

Differences in Autonomic Defensive Responses between Aversive Dyspneic and Cold Pain Challenges due to Homeostatic Regulatory Mechanisms

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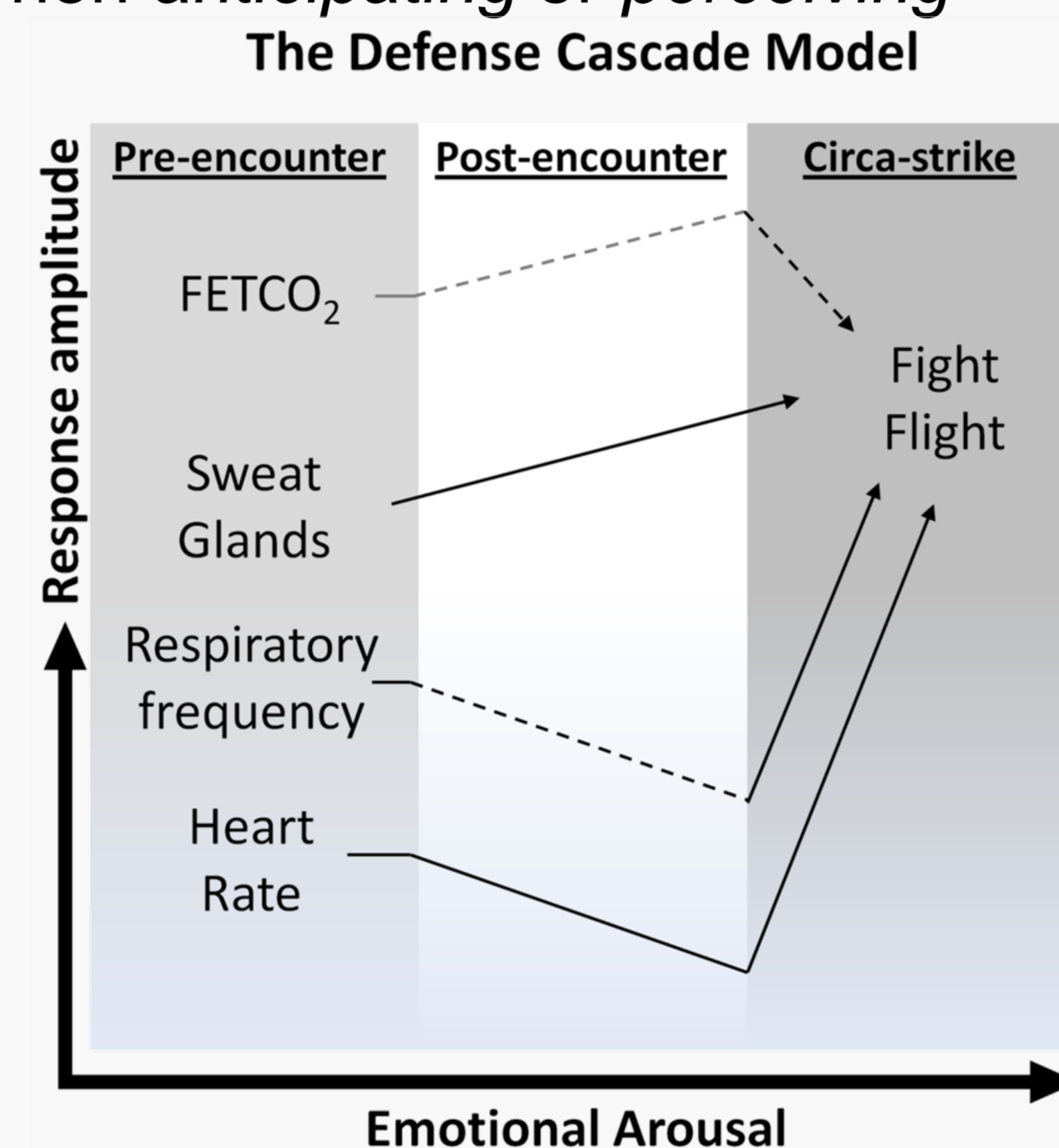
(1) Introduction

Interoception = perception of body state, linked to emotions – serves to maintain homeostasis [1]
Interoceptive fear = apprehension of bodily sensations; manifests when *anticipating* or *perceiving* homeostatic disturbance [2].

