Supplementary Materials for

Gut markers of bodily self-consciousness

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Materials and Methods

Participants

Thirty-one healthy male subjects aged 20-30 years (M = 24.42, SD = 2.8) took part in the study after giving their informed consent. No subject had a history of psychiatric or neurologic disorders. A detailed screening procedure ensured that all participants were eligible for ingesting the SmartPill^{TM} without any known contraindication (history of gastric bezoars; history of any abdominal/pelvic surgery within the previous three months; swallowing disorders; suspected or known strictures, fistulas, or physiological/mechanical obstruction within the gastro-intestinal tract; dysphagia to food or pills; Crohn's disease or diverticulitis; body mass index ≥ 40; and cardiac pacemakers or defibrillators (*11*)). All subjects were naïve to the purpose of the research and were paid for their participation. The study was approved by the local Institutional Review Board (Fondazione Santa Lucia ethics committee).

Materials

1. SmartPill^{TM}

The gastro-intestinal milieu of each participant was monitored through a SmartPill^{TM} (SmartPill Motility Testing System, Medtronic plc). SmartPills are light, single-use, orally ingestible capsules (length: 26 mm; width: 13 mm; weight: 4.5 g) (**Fig. S1**). Each pill consists of a polyurethane shell fitted with a long-lasting battery (> 5 days), a transmitter (broadcast frequency: 434.2 MHz), and internal sensors probing temperature (range: 20-42 °C; accuracy: ± 1 °C), intraluminal pressure (range: 0-350 mmHg; accuracy: ± 5 mmHg in the 0-99 mmHg sub-range, ± 10% of applied pressure in the 100-350 mmHg sub-range) and pH (range: 1-9; accuracy: ± 0.5 pH units) of the gastro-intestinal (GI) tract.

Before being ingested, the pill is activated through a magnetic fixture and the pH sensor is calibrated through a buffer solution. After ingestion, the capsule samples temperature data every 20 s, pressure every 0.5 s, and pH every 5 s for the first 24 hours; sampling frequencies are halved thereafter. The pill transmitter wirelessly sends these data to an external radio receiver (operating range: ~ 1.5 m), which can be either docked in a dedicated station or comfortably fastened to a belt worn by the participant.

Combining pH, pressure, and temperature information, the MotiliGI software (Medtronic plc) univocally identifies the specific segment of the GI tract in which the pill is located at a given time. The software takes an abrupt increase of ≥ 2 pH units as a sign that the pill left the stomach and entered the small intestine. Likewise, the software interprets a subsequent gradual decrease of ≥ 1 pH unit for at least 10 consecutive minutes as a sign that the pill left the small intestine and entered the large intestine. If the pH decrease cannot be observed, MotiliGI relies on pressure data to mark the transition between small and large bowel. In our sample, 30 out of 31 subjects displayed a pH increase and decrease as expected, while for the remaining subject the software was still able to localize the GI districts that the pill went through based on the other data.

2. Electrogastrography (EGG) and electrocardiography (EKG)

Electrogastrographic (EGG) recordings were used as a measure of gastric contractions. EGG records the electrophysiological activity of a selected cluster of cells at the junction of the enteric nervous system with the stomach – the so-called interstitial cells of Cajal (ICC). ICC act as pacemakers of stomach contractions by generating and propagating electric slow waves that have a normal frequency of 0.05 Hz, i.e. 3 cycles/minute (*27*, *28*). In healthy subjects, each slow wave is coupled to a gastric contraction (*18*).

Slow wave electrical signals were recorded through a standard 1-channel EGG bipolar montage (*18*) with 3 pre-gelled disposable Ag/AgCl electrodes. Participants were instructed to lie supine on a deck chair, then their abdominal skin was accurately cleansed to reduce impedance. The first recording electrode was placed halfway between their xyphoid and their umbilicus, while the second recording electrode lay 5 cm up and 5 cm to the left of the first (taking the left side of participants as a reference) and the ground electrode lay on the left costal margin (**Fig. S2**). EGG electrodes were used also to pick electrocardiographic (EKG) signals for the heartbeat counting task (see section 5 below).

3. Immersive virtual reality

The immersive virtual reality apparatus for the embreathment illusion (*8*) included a virtual scenario designed in 3DS Max 2015 (Autodesk Inc) and Unity 2017.1 (Unity Technologies SF). The scenario was broadcasted to a VIVE headset (HTC Corp., 6 degrees of freedom, field of view: ~110°, resolution: 2160x1200 (1080x1200 per eye, aspect ratio 9:5), refresh rate: 90 Hz) and consisted of a life-size room in which a virtual body (avatar) lay on a deck chair.

In the *congruent* condition, the avatar was seen from a first-person perspective, had a human-like appearance, and breathed as the participant, i.e. it inspired when the participant inspired and expired when the participant expired, in real time. The exact alignment of real and virtual breathing was obtained through a customized VIVE sensor (**Movie S1**) that mapped real, respiration-induced belly movements onto the virtual body with sub-millimetric precision (error $< 10^{-3}$ m).

In the *incongruent* condition, the avatar was seen from a third-person perspective, had a wooden appearance, and breathed in anti-phase with the participant, i.e. it expired when the participant inspired and vice versa, in real time. The same VIVE sensor described above was adopted also in this condition, although in this case the y-axis of the sensor was mapped in a reverse fashion onto the virtual body to further enhance the incongruity effect.

A custom graphical user interface (GUI) was embedded in the virtual scenario, allowing participants to answer some questions relative to bodily self-consciousness (see section 4 below) at the end of each condition. For a detailed footage of the immersive virtual reality experience, please see **Movie S1** below.

4. Measures of bodily self-consciousness

At the end of each virtual reality condition, we administered a customized bodily self-consciousness questionnaire (as in (*8*)) consisting of five different 0-100 visual analogue scales (VAS). In each scale, participants indicated how much they agreed with a statement by selecting a point on a line ranging from complete disagreement (leftmost point) to complete agreement (rightmost point) through a joystick. **Table S1** shows the complete list of statements.

5. Measures of interoception

Interoceptive sensibility, that is, the participant's self-reported ability to monitor interoceptive signals (*29*), was measured through the Italian version of the Multidimensional Assessment of Interoceptive Awareness (MAIA) (*20*), a list of 32 questions sampling how much each participant is aware of their physiological state. In particular, the average of three MAIA subscales (*Noticing*, *Attention Regulation*, and *Body Listening*) was taken as a proxy of interoceptive sensibility. Responses were provided with a 6-points Likert scale.

Interoceptive accuracy, that is, the participant's objective performance at perceiving interoceptive signals (*29*), was assessed via Schandry's heartbeat counting task (*19*). Subjects were asked to report the number of heartbeats they perceived in four different time windows (25 s, 35 s, 45 s, 100 s) without guessing or relying on external cues (e.g. taking their own pulse). Subjective heartbeat counts were then compared with objective EKG recordings to compute an interoceptive accuracy index ranging from 0 (not accurate at all) to 1 (perfect accuracy).

<u>Data collection procedure</u>

To ensure that the data gathered by the SmartPill were as reliable as possible, subjects were instructed to discontinue any medication that could interfere with pH values and gastro-intestinal motility (*11*). Specifically, we checked that none of the participants was assuming any: i) proton pump inhibitors in the seven days before the experiment; ii) antihistamines, prokinetics, antiemetics, anticholinergics, antidiarrheals, narcotic analgesics, and non-steroidal anti-inflammatory drugs in the three days before the experiment; iii) laxatives in the two days before the experiment. Participants were instructed not to take antacids and any alcohol the day before the experiment. Eight hours before the experiment, they also stopped eating and smoking.

The day of the experiment, participants came to the laboratory, filled in the informed consent form, and ate a standardized ~260 kcal breakfast consisting of egg whites (120 g), two slices of bread, and jam (30 g) to make sure that gastro-intestinal transit times of the SmartPill were not affected by meal variability. Meanwhile, we activated the capsule through a magnetic fixture and calibrated the capsule pH sensor (see Materials above, section 1).

After calibration was complete, the pill started transmitting data to the radio receiver. Data came with a relative time stamp indicating the number of seconds elapsed from calibration, but no absolute time reference. To overcome this issue, we synchronized calibration with an external clock that provided us with the required absolute time frame. At that point, participants swallowed the SmartPill while drinking a glass of water (120 ml). A medical doctor supervised the ingestion procedure to help in case of swallowing problems. All subjects ingested the pill without any trouble. After the ingestion, participants fastened the receiver around their belt and lay supine on a deck chair. This allowed the experimenters to place EGG electrodes according to the montage described above (see Materials, section 2).

