Supplementary Material

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Manuscript title: Cross-Modal Relationships of Neural Gating with the Subjective Perception of Respiratory and Somatosensory Sensations

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1. Correlational analysis with the neural gating quantified as a difference score

In the current study, we quantified neural gating as the ratio of individual peak response to the second relative to the first stimulus in a pair (S2/S1). However, another common approach is to quantify neural gating as the *difference* of the peak S2 and S1 activity (S2-S1). This approach has a distinct advantage as the gating score is not sensitive to polarity shift, and therefore participants do not need to be excluded if either of their N1 amplitudes is positive. However, the approach also comes with a theoretical drawback – the difference score is heavily influenced by the S1 amplitude, while the ratio contains relatively equal amounts of information on both S1 and S2 amplitudes. For this reason, we have opted *a priori* to use ratio as the measurement of gating in the current study, despite having to exclude some participants.

To assess if our trends would significantly change when retaining these participants, we report an additional post-hoc explorative correlational analysis with the neural gating quantified as S2-S1. The resulting descriptive statistics and correlation table are included below, as Tables Sup1 and Sup2 respectively. In the Table Sup2, we omitted the correlations between the perceptual outcomes, as they are identical to those already reported in the Table 3 of the manuscript.

	RREP			SEP		
	S1 amplitude (μ V)	S2 amplitude (μ V)	NG difference	S1 amplitude (μ V)	S2 amplitude (μ V)	NG difference
<i>M</i>	-5.65	-2.90	2.75	-3.69	-1.57	2.12
<i>SD</i>	3.888	2.202	3.50	2.888	1.810	2.55
<i>N</i>	85	85	85	82	82	82

Table Sup1 Descriptive statistics for the N1 activity measured as peak activity and neural gating measured as the difference between S2 peak activity and S1 peak activity, NOTE: larger difference = better gating

<i>Variables</i>	1.	2.
1. Respiratory gating difference	–	.26
2. Somatosensory gating difference	.26	–
3. Paired occlusion intensity	.11	.17
4. Paired occlusion unpleasantness	.16	.21
5. Respiratory magnitude estimation intensity	.07	.22
6. 10 inspiratory load unpleasantness	.11	.22
7. Respiratory perceptual sensitivity	.16	.03
8. Paired electrocutaneous stimulation intensity	.08	.27
9. Paired electrocutaneous stimulation unpleasantness	.05	.28
10. Somatosensory magnitude estimation intensity	.06	.07
11. 10 electrocutaneous stimuli unpleasantness	-.05	.06
12. Somatosensory perceptual sensitivity	.02	.17

Table Sup2 *r*-values for the bivariate correlations between the perceptual outcomes and the neural gating difference. NOTE: larger difference = better gating

As can be seen from Table Sup2, the correlations between neural gating when expressed as the difference score and the perceptual outcomes largely follow the same trend as the neural gating ratio correlations reported in the main manuscript (note that the larger difference score denotes better gating, opposite to the gating ratio, therefore the correlations have opposite signs). However, none of the relationships are large enough to reach the corrected significance threshold. Nevertheless, these trends suggest that the exclusion of the participants with negative gating ratios did not significantly affect our results nor interpretation. Given the theoretical advantage of the gating ratio, in terms of not weighting S1 over S2, we can conclude that our *a priori* decision to use ratio instead of difference did not result in a skewed interpretation.

In conclusion, we would like to see more attention paid to this decision in the future studies on neural gating and repetition suppression, as we find that there is a marked lack of consensus on the preferred approach in the literature.

2. Variability of individual peak activity – a brief signal-to-noise-ratio discussion

In the current study, we measured N1 activity as individual peak responses, extracted from the individual averages of 40 stimulus presentations (~35 after the exclusion of noisy trials). While we found the ERPs generated from this number of presentations to be stable enough to extract peak N1 activity, we decided post-hoc to extract the standard deviations of these individual peaks for explorative purposes, and to have a better picture of the intra-individual variability in our dataset. We extracted each individual SD at the same hotspot cluster and latency as the peak. The descriptive statistics for S1 and S2 peaks in both modalities are reported below, with both the amplitude and its SD averaged over each individual hotspot cluster of three electrodes.

	RREP				SEP			
	S1	S1	S2	S2	S1	S1	S2	S2
	amplitude	standard	amplitude	standard	amplitude	standard	amplitude	standard
	(μ V)	deviation	(μ V)	deviation	(μ V)	deviation	(μ V)	deviation
<i>M</i>	-5.65	6.19	-2.90	7.41	-3.69	5.76	-1.57	6.72
<i>SD</i>	3.888	1.68	2.202	2.00	2.888	1.57	1.810	1.77
<i>N</i>	85	85	85	85	82	82	82	82

Table Sup3 Descriptive statistics for the N1 amplitudes and their intra-individual variability

As can be seen from Table Sup3, despite the seeming stability of the RREP and SEP averages we extracted individual peaks from, it is clear that the intra-individual variability of the peaks is fairly high, especially for SEP. Since it is of crucial importance to keep the signal-to-noise ratio in extracted ERPs high for the confident conclusions about the studied relationships, we would suggest that future studies increase the number of pairs presented. However, for studies on gating and neural adaptations, it is also important to prevent habituation of the neural response which could artificially reduce the magnitude of neural gating, which is why a moderate increase from the current trial number would seem to be optimal.

3. Depiction of the set-ups used to deliver respiratory occlusions and loaded breathing, with a brief discussion on timing of the occlusions and respiratory parameters

To address the issue of the second respiratory occlusion being administered in a different phase of the inspiration relative to the first occlusion, we report the descriptive statistics of the respiratory parameters during normal and occluded breathing in the respiratory blocks in table Sup4, as well as an ensemble average of the occluded breaths in the inspiratory flow and pressure signal from a single participant. The reported means show that the pressure change

between the first and the second occlusion was not significantly different. This can also be seen from an ensemble average example.

For the purposes of methodological clarity and aiding the potential replication efforts, we provide a graphical depiction of the occlusion set-up and the loading manifold.

Variable	<i>M</i>	<i>SD</i>	<i>N</i>
Inspiratory time (s) normal breathing	1.94	0.62	85
Mean inspiratory flow (l/s) normal breathing	0.47	0.30	85
Tidal volume (l) normal breathing	0.68	0.42	85
Peak inspiratory pressure (cmH ₂ O) normal breathing	1.81	0.45	85
Peak inspiratory pressure (cmH ₂ O) 1 st occlusion	4.09	1.93	85
Peak inspiratory pressure (cmH ₂ O) 2 nd occlusion	4.33	2.14	85

Table Sup4 Descriptive statistics for the respiratory parameters during normal and occluded breathing

Figure Sup1 An ensemble average from a single participant showing the occluded breath preceded and succeeded by unoccluded breaths. The graph shows changes due to occlusion in the flow signal (above) and the pressure signal (below).

Figure Sup2 A schematic/photographic depiction of the respiratory set-up used to deliver respiratory occlusions. The occlusions were delivered manually from the control cubicle, using the mouth pressure and inspiratory flow signals from the participant as a reference. Note: PTG = pneumotachograph

Figure Sup1 A schematic/photographic depiction of the set-up used to deliver inspiratory loads during the magnitude estimation task. The loads were delivered manually using the mouth pressure and inspiratory flow signals from the participant as a reference. The loads were differentiated using a manifold allowing to deliver different load magnitudes on different trials. The keyboard was used to manually control the trial flow, with the experimenter pressing the space key to end the trial and show the rating scale on a monitor in front of the participant. Note: PTG = pneumotachograph