Autonomous fear responses to external but not to interoceptive threats has been described by the defense cascade model.

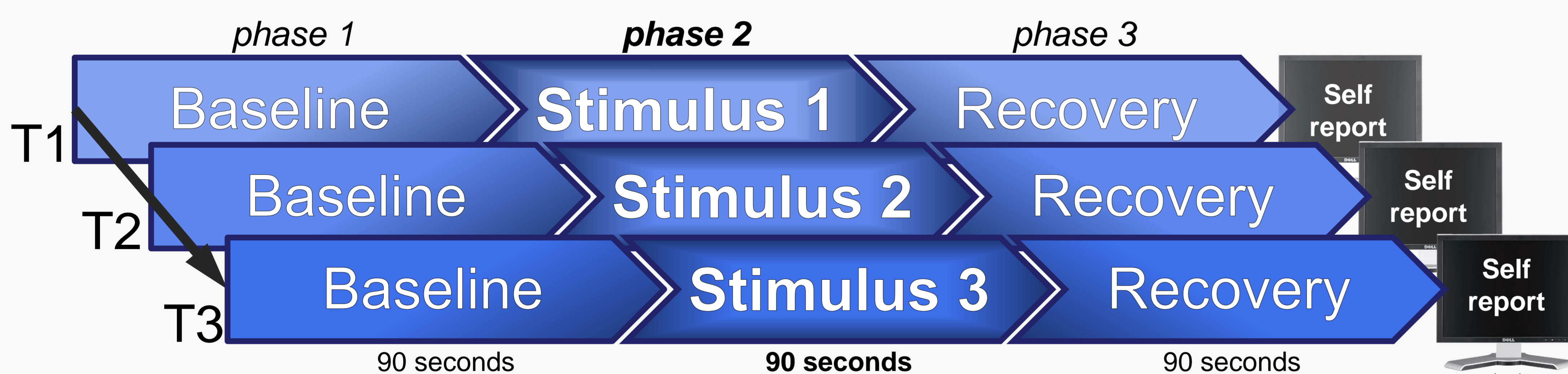
Solid lines represent patterns described by [3] and [4], whereas dashed lines represent hypothetical patterns of responding. (Picture adapted and modified from Lang, Bradley & Cuthbert, 1997)

Aim: To explore and describe autonomous fear responses to a selection of imminent interoceptive threats.