When the whole apparatus was in place, we recorded a 15-minute resting-state SmartPill/EGG baseline session in which participants were instructed to relax and keep their eyes open. Then, we perused real-time pH data displayed on the receiver to make sure that the capsule was working and actually lay in the stomach, as signaled by a highly acidic pH (~1-2). After this requirement was fulfilled, we administered a simplified version of the embreathment illusion (*8*) delivered through a virtual reality headset and a customized breathing sensor (see Materials, section 3).

Both the *congruent* and the *incongruent* condition of the illusion (see above) lasted for 240 s and were followed by the bodily self-consciousness questionnaire described in section 4 of the Materials. The order of experimental conditions was counterbalanced across participants. Conditions were interspersed with 5' washout pauses to avoid carryover effects. Throughout each experimental condition, the receiver logged SmartPill data about the pressure, temperature, and pH of the stomach, while a dedicated amplifier (ADInstruments PowerLab) registered the EGG signal (**Fig. S3**).

As we were interested in assessing the coupling between bodily self-consciousness and the physiology of each main segment of the gastro-intestinal tract, we waited until the pill went through the pylorus (as marked by a ≥ 2 pH units sudden increase: see above) to repeat the virtual reality experience. This normally occurred within 2-5 hours from the ingestion of the capsule. At that point, we administered again the embreathment illusion, this time recording small bowel data from both the SmartPill and the EGG. Afterwards, we asked participants to complete the heartbeat counting task (see Materials, section 5). When the capsule entered the large bowel (as marked by a ≥ 1 pH unit decrease lasting for at least 10 minutes, typically observed after 2-6 hours from the stomach-small bowel transition: cf. above), we administered the illusion again for the third and last time, always logging SmartPill and EGG data for each experimental condition (**Fig. S3**).

After the first 6 hours from the beginning of the experiment, participants were provided with a meal. After the first 8 hours, they could smoke again. After 3 days, they were allowed to drink alcohol as usual. During the pauses between the stomach and small bowel data collection and between the small and large bowel, subjects filled in the MAIA questionnaire (see Materials, section 5) and then they were free to work or study as they pleased, although they had to avoid strenuous physical exercise. Finally, after the last experimental condition of the large bowel was over, participants could leave the lab. However, they kept the receiver with them, so that they could check the gut physiological parameters for themselves until the capsule stopped transmitting data and was expelled through defecation, ordinarily 10-73 h after ingestion (*10*).

Data analysis procedure

1. Data pre-processing

Raw SmartPill data were downloaded from the receiver and exported as .txt files. A custom MATLAB algorithm converted relative timestamps in absolute times, so that each event (e.g. beginning and end of each experimental condition) was paired to a definite hh:mm:ss:ms string. We computed the gastric, small bowel, large bowel, and whole gut transit times of the capsule (*10*) to check whether any subject displayed anomalies in their gastric physiology. 30 out of 31 subject had normal transit times, while the remaining subject had an abnormal large bowel transit time (>> 59 h, cf. (*11*)). Consequently, his SmartPill data were discarded.

Raw EGG recordings were visually inspected to remove artifacts due to body movements. A 0.016-0.15 Hz bandpass filter removed pink noise and unwanted higher frequencies that are ordinarily associated with cardiac, respiratory, and small bowel activity (cf. (*30*)). The artifact-free tracings thus obtained were then used to extract the EGG peak frequency for each subject and experimental condition (**Fig. S2**). EGG spectral density was computed using Welch's method on 200 s time windows with 150 s overlap (*15*). EGG peak frequency was defined as the maximum periodogram peak in the 'normogastric' range, i.e. the range of frequencies that is compatible with the number of stomach contractions in healthy individuals (0.033–0.066 Hz ~ 2-4 cycles per minute; cf. (*15*)). The whole EGG analysis procedure was performed with BrainVision Analyzer (Brain Products GmbH) and the MATLAB FieldTrip toolbox (*31*).

Raw EKG recordings were processed in LabChart to detect the QRS complex associated with each heartbeat and thus compute the actual number of heartbeats for each time window of the heartbeat counting task. These objective data were then paired with self-reported numbers of heartbeat for each time window to calculate an interoceptive accuracy score for each participant.

Raw bodily self-consciousness ratings provided by the subjects through the VAS questionnaire in the virtual reality GUI were exported, then matched with the average pH, pressure, temperature, and EGG peak frequency values computed for each participant, each experimental condition, and each gastro-intestinal district (stomach, small bowel, large bowel). The resulting data matrices are available at
https://osf.io/wecta/?view_only=45e1a9e30c2a47efa82c10161b70b732

2. Statistical analysis

We used R (version 3.6.1) and the R *lme4* package (*32*) to perform a linear mixed-effects analysis of the data. We modelled how much ratings of perceived body ownership, agency, location, disembodiment, and two bodies (see above and **Table S1**) changed depending on the experimental conditions, the GI district, and, most importantly, the mean pH, pressure, temperature, and peak frequency values recorded in each experimental condition. We built four distinct mixed-effects models: the first three tested the influence of pH, pressure, and temperature of the three GI districts (stomach, small bowel, and large bowel) over bodily self-consciousness, while the fourth assessed the influence of EGG peak frequencies over bodily self-consciousness.

For the first three models, the dependent variables were the bodily self-consciousness VAS ratings collected when the pill was in the stomach, in the small bowel, and in the large bowel, respectively. For the fourth model, the dependent variable were bodily self-consciousness VAS ratings collected when the pill was in the stomach.

As fixed effects, the first three models had the experimental *condition*, i.e. human-avatar sensory congruency (two levels: congruent and incongruent), the VAS *item* (five levels: perceived ownership, agency, location, disembodiment, and two bodies: see **Table S1**), the individual scores of *interoceptive accuracy* (continuous) and *interoceptive sensibility* (continuous), the condition-specific *pH* (continuous), *pressure* (continuous), and *temperature* (continuous). Also the fourth (EGG) model featured condition, item, accuracy, and sensibility as factors, but replaced pH, pressure, and temperature with condition-specific *EGG peak frequencies*. In all four models fixed effects were tested for interactions with each other.

As random effects, the models included by-condition and by-item random slopes as well as by-subject intercepts. Hence, each mixed model was specified as follows.

Model 1 (SmartPill data, stomach)
*VAS ~ condition * item * (ph + pressure + temperature) * (int. accuracy + int. sensibility) + (condition + item | subject), data = stomach, control = lmerControl(optimizer = "bobyqa")*

Model 2 (SmartPill data, small bowel)
*VAS ~ condition * item * (ph + pressure + temperature) * (int. accuracy + int. sensibility) + (condition + item | subject), data = smallbowel, control = lmerControl(optimizer = "bobyqa")*

Model 3 (SmartPill data, large bowel)
*VAS ~ condition * item * (ph + pressure + temperature) * (int. accuracy + int. sensibility) + (condition + item | subject), data = largebowel, control = lmerControl(optimizer = "bobyqa")*

Model 4 (EGG data, stomach)
*VAS ~ condition * item * egg peak frequencies * (int. accuracy + int. sensibility) + (condition + item | subject), data = egg.data, control = lmerControl(optimizer = "bobyqa")*

We used the *lmerTest* package (*33*) to extract p-values through a type II analysis of variance with Satterthwaite's method. Statistically significant interactions were followed up with post-hoc tests of the simple effects involving gut physiological parameters, experimental conditions, and bodily self-consciousness ratings against the null hypothesis of a slope equal to zero. When the significant interactions included a continuous moderator (interoceptive accuracy or sensibility) these post-hoc tests were performed at three spotlight values of the continuous moderator (average and +/- 1 standard deviation values of interoceptive accuracy or sensibility). All post-hoc tests were done through the *emmeans* package to obtain estimated marginal means (EMMs). EMMs were then plotted with the *emmip* function. The standard assumptions and requirements of mixed models (linearity, homoscedasticity, absence of collinearity, and normality of residuals) were assessed through visual inspection of residual plots, the *shapiro.test* function, and the *vif* function. The percentage of variance explained by each mixed-effects model (*34*) was computed through the *r.squaredGLMM* function of Kamil Bartoń's MuMIn Package.

Supplementary Text

Please find below an extended technical description of the results presented in the main text.

