lower following GNG training (e.g., Chen et al., 2016; Lawrence, O'Sullivan et al., 2015; Lawrence, Verbruggen et al., 2015; Veling et al., 2013a), although there have also been some studies that have shown that no-go associated food is devalued using tasks with a stronger motivational component. For instance, GNG training has been found to be associated with reductions in impulsive food choice under time pressure (e.g. Porter et al., 2017; Veling et al., 2013b), and with reduced willingness to pay for no-go associated food (e.g., Stice, Yokum, Veling, Kemps, & Lawrence, 2017). For other types of stimuli, research has also demonstrated that GNG training reduces the willingness to pay for no-go associated stimuli (e.g., Wessel, Tonnesen, & Aron, 2015; Wessel, O'doherty, Berkebile, Linderman, & Aron, 2014) as well as the willingness to work to obtain the stimuli (e.g., Ferrey et al., 2012). The present findings complement these results and, together, these findings indicate that GNG training not only reduces the hedonic value of no-go associated stimuli but also decreases their motivational, reinforcing value. Specifically with respect to food, this is an important finding as the motivational value of food may be a more powerful predictor of food consumption than the hedonic value of food (e.g., Epstein et al., 2015, 2011; Temple et al., 2008). Therefore, for future research, it would be interesting to directly compare GNG training effects on measures of hedonic and motivational value and to test how such changes mediate behavioral change.

It should be noted that the effect of GNG training on food

reinforcement was relatively small, albeit significant. In part, this small effect size could be due to the fact that the GNG training was performed with a larger subset of stimuli than the CST. To be more concrete, the GNG training (and control task) were the same for all participants and presented an array of eight food items (four high-caloric and four low-caloric food items) that were paired with the go and no-go cues. The CST, however, was performed with participants' most preferred high- and low-caloric food item (matched on hedonic liking) from this selection of eight food stimuli. Consequently, only 25% of GNG training trials were relevant to the CST. For future research, it would be better to increase the correspondence between the stimuli used in GNG training and the stimuli used in assessment tasks. A further limitation to the present study is that participants consisted of undergraduate students. Given that food reinforcement has been found to be stronger in overweight individuals (e.g., Giesen et al., 2010; Saelens & Epstein, 1996; Temple et al., 2008) as well as in unsuccessful restrained eaters (e.g. Giesen, Havermans, Nederkoorn, Strafacci, & Jansen, 2009), future research needs to investigate whether GNG training similarly affects the reinforcing value of food in other target groups that are characterized by elevated food reinforcement.

In conclusion, consistently and repeatedly inhibiting responses toward high-caloric food during GNG training reduces the reinforcing value of those food items. These results extend previous research showing that GNG training induces automatic motor inhibition toward no-go associated stimuli and decreases the hedonic value of those stimuli. Together, these findings support the idea that motor inhibition is closely connected to reward value. However, whether exerting motor inhibition directly causes a devaluation of no-go associated stimuli in terms of hedonic and motivational value, or whether these are two separately operating mechanisms remains a question for future research.

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