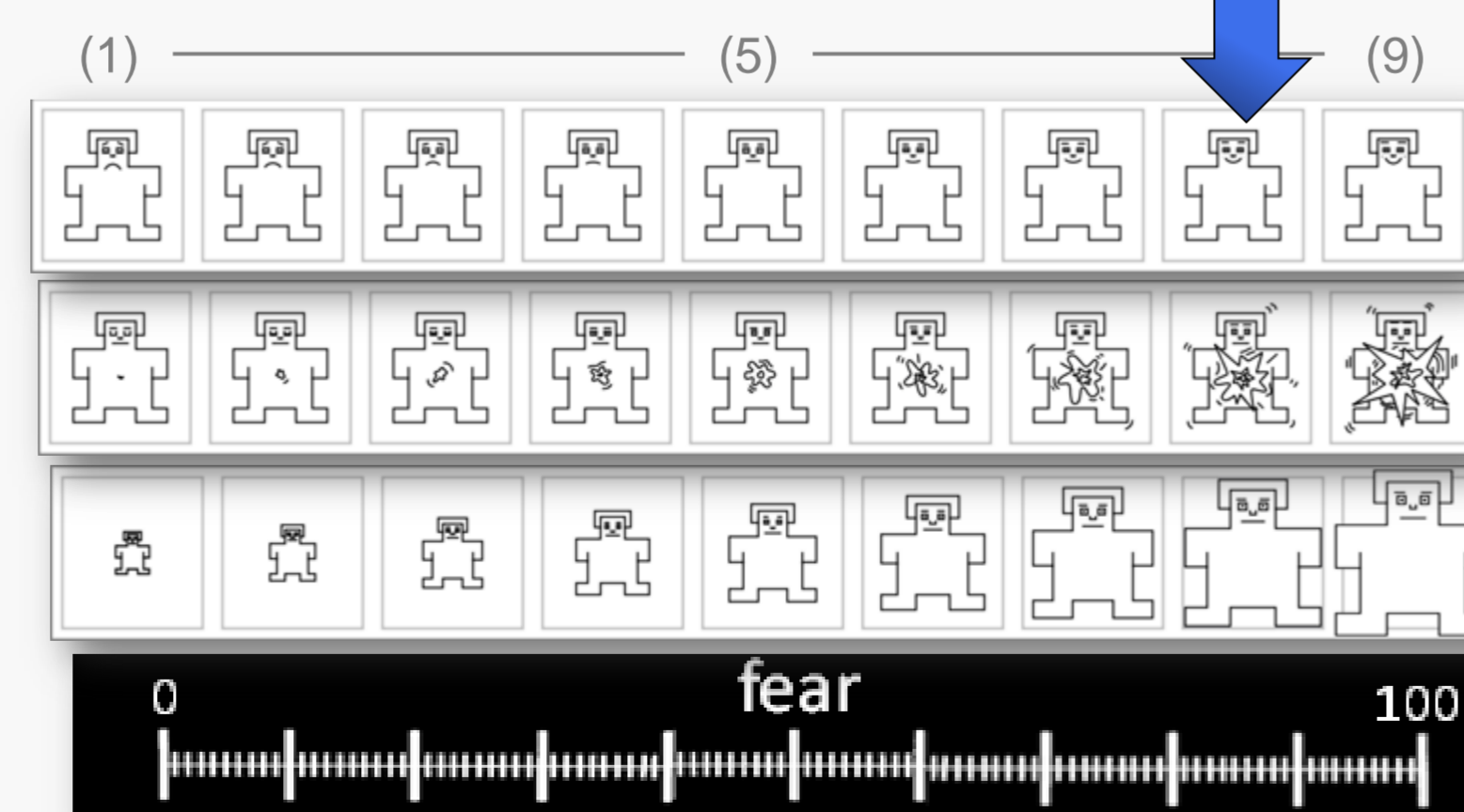


(2) Methods

N = 36♀ (mean age = 19y/o)



3 stimuli per participant (orders were counterbalanced)