1. SmartPill results – stomach

Model 1 (see above, data analysis procedure, section 2) resulted in a boundary fit, had a marginal R^2 = .55 and a conditional R^2 = .85. Visual inspection of the plots did not reveal any obvious deviation from homoscedasticity. Residuals were not normally distributed (Shapiro-Wilk normality test, W = 0.983, p = .005), but linear models are robust against violations of normality (*35*). As for collinearity, all independent variables had a (GVIF^(1/(2*Df)))^2 < 10) except for the *pressure* variable ((GVIF^(1/(2*Df)))^2 = 34.57).

Type II analysis of variance of Model 1 yielded statistically significant 4-way interactions between condition, item, accuracy, and pH (F = 2.9156, p = 0.026); between condition, item, accuracy, and pressure (F = 3.0095, p = 0.024); between condition, item, sensibility, and pressure (F = 2.6013, p = 0.042); and between condition, item, accuracy, and temperature (F = 3.2093, p = 0.017) (**Table S2**). The complete post-hoc tests of the 4-way interactions, whose key results are already described in the main text, are presented in **Tables S3-S6**.

Other significant 3-way and 2-way interactions, as well as significant main effects, are listed in **Table S2** and were not further discussed due to the presence of the higher-order, 4-way interactions described above.

2. SmartPill results – small bowel

Model 2 (see above, data analysis procedure, section 2) resulted in a boundary fit, had a marginal R^2 = .47 and a conditional R^2 = .78. Visual inspection of the plots did not reveal any obvious deviation from homoscedasticity. Residuals were normally distributed (Shapiro-Wilk normality test, W = 0.991, p = 0.111). There were no collinearity issues (for all independent variables, (GVIF^(1/(2*Df)))^2 < 10).

Type II analysis of variance of Model 2 yielded a statistically significant interaction between condition and item (F = 23.3875, p < 0.001) but no statistically significant effect of pH, pressure, or temperature (**Table S7**). Significant main effects are listed in **Table S7**. The interaction and the main effects were not further discussed since no effect of small bowel physiological signals on bodily self-consciousness ratings was found.

3. SmartPill results – large bowel

Model 3 (see above, data analysis procedure, section 2) resulted in a boundary fit, had a marginal R^2 = .50 and a conditional R^2 = .79. Visual inspection of the plots did not reveal any obvious deviation from homoscedasticity. Residuals were not normally distributed (Shapiro-Wilk normality test, W = 0.944, p < 0.001) but linear models are robust against violations of normality (*35*). The *pressure*, *temperature*, and *interoceptive accuracy* variables had a GVIF^(1/(2*Df)))^2 of 26.32, 10.18, and 10.05, respectively. For all other independent variables (GVIF^(1/(2*Df)))^2 < 10.

Type II analysis of variance of Model 3 yielded a statistically significant 2-way interaction between pH and accuracy ($F = 4.8799$, $p = 0.042$) (**Table S8** and **Figure S4**) and a statistically significant 3-way interaction between condition, item, and pH ($F = 4.5602$, $p = 0.002$) (**Table S8**; see also **Figure 2**).

Other significant effects are listed in **Table S8** and were not further discussed since they did not involve gut signals or due to the presence of a higher-order interaction. Post-hoc tests of the *pH x accuracy* and *condition x item x pH* interactions, whose key results are already described in the main text (see **Figure 2**), are presented in **Tables S9-S10**.

4. Electrogastrography (EGG) results

Model 4 (see above, data analysis procedure, section 2) resulted in a boundary fit, had a marginal $R^2 = .48$ and a conditional $R^2 = .77$. Visual inspection of the plots did not reveal any obvious deviation from homoscedasticity. Residuals were not normally distributed (Shapiro-Wilk normality test, $W = 0.986$, $p < 0.024$) but linear models are robust against violations of normality (*35*). For the condition-specific EGG peak frequency variable, (GVIF^(1/(2*Df)))^2 = 10.18; for all other independent variables, (GVIF^(1/(2*Df)))^2 < 10.

Type II analysis of variance of Model 4 yielded a statistically significant 3-way interaction between condition, EGG peak frequency, and interoceptive sensibility ($F = 9.8104$, $p = 0.003$) (**Table S11**). Other significant effects are listed in **Table S11** and were not further discussed since they did not involve gut signals. Post-hoc tests of the *condition x EGG peak frequency x sensibility* interaction, whose key result is already mentioned in the main text, are presented in **Table S12 and Figure S5**.

Construct	Statement
p. body ownership	I had the feeling the virtual body/object was mine
p. body agency	I had the feeling I controlled the movements of the virtual body/object
p. body location	I had the feeling I occupied the same place of the virtual body/object
p. disembodiment	I had the feeling I had no body
p. two bodies	I had the feeling I had more than one body

Table S1. Bodily self-consciousness questionnaire. *p.*: perceived.

	Sum Sq	*Mean Sq*	*NumDF*	*DenDF*	*F*	*p*
condition	9035.1	9035.1	1	11.459	42.5370	< 0.001 ***
item	20075.7	5018.9	4	21.118	23.6289	< 0.001 ***
ph	3.2	3.2	1	19.494	0.0152	0.903153
pressure	178.6	178.6	1	30.091	0.8409	0.366439
temperature	315.0	315.0	1	14.018	1.4830	0.243413
iacc	696.7	696.7	1	13.945	3.2801	0.091715
isen	1333.8	1333.8	1	17.440	6.2793	0.022385 *
condition:item	22504.1	5626.0	4	81.470	26.4872	< 0.001 ***
condition:ph	54.7	54.7	1	13.256	0.2576	0.620120
condition:pressure	125.5	125.5	1	15.838	0.5907	0.453452
condition:temperature	386.7	386.7	1	11.745	1.8204	0.202699
item:ph	5289.5	1322.4	4	30.072	6.2257	< 0.001 ***
item:pressure	1746.9	436.7	4	51.924	2.0561	0.100038
item:temperature	2786.4	696.6	4	22.527	3.2795	0.029283 *
condition:iacc	72.6	72.6	1	11.507	0.3416	0.570175
condition:isen	96.4	96.4	1	14.687	0.4539	0.510966
item:iacc	783.8	195.9	4	22.385	0.9225	0.468372
item:isen	1160.7	290.2	4	27.623	1.3662	0.271174
ph:iacc	1428.8	1428.8	1	29.460	6.7268	0.014646 *
ph:isen	402.0	402.0	1	19.687	1.8924	0.184380
pressure:iacc	86.1	86.1	1	22.852	0.4055	0.530585
pressure:isen	1.0	1.0	1	27.536	0.0046	0.946344
temperature:iacc	0.1	0.1	1	17.572	0.0006	0.981351
temperature:isen	404.5	404.5	1	17.963	1.9045	0.184506
condition:item:ph	3049.1	762.3	4	82.603	3.5887	0.009508 **
condition:item:pressure	2013.1	503.3	4	82.115	2.3694	0.059203
condition:item:temperature	1329.8	332.5	4	82.147	1.5652	0.191350
condition:item:iacc	2396.9	599.2	4	81.398	2.8212	0.030205 *
condition:item:isen	2967.8	741.9	4	83.991	3.4930	0.010912 *
condition:ph:iacc	0.9	0.9	1	17.749	0.0044	0.947988
condition:ph:isen	177.1	177.1	1	13.563	0.8336	0.377171
condition:pressure:iacc	684.2	684.2	1	24.789	3.2212	0.084897
condition:pressure:isen	482.8	482.8	1	18.870	2.2729	0.148214
condition:temperature:iacc	407.5	407.5	1	15.392	1.9187	0.185745
condition:temperature:isen	510.2	510.2	1	14.800	2.4019	0.142301
item:ph:iacc	1529.1	382.3	4	48.892	1.7997	0.144015
item:ph:isen	800.6	200.2	4	29.839	0.9423	0.453186
item:pressure:iacc	2727.4	681.9	4	74.717	3.2101	0.017316 *
item:pressure:isen	1636.1	409.0	4	57.483	1.9256	0.118425
item:temperature:iacc	2267.0	566.7	4	28.429	2.6682	0.052554
item:temperature:isen	78.8	19.7	4	28.515	0.0927	0.983993
condition:item:ph:iacc	2477.1	619.3	4	81.206	2.9156	0.026239 *
condition:item:ph:isen	1569.6	392.4	4	83.525	1.8474	0.127443
condition:item:pressure:iacc	2557.0	639.2	4	65.994	3.0095	0.024183 *
condition:item:pressure:isen	2210.1	552.5	4	78.205	2.6013	0.042294 *
condition:item:temperature:iacc	2726.7	681.7	4	83.780	3.2093	0.016739 *
condition:item:temperature:isen	416.3	104.1	4	83.611	0.4899	0.743086

