Supplementary Data

1. Pilot study 1: Pictures selection and evaluation (arousal, disgust and positive emotion).

We performed a first pilot study to select our 24 emotional pictures (4 disgust and 4 positive pictures for each of the food, face, and invertebrate category) from an initial sample of 132 pictures. The initial picture sample included 56 foods, 56 invertebrates and 20 faces from the Nimstim database. Half pictures depicted disgust-related and half positive stimuli. Each picture was individually presented to a group of 14 healthy participants (7 females, age range 20-40), who were asked to report on a 9-points Likert scale, the arousal they subjectively felt during picture presentation. The order of presentation was randomized. Two additional separate blocks of ratings were then performed. In each block, the whole set of pictures was presented again and participants were asked to rate the degree to which the picture could be associated with the emotion of disgust (in one block) and a positive emotion (in the other block). This way, we tested the imaginative aspects of disgust (and of positive emotions) associated with the pictures. The order of the two blocks was counterbalanced across participants.

Pictures were selected in order to obtain similar moderate emotion ratings across categories. To do so, we first selected 2 female and 2 male facial expressions of distaste and joy with moderate emotional ratings. Then, we selected a subset of invertebrate and food stimuli with similar arousal, disgust and positive emotion ratings. The ratings of the selected stimuli are shown in Supplementary Table 1.

	Food		Invertebrates		Faces	
	Positive	Disgust	Positive	Disgust	Positive	Disgust
Arousal	5.3 ± 1.4	5.0 ± 1.7	5.2 ± 1.6	5.1 ± 1.5	5.2 ± 1.6	4.9 ± 2.0
Disgust	2.1 ± 1.3	6.9 ± 2.0	2.4 ± 1.5	5.4 ± 2.4	1.9 ± 1.3	6.7 ± 2.3
Positive emotion	6.4 ± 1.1	1.6 ± 0.8	6.0 ± 1.9	2.0 ± 1.2	6.4 ± 1.7	1.7 ± 1.0

Supplementary Table 1. Mean ratings ± S.D. of the final set of stimuli in the first pilot study.

To test the emotional qualities of the selected pictures, we performed a Stimulus category (food, face, invertebrate) x Emotion (positive, disgust) repeated measure analysis of variance (ANOVA) on arousal judgments. The ANOVA revealed no significant effect (all $F < 1$, $p > .48$), confirming that the selected pictures evoked comparable arousal in the observers. Similar Stimulus category x Emotion ANOVAs were performed on disgusts and positive emotion ratings. Both analyses revealed a significant main effect of Emotion (all $F_{1,13} > 77.00$, all $p < .0001$), indicating higher disgust ratings for disgust than for positive pictures and higher positive emotion ratings for positive than for disgust pictures. No main effects or interactions with the factor Stimulus category were found (all $F < 2.58$, all $p > .09$). These analyses confirm that the selected pictures were matched not only for arousal, but also disgust and positive emotions across the different picture categories.

2. Pilot study 2: Picture evaluation (arousal, valence, revulsion and repulsion).

In a second pilot study, we presented the selected 24 pictures to an additional group of 16 healthy participants (7 females, age range 21-40) to further assess emotional qualities of the selected stimuli. We performed four blocks of evaluation during which the 24 stimuli were individually presented and participants had to provide an emotional judgment. In the first two blocks, participants were asked to rate the arousal and valence evoked by the picture using a 5-points Self-Assessment Manikin (SAM). In the following two blocks, participants were asked to evaluate two distinct aspects of the emotion of disgust using a 5-points Likert scale. They rated the degree to which the picture could be associated with revulsion (i.e., distaste, yuck, unpleasant feelings related to the mouth) or with repulsion (i.e., loathing, physical withdrawal/not wanting to touch or be touched by the subject of the picture). The order of the first two blocks (arousal, valence) and the second two blocks (revulsion, repulsion) was randomized across participants.

Supplementary Table 2 show data from the second pilot study.