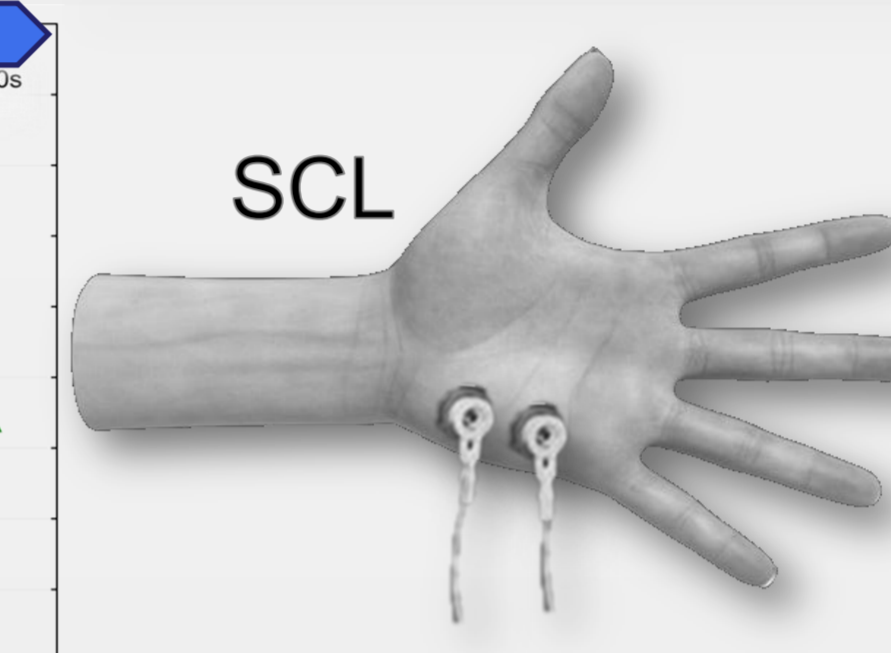
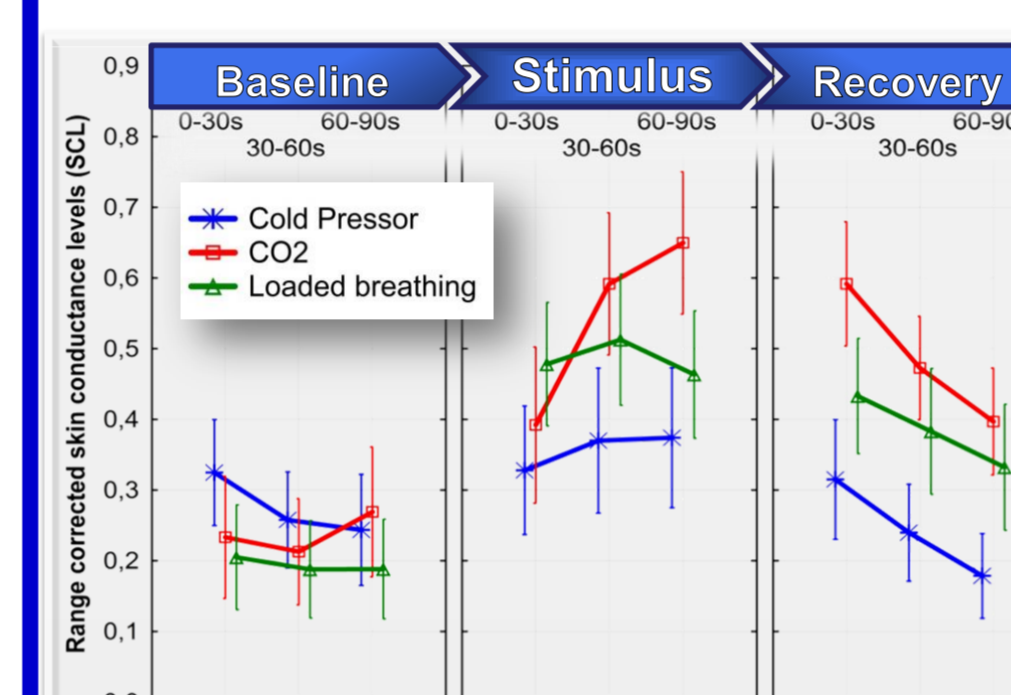
Additional details: - all baseline, all recovery phases & CPT stimulus phase ⇒ room air through mouthpiece.
- CPT baseline and recovery phase ⇒ hand immersed in lukewarm water (30°C / 86°F).