Table S2. Model 1 type II analysis of variance table with Satterthwaite's method. *iacc*: interoceptive accuracy. *isen*: interoceptive sensibility. Blue rows show interactions that were further analyzed through post-hoc tests. Significance codes: '***' < 0.001 '**' < 0.01 '*' < 0.05

Low interoceptive accuracy (- 1 S.D.)								
condition	*item*	*T.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	−14.45	27.3	20.0	−71.398	42.49	−0.529	0.6023
cong	*ownership*	62.62	29.8	21.9	0.881	124.37	2.104	0.0471*
inc	*agency*	−36.33	34.3	19.4	−108.000	35.34	−1.060	0.3023
cong	*agency*	−28.18	33.8	22.1	−98.174	41.82	−0.835	0.4129
inc	*location*	−60.02	30.1	19.6	−122.826	2.79	−1.996	0.0600
cong	*location*	56.15	34.0	21.7	−14.356	126.66	1.653	0.1127
inc	*disembodiment*	−46.54	28.1	20.7	−105.058	11.99	−1.655	0.1130
cong	*disembodiment*	−44.56	36.4	21.7	−120.090	30.98	−1.224	0.2339
inc	*twobodies*	21.74	26.8	20.8	−34.088	77.56	0.810	0.4270
cong	*twobodies*	6.47	36.5	21.2	−69.336	82.28	0.178	0.8608

Average interoceptive accuracy								
condition	*item*	*T.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	−14.86	13.3	19.4	−42.573	12.85	−1.121	0.2759
cong	*ownership*	19.01	12.3	19.1	−6.648	44.67	1.550	0.1375
inc	*agency*	−8.13	16.9	18.4	−43.483	27.23	−0.482	0.6353
cong	*agency*	3.28	14.4	17.7	−27.035	33.59	0.227	0.8228
inc	*location*	−22.71	14.6	18.7	−53.344	7.93	−1.553	0.1373
cong	*location*	10.42	14.5	17.9	−19.972	40.81	0.720	0.4805
inc	*disembodiment*	−36.09	13.7	19.7	−64.794	−7.38	−2.625	0.0164*
cong	*disembodiment*	−41.78	15.7	17.4	−74.911	−8.64	−2.655	0.0164*
inc	*twobodies*	−2.30	13.1	20.0	−29.600	25.00	−0.176	0.8621
cong	*twobodies*	−3.72	15.2	17.3	−35.772	28.32	−0.245	0.8094

High interoceptive accuracy (+ 1 S.D.)								
condition	*item*	*T.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	−15.27	24.4	20.3	−66.015	35.48	−0.627	0.5376
cong	*ownership*	−24.60	23.2	22.8	−72.591	23.40	−1.061	0.2999
inc	*agency*	20.08	30.4	20.2	−43.365	83.52	0.660	0.5169
cong	*agency*	34.73	26.0	24.3	−18.819	88.27	1.338	0.1934
inc	*location*	14.61	26.8	19.9	−41.360	70.57	0.545	0.5921
cong	*location*	−35.31	26.1	23.3	−89.333	18.71	−1.351	0.1896
inc	*disembodiment*	−25.64	25.0	21.3	−77.481	26.21	−1.027	0.3158
cong	*disembodiment*	−38.99	27.8	23.7	−96.450	18.46	−1.402	0.1740
inc	*twobodies*	−26.34	24.0	21.3	−76.177	23.49	−1.098	0.2843
cong	*twobodies*	−13.92	28.3	22.8	−72.460	44.61	−0.492	0.6273

Table S3. Model 1 post-hoc analysis of the interaction between condition, item, accuracy, and stomach temperature (*T*). *inc*: incongruent condition. *cong*: congruent condition. Degrees-of-freedom (*df*) method: Kenward-Roger. Confidence level (*CL*): 0.95.

Low interoceptive accuracy (- 1 S.D.)								
condition	*item*	*P.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	−1.625	5.34	24.3	−12.63	9.38	−0.305	0.7633
cong	*ownership*	11.089	8.21	21.4	−5.96	28.14	1.351	0.1908
inc	*agency*	0.414	5.61	41.8	−10.92	11.75	0.074	0.9416
cong	*agency*	5.087	8.62	35.2	−12.40	22.57	0.590	0.5587
inc	*location*	−2.132	5.72	26.8	−13.86	9.60	−0.373	0.7121
cong	*location*	12.994	8.76	24.9	−5.05	31.03	1.484	0.1504
inc	*disembodiment*	−6.297	4.97	29.9	−16.45	3.86	−1.266	0.2152
cong	*disembodiment*	10.460	8.95	35.2	−7.70	28.62	1.169	0.2502
inc	*twobodies*	−2.573	4.87	20.5	−12.71	7.56	−0.529	0.6026
cong	*twobodies*	−5.501	9.80	29.3	−25.53	14.53	−0.562	0.5787
Average interoceptive accuracy								
condition	*item*	*P.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	1.183	8.27	24.8	−15.86	18.23	0.143	0.8875
cong	*ownership*	−6.193	7.01	22.4	−20.72	8.34	−0.883	0.3866
inc	*agency*	20.212	8.87	40.8	2.29	38.13	2.278	0.0280*
cong	*agency*	0.808	7.47	34.4	−14.36	15.97	0.108	0.9144
inc	*location*	14.086	8.89	27.2	−4.14	32.31	1.585	0.1245
cong	*location*	−5.608	7.64	26.1	−21.31	10.10	−0.734	0.4696
inc	*disembodiment*	−22.435	7.79	30.8	−38.34	−6.53	−2.878	0.0072**
cong	*disembodiment*	−2.214	7.78	34.7	−18.01	13.59	−0.285	0.7777
inc	*twobodies*	0.560	7.60	22.4	−15.19	16.31	0.074	0.9420
cong	*twobodies*	2.650	8.39	28.3	−14.52	19.82	0.316	0.7543
High interoceptive accuracy (+ 1 S.D.)								
condition	*item*	*P.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	3.991	17.48	24.7	−32.03	40.01	0.228	0.8213
cong	*ownership*	−23.476	13.91	21.7	−52.35	5.40	−1.687	0.1058
inc	*agency*	40.011	18.68	41.1	2.28	77.74	2.141	0.0382*
cong	*agency*	−3.471	14.67	35.1	−33.26	26.32	−0.237	0.8144
inc	*location*	30.303	18.76	27.2	−8.17	68.78	1.615	0.1178
cong	*location*	−24.210	14.95	25.4	−54.98	6.56	−1.619	0.1178
inc	*disembodiment*	−38.573	16.44	30.7	−72.12	−5.02	−2.346	0.0256*
cong	*disembodiment*	−14.887	15.25	35.1	−45.83	16.06	−0.976	0.3355
inc	*twobodies*	3.692	16.03	22.1	−29.54	36.92	0.230	0.8199
cong	*twobodies*	10.801	16.61	29.0	−23.18	44.78	0.650	0.5207

Table S4. Model 1 post-hoc analysis of the interaction between condition, item, accuracy, and stomach pressure (*P*). Symbols and abbreviations as in Table S2. Degrees-of-freedom method: Kenward-Roger. Confidence level: 0.95.