	Food		Faces		Invertebrates	
	Positive	Disgust	Positive	Disgust	Positive	Disgust
Arousal	3.3 ± 0.9	3.6 ± 0.9	3.2 ± 0.9	3.2 ± 1.0	3.3 ± 1.0	3.7 ± 1.0
Valence	4.1 ± 0.5	1.6 ± 0.6	4.0 ± 0.7	1.9 ± 0.7	4.1 ± 0.6	1.7 ± 0.6
Revulsion	1.1 ± 0.1	4.6 ± 0.6	1.1 ± 0.2	3.9 ± 1.1	1.6 ± 0.8	2.8 ± 1.4
Repulsion	1.1 ± 0.4	3.1 ± 1.1	1.1 ± 0.3	2.0 ± 1.0	1.5 ± 0.7	4.4 ± 0.8

Supplementary Table 2. Mean ratings ± S.D. of the final set of stimuli in the second pilot study

To assess subjective ratings of the pictures, we performed a Stimulus category x Emotion ANOVA as in pilot study 1. The ANOVA on arousal ratings showed no significant effects (all $F < 1.98$, all $p > .18$), further indicating comparable arousal across stimuli types. The ANOVA on valence ratings showed a main effect of Emotion ($F_{1,15} = 200.86$, $p < .0001$), accounted for by the lower valence ratings for the disgusting stimuli. No main effect or interaction with the factor Stimulus category was found (all $F < 1$, $p > .56$). These findings confirm the general emotional features of our stimuli already highlighted in the first pilot study.

Interestingly, however, although the three types of disgusting stimuli were similar for arousal, valence, disgust and positive emotions (pilot studies 1 and 2), when we monitored revulsion and repulsion aspects of disgust, a double dissociation emerged between pictures representing gustatory disgust (i.e., rotten foods, distaste facial expressions) and pictures of disgusting invertebrates. Both the ANOVA on revulsion ratings and the ANOVA on repulsion ratings showed the significance of the main effects (all $F > 3.70$, $p < .036$) and, critically, of the Stimulus category x Emotion interaction ($F_{2,30} > 18.70$ $p < .0001$). Post-hoc analyses of the interactions were performed with the Duncan test to correct for multiple comparisons.

The analysis of revulsion ratings showed that rotten food pictures were rated higher on revulsion than fresh food pictures ($p < .0001$), pictures of distaste facial expressions were rated higher than pictures of positive expressions ($p < .0001$), and pictures of disgusting invertebrates were rated higher than pictures of positive invertebrates ($p = .0002$); critically, pictures signaling gustatory disgust (foods and distaste expressions) were rated higher on revulsion than disgusting invertebrates (all $p < .0001$) and pictures of disgusting foods tended to be rated higher than pictures of distaste expressions (p = .01). Pictures of fresh foods, positive facial expressions and invertebrates were rated similarly on revulsion (all $p > .09$).

The analysis of repulsion ratings showed that pictures of rotten foods were rated higher on repulsion than pictures of fresh foods ($p < .0001$), pictures of distaste facial expressions were rated higher than pictures of positive expressions ($p = .0009$), and pictures of disgusting invertebrates were rated higher than pictures of positive invertebrates ($p < .0001$); critically, pictures of disgusting invertebrates were rated higher than pictures related to gustatory disgust (foods and distaste expressions; all $p < .0001$); pictures of rotten foods were be rated higher than pictures of distaste expressions (p = .0002). Pictures of fresh foods, positive facial expressions and invertebrates were rated similarly on revulsion (all $p > .17$).

In sum, the two pilot studies assured that the three categories of disgust pictures were comparable across different affective dimensions (arousal, valence and "general" disgust), but differed when considering specific emotional aspects of disgust. In particular, pictures associated with gustatory disgust (i.e., in particular pictures of rotten foods but also pictures of distaste expressions) were rated higher on revulsion but lower on repulsion relative to disgusting invertebrates. This confirms our assumption of a stronger association between our gustatory disgust pictures and imaginative oral-related aspects of disgust.