(3) Results

Means and standard deviations for valence, arousal, dominance, and fear experienced during stimulation

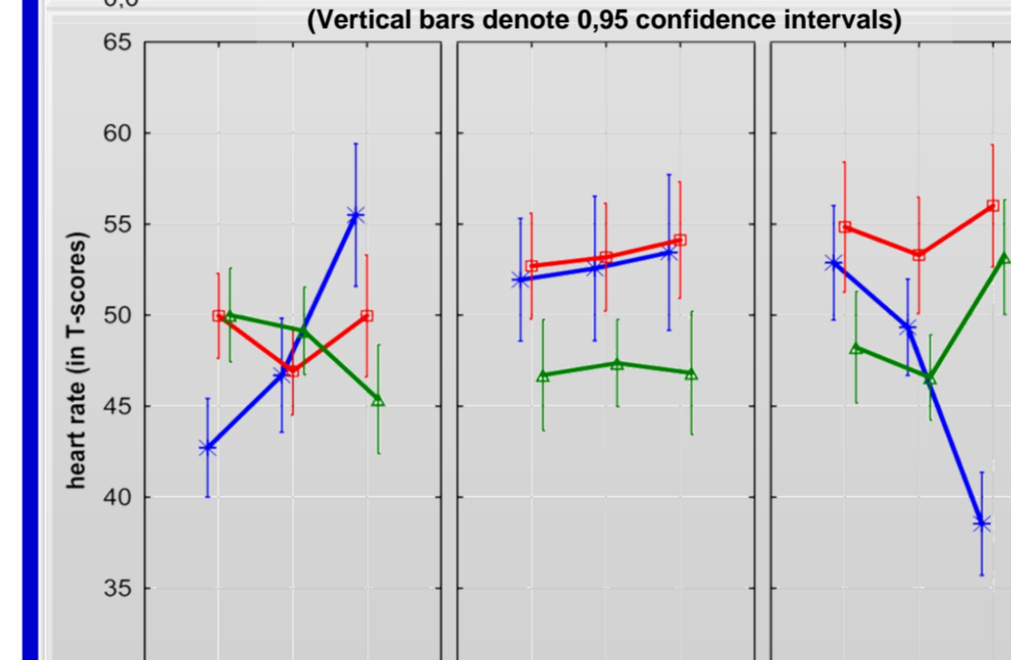
| | CO ₂ inhalation | | Cold pain | | Loaded breathing | |
|-----------|----------------------------|-----|------------------|-----|------------------|-----|
| | MEAN | SD | MEAN | SD | MEAN | SD |
| valence | 3.8 _a | 1.5 | 3 _b | 1.6 | 3.8 _a | 1.6 |
| arousal | 5.6 _a | 1.7 | 6 _a | 1.9 | 5.4 _a | 1.8 |
| dominance | 4.4 _a | 1.9 | 3.9 _a | 1.9 | 4.5 _a | 2.2 |
| fear | 47 _a | 25 | 43 _a | 24 | 45 _a | 30 |

Note. Valence, arousal, and dominance all ranged from 1 to 9, respectively unpleasant versus pleasant, calm versus excited, and a lack of control versus a sense of control. Fear ranged from 0 to 100, respectively from not at all scared to extremely scared. Means in the same row which share a subscript are not significantly different from one another according to Tukey-Kramer post-hoc tests.



- Both respiratory stimuli evoked a significant increase in Skin Conductance Level (SCL) as compared to baseline. Even during the recovery phase overall SCLs were still significantly higher than during baseline.