Low interoceptive sensibility (- 1 S.D.)								
condition	*item*	*P.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	9.410	20.28	24.8	−32.38	51.20	0.464	0.6468
cong	*ownership*	−19.424	15.10	22.1	−50.74	11.89	−1.286	0.2117
inc	*agency*	45.536	21.81	40.6	1.48	89.60	2.088	0.0431*
cong	*agency*	−3.122	16.00	34.8	−35.62	29.37	−0.195	0.8464
inc	*location*	32.484	21.79	27.3	−12.21	77.18	1.491	0.1476
cong	*location*	−19.207	16.35	25.8	−52.83	14.42	−1.175	0.2509
inc	*disembodiment*	−40.291	19.14	30.9	−79.33	−1.25	−2.105	0.0435*
cong	*disembodiment*	−8.877	16.65	35.0	−42.68	24.92	−0.533	0.5973
inc	*twobodies*	7.199	18.66	22.6	−31.43	45.83	0.386	0.7032
cong	*twobodies*	13.847	18.05	28.7	−23.08	50.78	0.767	0.4492
Average interoceptive sensibility								
condition	*item*	*P.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	1.290	9.14	24.8	−17.55	20.13	0.141	0.8890
cong	*ownership*	−8.240	7.49	22.3	−23.75	7.27	−1.101	0.2828
inc	*agency*	22.180	9.81	40.8	2.37	41.99	2.262	0.0291*
cong	*agency*	0.326	7.96	34.5	−15.84	16.49	0.041	0.9676
inc	*location*	15.785	9.82	27.2	−4.35	35.92	1.607	0.1195
cong	*location*	−7.835	8.14	26.1	−24.57	8.90	−0.962	0.3449
inc	*disembodiment*	−24.142	8.61	30.8	−41.71	−6.57	−2.803	0.0087**
cong	*disembodiment*	−3.828	8.29	34.8	−20.67	13.01	−0.462	0.6472
inc	*twobodies*	0.773	8.40	22.4	−16.64	18.18	0.092	0.9275
cong	*twobodies*	3.432	8.95	28.4	−14.89	21.76	0.383	0.7043
High interoceptive sensibility (+ 1 S.D.)								
condition	*item*	*P.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	−6.831	7.86	24.3	−23.05	9.38	−0.869	0.3934
cong	*ownership*	2.943	5.10	23.1	−7.60	13.49	0.577	0.5693
inc	*agency*	−1.177	9.00	33.5	−19.48	17.12	−0.131	0.8967
cong	*agency*	3.773	5.49	32.6	−7.39	14.94	0.688	0.4964
inc	*location*	−0.915	8.57	25.6	−18.54	16.71	−0.107	0.9158
cong	*location*	3.537	5.61	26.7	−7.98	15.06	0.630	0.5339
inc	*disembodiment*	−7.993	7.62	29.8	−23.56	7.58	−1.049	0.3028
cong	*disembodiment*	1.221	5.75	33.1	−10.48	12.93	0.212	0.8332
inc	*twobodies*	−5.653	7.55	24.7	−21.21	9.91	−0.749	0.4611
cong	*twobodies*	−6.984	6.12	27.5	−19.53	5.56	−1.141	0.2636

Table S5. Model 1 post-hoc analysis of the interaction between condition, item, sensibility, and stomach pressure (*P*). *inc*: incongruent condition. *cong*: congruent condition. Degrees-of-freedom method: Kenward-Roger. Confidence level: 0.95.

Low interoceptive accuracy (- 1 S.D.)								
condition	*item*	*pH.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	36.99	24.36	24.6	−13.22	87.20	1.518	0.1417
cong	*ownership*	47.74	24.66	23.2	−3.27	98.74	1.935	0.0652
inc	*agency*	25.68	27.51	35.7	−30.12	81.48	0.934	0.3568
cong	*agency*	−8.18	26.53	32.4	−62.20	45.84	−0.308	0.7598
inc	*location*	16.93	26.48	26.2	−37.48	71.34	0.639	0.5282
cong	*location*	41.65	27.03	26.8	−13.84	97.13	1.541	0.1351
inc	*disembodiment*	52.46	23.44	30.5	4.62	100.29	2.238	0.0327*
cong	*disembodiment*	17.17	27.90	32.7	−39.60	73.95	0.616	0.5424
inc	*twobodies*	16.66	23.24	24.4	−31.27	64.59	0.717	0.4802
cong	*twobodies*	34.94	29.65	27.7	−25.81	95.70	1.179	0.2485
Average interoceptive accuracy								
condition	*item*	*pH.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	10.91	9.42	23.5	−8.56	30.38	1.158	0.2586
cong	*ownership*	10.64	10.40	23.3	−10.87	32.15	1.023	0.3169
inc	*agency*	6.14	11.07	28.9	−16.51	28.78	0.554	0.5836
cong	*agency*	1.03	11.47	27.7	−22.47	24.53	0.090	0.9290
inc	*location*	22.71	10.31	24.3	1.46	43.97	2.204	0.0372*
cong	*location*	7.45	11.71	25.6	−16.64	31.54	0.636	0.5304
inc	*disembodiment*	−1.52	9.30	27.7	−20.58	17.53	−0.164	0.8712
cong	*disembodiment*	−9.28	12.20	28.1	−34.26	15.71	−0.760	0.4533
inc	*twobodies*	−1.12	9.12	24.6	−19.93	17.68	−0.123	0.9032
cong	*twobodies*	7.48	12.60	24.8	−18.47	33.44	0.594	0.5578
High interoceptive accuracy (+ 1 S.D.)								
condition	*item*	*pH.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	−15.16	14.43	23.6	−44.98	14.65	−1.051	0.3041
cong	*ownership*	−26.46	16.97	22.9	−61.58	8.67	−1.559	0.1328
inc	*agency*	−13.41	16.91	29.1	−47.99	21.18	−0.793	0.4343
cong	*agency*	10.24	18.14	33.4	−26.64	47.13	0.565	0.5760
inc	*location*	28.50	15.77	24.4	−4.02	61.03	1.807	0.0831
cong	*location*	−26.75	18.45	26.7	−64.63	11.13	−1.450	0.1588
inc	*disembodiment*	−55.50	14.22	27.8	−84.63	−26.37	−3.904	0.0005***
cong	*disembodiment*	−35.73	19.01	33.7	−74.38	2.92	−1.879	0.0689
inc	*twobodies*	−18.91	13.95	24.7	−47.66	9.85	−1.355	0.1876
cong	*twobodies*	−19.98	20.36	28.3	−61.67	21.71	−0.981	0.3349

Table S6. Model 1 post-hoc analysis of the interaction between condition, item, accuracy, and stomach pH. *inc*: incongruent condition. *cong*: congruent condition. Degrees-of-freedom method: Kenward-Roger. Confidence level: 0.95.

	Sum Sq	*Mean Sq*	*NumDF*	*DenDF*	*F*	*p*
condition	9930.1	9930.1	1	20.116	31.0816	< 0.001 ***
item	16300.3	4075.1	4	17.902	12.7552	< 0.001 ***
ph	668.8	668.8	1	22.292	2.0934	0.1619
pressure	88.8	88.8	1	46.711	0.2781	0.6005
temperature	19.1	19.1	1	16.647	0.0599	0.8097
iacc	333.9	333.9	1	18.625	1.0451	0.3197
isen	1059.7	1059.7	1	17.933	3.3169	0.0853
condition:item	29887.8	7472.0	4	77.294	23.3875	< 0.001 ***
condition:ph	56.6	56.6	1	18.276	0.1772	0.6787
condition:pressure	54.6	54.6	1	21.164	0.1710	0.6834
condition:temperature	180.3	180.3	1	26.358	0.5644	0.4591
item:ph	1790.7	447.7	4	22.142	1.4012	0.2661
item:pressure	627.0	156.7	4	37.519	0.4906	0.7426
item:temperature	139.5	34.9	4	20.233	0.1092	0.9779
condition:iacc	10.4	10.4	1	21.636	0.0325	0.8585
condition:isen	62.9	62.9	1	22.770	0.1969	0.6615
item:iacc	1015.5	253.9	4	21.568	0.7947	0.5416
item:isen	1007.2	251.8	4	21.000	0.7881	0.5458
ph:iacc	0.0	0.0	1	30.954	0.0001	0.9934
ph:isen	82.9	82.9	1	21.978	0.2595	0.6156
pressure:iacc	0.1	0.1	1	44.209	0.0002	0.9900
pressure:isen	25.9	25.9	1	44.871	0.0811	0.7771
temperature:iacc	311.9	311.9	1	17.518	0.9763	0.3366
temperature:isen	156.1	156.1	1	16.519	0.4887	0.4942
condition:item:ph	2683.8	670.9	4	76.827	2.1001	0.0889
condition:item:pressure	1597.6	399.4	4	79.362	1.2502	0.2967
condition:item:temperature	1135.2	283.8	4	80.287	0.8883	0.4749
condition:item:iacc	516.0	129.0	4	78.434	0.4038	0.8054
condition:item:isen	1146.3	286.6	4	80.630	0.8970	0.4698
condition:ph:iacc	599.8	599.8	1	20.964	1.8773	0.1851
condition:ph:isen	805.0	805.0	1	27.303	2.5196	0.1240
condition:pressure:iacc	8.8	8.8	1	26.758	0.0277	0.8691
condition:pressure:isen	140.5	140.5	1	27.111	0.4399	0.5128
condition:temperature:iacc	159.6	159.6	1	22.832	0.4994	0.4869
condition:temperature:isen	360.8	360.8	1	21.406	1.1293	0.2998
item:ph:iacc	165.3	41.3	4	30.085	0.1293	0.9705
item:ph:isen	666.3	166.6	4	27.907	0.5214	0.7207
item:pressure:iacc	402.1	100.5	4	38.270	0.3147	0.8664
item:pressure:isen	700.5	175.1	4	41.971	0.5481	0.7014
item:temperature:iacc	914.4	228.6	4	20.134	0.7155	0.5911
item:temperature:isen	579.0	144.7	4	19.539	0.4530	0.7690
condition:item:ph:iacc	953.3	238.3	4	79.467	0.7459	0.5636
condition:item:ph:isen	840.6	210.2	4	79.819	0.6578	0.6231
condition:item:pressure:iacc	406.0	101.5	4	80.234	0.3177	0.8653
condition:item:pressure:isen	451.0	112.7	4	79.466	0.3529	0.8413
condition:item:temperature:iacc	589.5	147.4	4	77.462	0.4613	0.7639
condition:item:temperature:isen	772.1	193.0	4	76.480	0.6042	0.6608

Table S7. Model 2 type II analysis of variance table with Satterthwaite's method. *iacc*: interoceptive accuracy. *isen*: interoceptive sensibility. Significance codes as in table S2.