3. Main experiment: assessment of changes in tongue motor cortex (tM1) and arm motor cortex (aM1) excitability over time.

To assess whether the prolonged stimulation was associated with changes in motor excitability over time, we analyzed MEPs amplitudes recorded during the neutral condition (i.e., the fixation cross) that was present in all the experimental blocks. Mean log-transformed MEP amplitudes in mV [log(value+1)] recorded during the observation of the fixation cross were considered as a function of the order of the block (first, second, third block) within each session and were analyzed using Friedman ANOVA. Neither the analysis of MEPs from tongue (Chi^2_2 = 2.71, p = .26) nor the analysis of MEPs from the ECR (Chi^2_2 = 2.00, p = .37) were significant. The lack of modulation of MEPs across blocks indicates that TMS *per se* did not change tM1 cortico-bulbar or aM1 cortico-spinal excitability over time.

4. Main experiment: Effect of experimental settings on tM1 cortico-hypoglossal modulation.

Participants in the TMS experiment were tested in two different laboratories at the University of Bologna (UB) and University of Queensland (UQ), with different equipment, but similar stimulation and recording parameters. Thus, it is important to check that similar results were obtained with the two experimental settings. Critically, a series of control analyses assured that the reduction of tongue MEPS for disgusting foods and distaste expressions was comparable in the two laboratories.

First, we used a non-parametric approach to assess the reduction of MEP amplitude for gustatory disgust relative to the control conditions. The reduction of MEP amplitude for the disgusting food relative to the control conditions (i.e., fresh food, food block baseline) resulted very similar in the two laboratories as shown by similar Wilcoxon-derived effect sizes computed on participants tested at UB (r = 0.44) and UQ (r = 0.37). Also, the reduction of MEP amplitude for distaste expressions relative to the control conditions was similar at UB (r = 0.56) and UQ (r = 0.37). Mann-Whithney U tests were used to directly compare MEP suppression effects (disgust minus control conditions) in the two laboratories. No between group difference was found for either the food or face category (all Z < 0.57, all p > .57).

Second, we further test the influence of the laboratory on tongue MEPs using a factorial design and parametric analyses. We performed a mixed factors Laboratory (UB, UQ) x Block category (Food, Invertebrates, Faces) x Emotion (Disgust, Positive, Baseline) parametric ANOVA on log-transformed

MEP amplitudes. The ANOVA showed a significant Block category x Emotion interaction ($F_{4,48} = 5.93$, $p = 0.002$), whereas the main effect of Laboratory or the high-order Laboratory x Block category x Emotion interaction were not significant (all $F < 1.56$, all $p > 0.2$). Although this parametric analysis further suggested no influence of the experimental setting, it should be noted that MEPs amplitudes were not normally distributed (see main text). Therefore, we additionally performed a Laboratory x Block category x Emotion using MEP ratios (each condition divided by the individual's grand average) that resulted normally distributed (Shapiro-Wilk tests: all $p > 0.22$). The ANOVA confirmed the significance of the Block category x Emotion interaction ($F_{4,48} = 3.02$, $p = 0.026$) and the absence of the Laboratory x Block category x Emotion interaction ($F_{4,48} = 1.38$, $p = 0.25$). The Block category x Emotion interaction was further analyzed using the Duncan test to correct for multiple comparisons. This post-hoc analysis confirmed the results reported in the main text: MEP amplitudes from the tongue were lower for rotten foods pictures than for pleasant foods and the food block baseline (all $p < .042$), which in turn did not differ from one another ($p = .40$); moreover, MEP amplitudes were lower for pictures of distaste facial expressions than for pictures of positive facial expressions and the face block baseline (all $p < .36$) which in turn did not differ from one another ($p = .18$). No changes in MEP amplitudes were found in the invertebrate block (all $p > .44$).