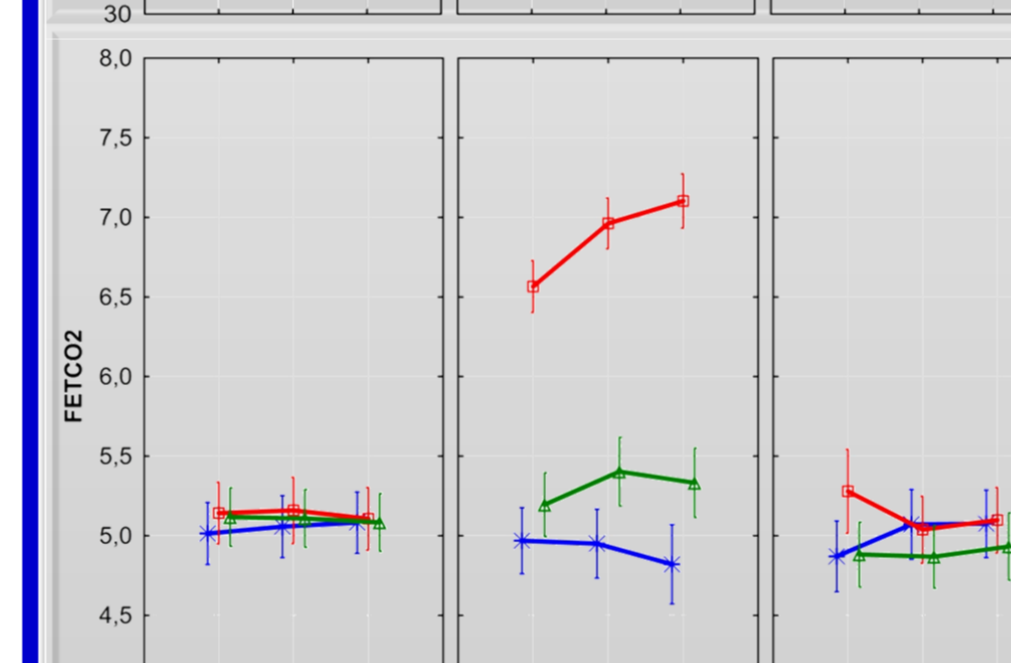
- In the cold pain trial, SCL was significantly lower during recovery than during cold immersion.



- In the CO₂ trial, heart rate (HR) during both stimulus and recovery phase of the same trial was significantly higher than baseline.

- During cold immersion, overall HR was significantly more elevated than during baseline or recovery of the same trial.