	Sum Sq	*Mean Sq*	*NumDF*	*DenDF*	*F*	*p*
condition	10710.1	10710.1	1	16.182	36.1729	< 0.001 ***
item	16920.4	4230.1	4	15.317	14.2869	< 0.001 ***
ph	664.8	664.8	1	17.156	2.2452	0.152205
pressure	269.2	269.2	1	21.235	0.9094	0.351015
temperature	33.8	33.8	1	14.786	0.1143	0.740069
iacc	593.2	593.2	1	14.224	2.0036	0.178444
isen	1420.5	1420.5	1	14.581	4.7978	0.045195 *
condition:item	24109.8	6027.5	4	71.362	20.3574	< 0.001 ***
condition:ph	183.1	183.1	1	19.908	0.6185	0.440862
condition:pressure	0.4	0.4	1	22.545	0.0015	0.969731
condition:temperature	59.0	59.0	1	20.310	0.1991	0.660140
item:ph	1991.8	497.9	4	18.629	1.6818	0.196487
item:pressure	2893.9	723.5	4	22.645	2.4435	0.075938
item:temperature	2157.2	539.3	4	16.859	1.8214	0.171606
condition:iacc	13.7	13.7	1	17.408	0.0462	0.832236
condition:isen	48.7	48.7	1	20.448	0.1643	0.689398
item:iacc	458.2	114.5	4	15.768	0.3869	0.814846
item:isen	297.2	74.3	4	16.601	0.2510	0.905001
ph:iacc	1444.9	1444.9	1	15.606	4.8799	0.042494 *
ph:isen	167.6	167.6	1	30.834	0.5662	0.457499
pressure:iacc	36.4	36.4	1	28.329	0.1230	0.728422
pressure:isen	778.8	778.8	1	37.549	2.6302	0.113214
temperature:iacc	1.2	1.2	1	15.630	0.0040	0.950313
temperature:isen	131.6	131.6	1	15.106	0.4446	0.514973
condition:item:ph	5400.7	1350.2	4	74.311	4.5602	0.002389 **
condition:item:pressure	847.7	211.9	4	74.591	0.7158	0.583780
condition:item:temperature	923.9	231.0	4	75.988	0.7801	0.541588
condition:item:iacc	169.2	42.3	4	73.052	0.1429	0.965594
condition:item:isen	376.1	94.0	4	76.185	0.3176	0.865386
condition:ph:iacc	1147.8	1147.8	1	20.071	3.8767	0.062923
condition:ph:isen	9.0	9.0	1	27.944	0.0303	0.863165
condition:pressure:iacc	516.4	516.4	1	22.556	1.7440	0.199875
condition:pressure:isen	33.6	33.6	1	24.481	0.1133	0.739253
condition:temperature:iacc	378.2	378.2	1	15.085	1.2773	0.276052
condition:temperature:isen	250.9	250.9	1	18.550	0.8476	0.369059
item:ph:iacc	997.6	249.4	4	16.808	0.8423	0.517594
item:ph:isen	1163.1	290.8	4	29.297	0.9821	0.432500
item:pressure:iacc	1948.1	487.0	4	26.435	1.6449	0.192566
item:pressure:isen	1269.2	317.3	4	31.314	1.0717	0.387068
item:temperature:iacc	1369.0	342.3	4	16.257	1.1560	0.366032
item:temperature:isen	1085.8	271.4	4	16.638	0.9168	0.477230
condition:item:ph:iacc	819.6	204.9	4	75.308	0.6921	0.599729
condition:item:ph:isen	432.6	108.2	4	76.938	0.3653	0.832620
condition:item:pressure:iacc	1323.7	330.9	4	76.565	1.1177	0.354426
condition:item:pressure:isen	528.2	132.1	4	75.399	0.4460	0.774958
condition:item:temperature:iacc	1211.1	302.8	4	68.879	1.0226	0.401891
condition:item:temperature:isen	453.7	113.4	4	74.610	0.3831	0.820053

Table S8. Model 3 type II analysis of variance table with Satterthwaite's method. *iacc*: interoceptive accuracy. *isen*: interoceptive sensibility. Blue rows show interactions that were further analyzed through post-hoc tests. Significance codes as in Table S2.

accuracy	*pH.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
low (−1 *S.D.*)	24.88	9.64	16.3	4.48	45.3	2.581	0.0199∗
average	9.89	5.28	17.7	−1.23	21.0	1.871	0.0779
high (+1 *S.D.*)	−5.11	7.42	15.9	−20.85	10.6	−0.688	0.5015

Table S9. Model 3 post-hoc analysis of the interaction between large bowel pH and pressure. Degrees-of-freedom method: Kenward-Roger. Confidence level: 0.95.

condition	*item*	*pH.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*ownership*	12.57	7.91	24.4	−3.739	28.9	1.589	0.1249
cong	*ownership*	19.51	9.03	22.9	0.825	38.2	2.160	0.0414∗
inc	*agency*	11.97	9.74	23.0	−8.179	32.1	1.229	0.2315
cong	*agency*	17.44	11.87	21.4	−7.212	42.1	1.470	0.1562
inc	*location*	−16.23	10.86	21.7	−38.769	6.3	−1.495	0.1492
cong	*location*	14.50	10.74	22.1	−7.766	36.8	1.351	0.1906
inc	*disembodiment*	13.81	7.30	24.9	−1.239	28.8	1.890	0.0704
cong	*disembodiment*	1.88	7.50	24.6	−13.579	17.3	0.251	0.8037
inc	*twobodies*	10.65	7.63	24.3	−5.094	26.4	1.395	0.1756
cong	*twobodies*	−6.54	8.12	23.7	−23.302	10.2	−0.805	0.4288

Table S10. Model 3 post-hoc analysis of the interaction between condition, item and large bowel pH. Degrees-of-freedom method: Kenward-Roger. Confidence level: 0.95.

	Sum Sq	*Mean Sq*	*NumDF*	*DenDF*	*F*	*p*
condition	22990.3	22990.3	1	18.927	79.8001	< 0.001 ***
item	11507.4	2876.9	4	24.933	9.9857	< 0.001 ***
eggcond	62.5	62.5	1	42.549	0.2168	0.643859
iacc	3404.4	3404.4	1	19.693	11.8167	0.002651 **
isen	1709.3	1709.3	1	19.939	5.9330	0.024370 *
condition:item	24902.4	6225.6	4	104.056	21.6092	< 0.001 ***
condition:eggcond	332.4	332.4	1	43.656	1.1539	0.288635
item:eggcond	1005.4	251.3	4	72.061	0.8724	0.484810
condition:iacc	85.5	85.5	1	22.510	0.2967	0.591333
condition:isen	5.8	5.8	1	19.172	0.0200	0.888886
item:iacc	1326.9	331.7	4	28.248	1.1515	0.352954
item:isen	1518.2	379.5	4	29.056	1.3174	0.286858
eggcond:iacc	263.3	263.3	1	42.132	0.9139	0.344529
eggcond:isen	922.1	922.1	1	35.358	3.2007	0.082178
condition:item:eggcond	2020.0	505.0	4	76.493	1.7528	0.147131
condition:item:iacc	2016.8	504.2	4	107.523	1.7501	0.144345
condition:item:isen	1761.9	440.5	4	104.794	1.5289	0.199143
condition:eggcond:iacc	6.2	6.2	1	43.086	0.0215	0.884230
condition:eggcond:isen	2826.4	2826.4	1	44.433	9.8104	0.003068 **
item:eggcond:iacc	618.1	154.5	4	78.110	0.5364	0.709408
item:eggcond:isen	139.1	34.8	4	50.148	0.1207	0.974464
condition:item:eggcond:iacc	743.8	185.9	4	82.075	0.6454	0.631695
condition:item:eggcond:isen	1504.4	376.1	4	77.720	1.3055	0.275386

Table S11. Model 4 type II analysis of variance table with Satterthwaite's method. *iacc*: interoceptive accuracy. *isen*: interoceptive sensibility. *eggcond*: EGG peak frequency. The blue row shows the interaction that was further analyzed through post-hoc tests. Significance codes as in table S2.

condition	*sensibility*	*EGG.trend*	*SE*	*df*	*lower.CL*	*upper.CL*	*t*	*p*
inc	*low* (−1 *S.D.*)	955	718	22.2	−533	2444	1.331	0.1967
cong	*low* (−1 *S.D.*)	163	589	21.1	−1061	1387	0.277	0.7842
inc	*average*	−972	651	20.9	−2326	383	−1.492	0.1506
cong	*average*	362	419	20.1	−511	1235	0.865	0.3975
inc	*high* (+1 *S.D.*)	−2899	1053	21.5	−5084	−713	−2.754	0.0117*
cong	*high* (+1 *S.D.*)	561	715	21.1	−925	2047	0.784	0.4415

Table S12. Model 4 post-hoc analysis of the interaction between condition, sensibility, and EGG peak frequency. Degrees-of-freedom method: Kenward-Roger. Confidence level: 0.95.

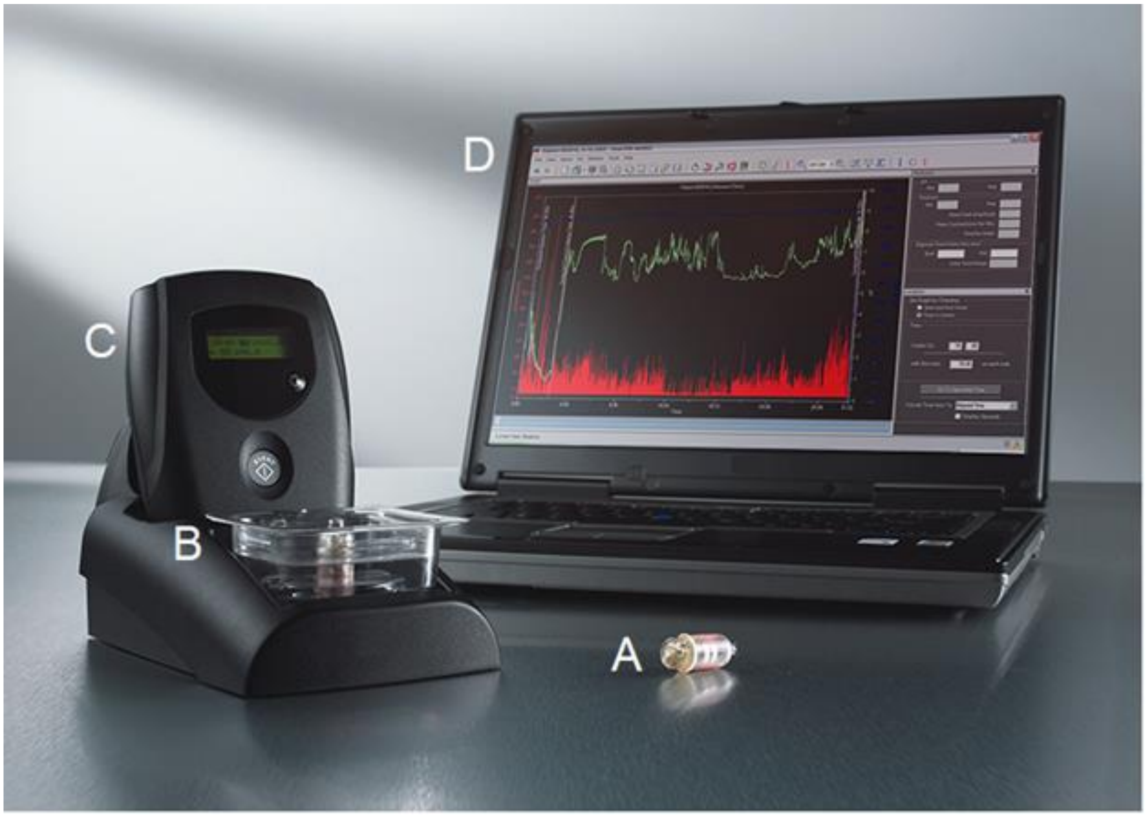

Figure S1. SmartPill apparatus. A: capsule. B: pH calibration buffer solution. C: data receiver and logger. D: laptop with graph showing pH (green line), temperature (blue line) and pressure (red bars) over time. Note the abrupt rise of the pH values in the left part of the screen, signaling the passage from the stomach to the small bowel, the slow build-up of the signal in the small bowel, and the rapid decrease marking the entrance of the pill in the large bowel. Adapted from a picture of Medtronic plc.

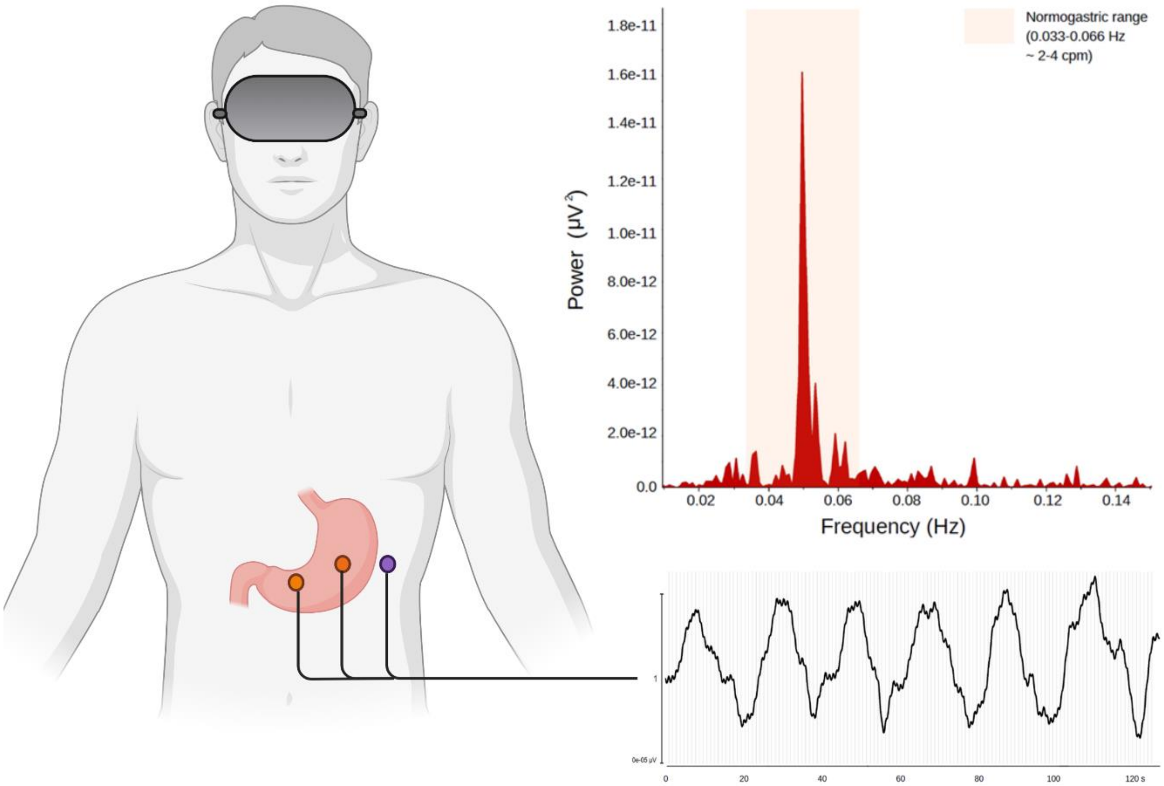

Figure S2. 1-channel EGG bipolar montage (left) with two recording electrodes (orange dots) and one ground electrode (purple dot), sample EGG recording (bottom right), and sample EGG periodogram (top right). Samples collected from a participant in our lab.