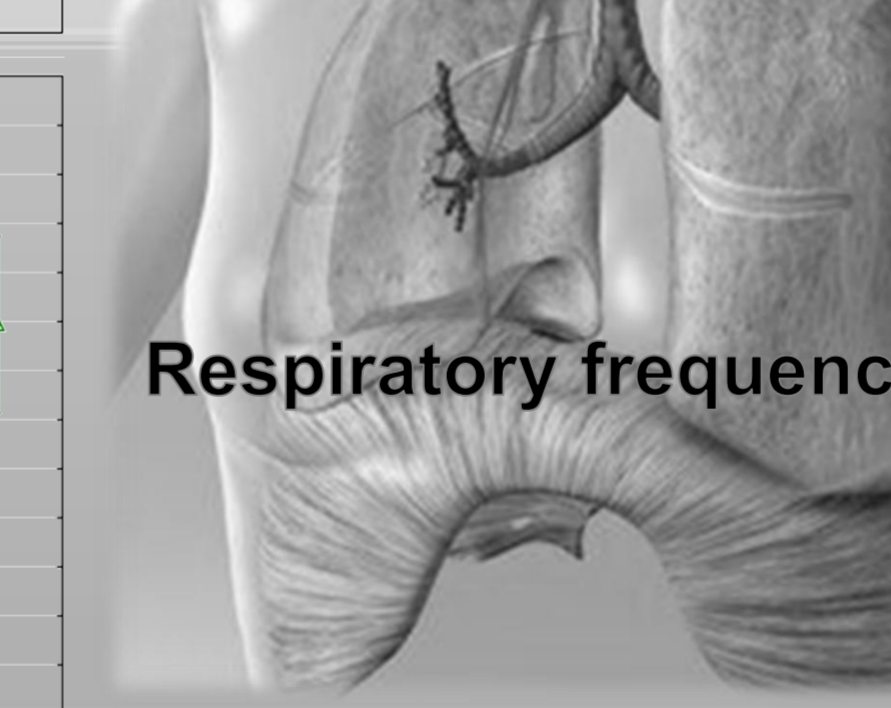
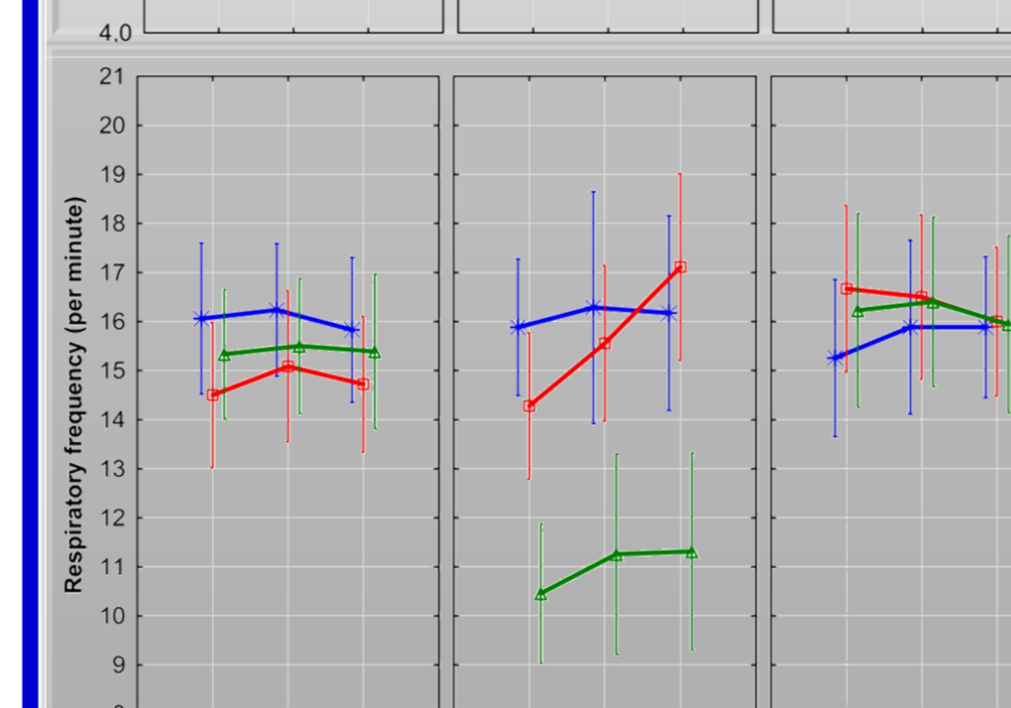
- For loaded breathing, overall there were no significant changes between the phases.



- During CO₂ inhalation, fractional end-tidal CO₂ (FETCO₂) increased, and returned to baseline levels during recovery.

- During the loaded breathing trial, FETCO₂ levels were significantly different from one another for all phases.

- The overall drop in FETCO₂ during cold immersion was NOT significantly different from baseline or recovery.



- During CO₂ inhalation there was a significant difference between the respiratory frequency (Rf) observed during the first 30 seconds of the stimulus trial and the last thirty seconds.

- During loaded breathing there was an overall significant drop in Rf as compared to baseline and recovery.

(4) Conclusion

Results indicate that autonomic responses to aversive interoceptive stimuli are affected not only by threat levels but also by regulatory homeostatic mechanisms.

As a consequence the defense cascade model does not seem to fully apply in face of these stimuli.

It remains to be tested whether the defense cascade model applies to other interoceptive stimuli. (E.g., gastro-intestinal sensations perhaps do not evoke regulatory autonomic responses.)

References

- [1] Craig, A. D. B. (2002). How do you feel? Interoception: the sense of the physiological condition of the body. *Nature Reviews Neuroscience*, 3(8), 655-666.
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- [4] Van Diest, I., Bradley, M. M., Guerra, P., Van den Bergh, O., & Lang, P. J. (2009). Fear-conditioned respiration and its association to cardiac reactivity. *Biol Psychol*, 80(2), 212-217.

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