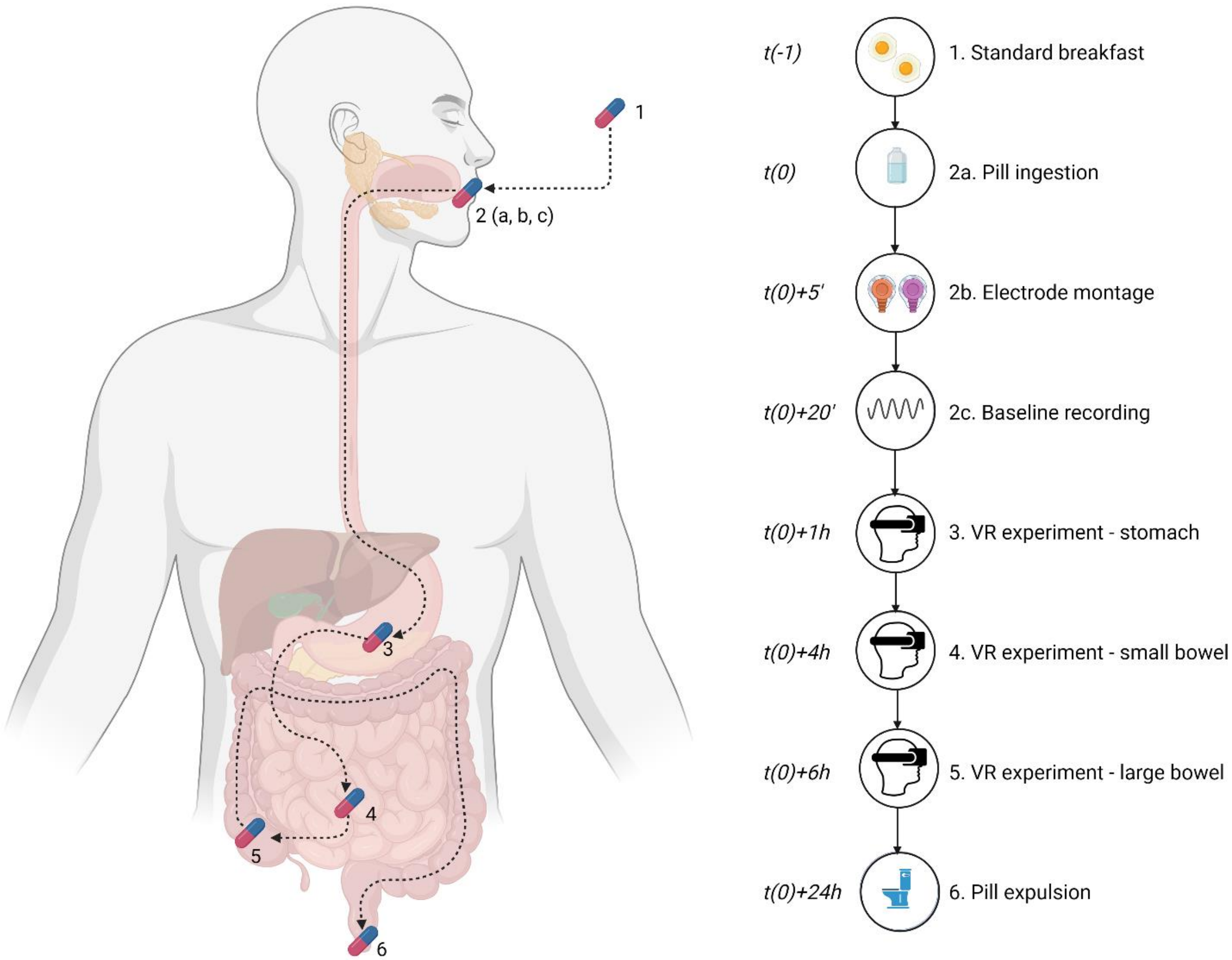

Figure S3. Timeline of the experimental procedures. Italicized text indicates the approximate average time at which each event occurs.

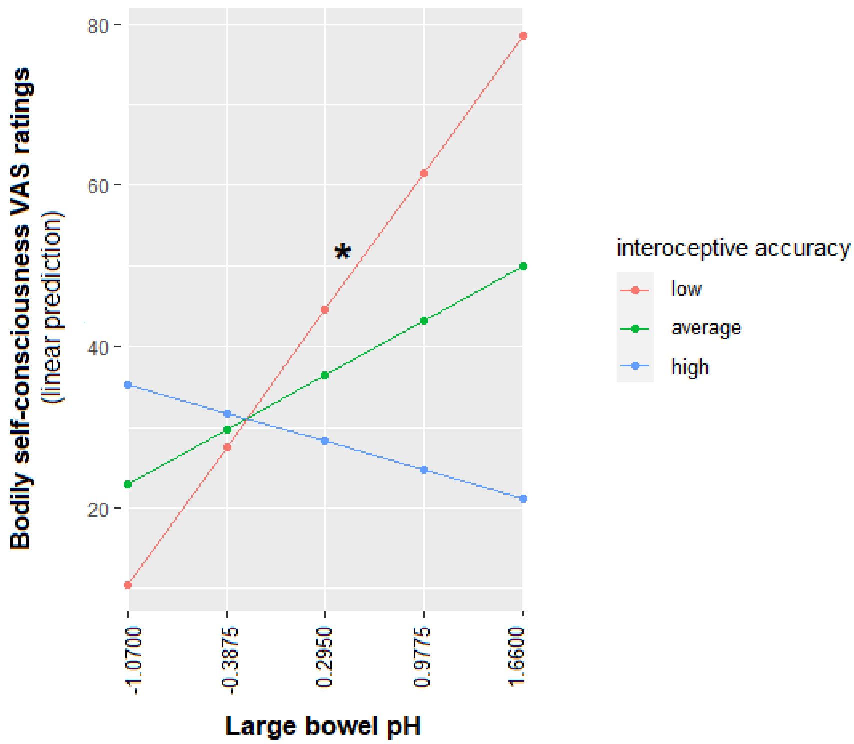

Figure S4. Effects of the large bowel pH and interoceptive accuracy across VAS ratings of bodily self-consciousness (estimated marginal means). ‘Low’ interoceptive accuracy indicates that results shown in red occur when accuracy is 1 standard deviation below the mean; ‘average’ indicates that results shown in green occur when accuracy is average; and ‘high’ indicates that results shown in blue occur when accuracy is 1 standard deviation above the mean.

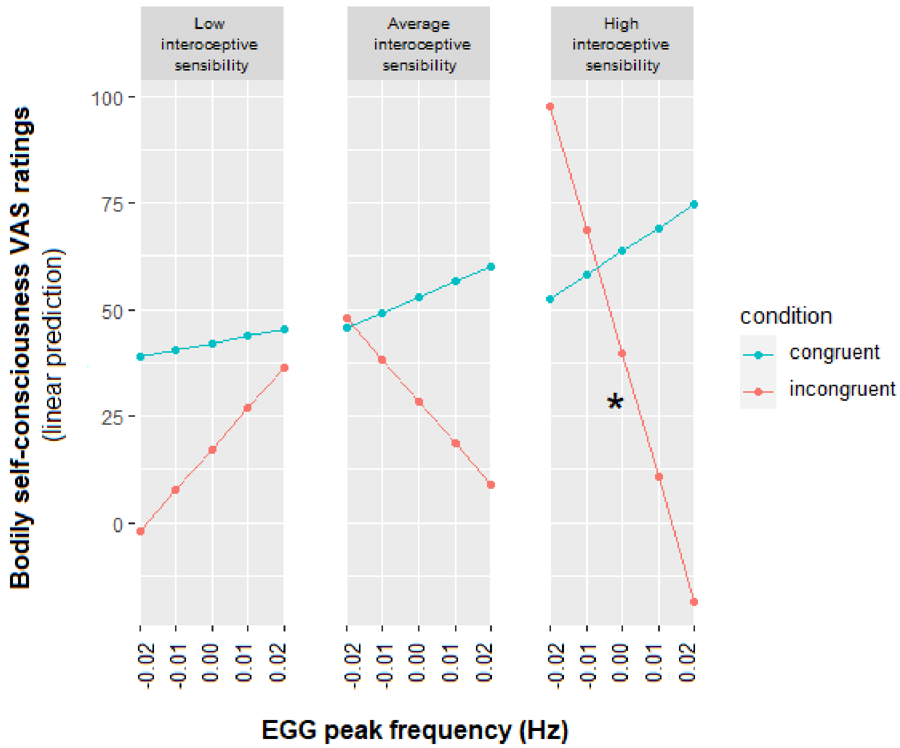

Figure S5. Electrogastrography (EGG) results. 'Low', 'average', and 'high' interoceptive sensibility are defined as in the main text.

Movie S1.
Movie describing each phase of the embreathment illusion. Available at https://youtu.be/4zBx27OoIRE