The Embodiment of Fear

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BACKGROUND

- According to **embodied prediction theories**, emotional processing uses bottom-up information from the outer world, the inner body, as well as top-down predictions from past experiences [1, 2, 3, & 4].
- In other words, the processing of an emotion, such as fear, re-enacts a distributed neural network of exteroceptive, interoceptive, and predictive states [5].
- Activating one of those states should consequently anticipate perception of that emotion.
- Pezzulo et al. (2018) found that an increased heart rate, via exercise, facilitates the processing of facial expressions conveying an emotion congruent with that interoception, i.e. **fear**, but not those conveying incongruent states, such as disgust or neutrality.
- As an extension of Pezzulo et al., in the present study, we investigated whether and how top-down **prior affective context** interacts with bottom-up **interoception** to facilitate bottom-up **exteroception** of emotional facial expressions.

HYPOTHESES

- We hypothesized a **three-way interaction** between affective priming, heart rate, and emotional facial expressions:
- We hypothesized that, while an increased heart rate would **facilitate** the processing of fearful and happy faces, the facilitation would be specific to negative and positive priming, respectively. In other words, facilitation would be specific to congruent pairs of expressed emotion and prior affective context.

METHOD

Design

- Within-Subjects. 2 × 3 × 3: *Physical Activity* (rest, exercise) × *Affective Priming* (negative, neutral, positive) × *Facial Expression* (fearful, neutral, happy).

Participants

- 36 participants (M_{age} = 20 yrs old, SD = .90; 50% females, 50% males, Caucasian, French nationals) from University of Rouen Normandie, France.

Materials

- *Affective Primes:* 540 negative, neutral, and positive images from the International Affective Picture System (IAPS) [6].
- *Emotional Faces:* 210 male and female images from the Karolinska Directed Emotional Faces (KDEF) [7]. A Hann window obscured facial peripheral information [8].

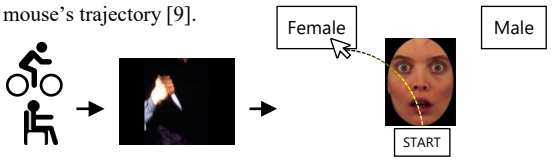
Procedure

Participants completed the task twice in 2 separate sessions, 1 week apart:

1. *Exercise:* They biked on a cycle ergometer for 3 mins, which induced an increased heart rate (122 +/- 6 bpm).
2. *Rest:* They rested for 3 mins, for a normal heart rate (69 +/- 8bpm).

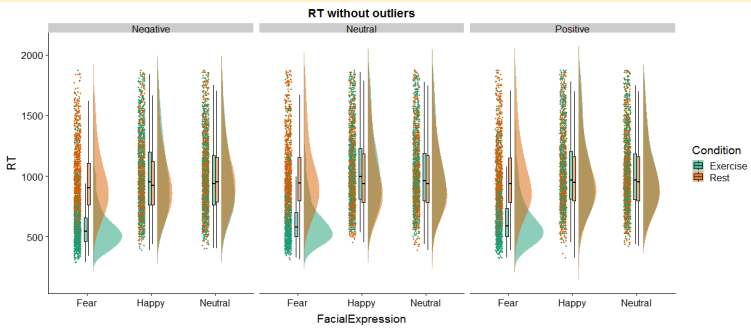
Gender-Categorization Task: Participants were shown a prime image for 200 ms, followed by a face image for 500 ms. Using their mouse, participants selected whether the face was male or female.

- MouseTracker software was used to record *reaction time*, *maximum deviation* of mouse from a straight trajectory, and *area under the curve* of the mouse's trajectory [9].



RESULTS

- Estimation statistics were used to calculate effects and their sizes in multi two-group comparisons.
- As hypothesized, we found a **three-way interaction**.
- After exercise, responses to **fearful faces** were 58.9 ms faster with **negative priming** than those with positive priming (Mann-Whitney test, $p < .05$, [8.4, 1.2e+02], $d = .52$) and 43.9 ms faster than those with neutral priming (Mann-Whitney test, $p < .05$, [-0.4, 86.8], $d = .47$).
- Contrary to our hypothesis, however, there were **no** congruency facilitation effects between **happy faces** and **positive priming**.



DISCUSSION

- Our findings support **embodied prediction theories of emotion** which posit that processing an emotion re-enacts a particular simulation of relevant multimodal states:
  - If an increased heart rate and negative affect are signature states of the simulation of fear, they might facilitate fearful face processing because they **anticipate** that simulation when activated.
  - These findings demonstrate a more sophisticated embodied congruency effect than that reported by Pezzulo et al. (2018), replicating and extending their findings.
- Further investigation needs to be done on alternative explanatory interoceptive signatures present in exercise, such as temperature, respiratory, or pH states.
- Note that this effect arose from participants completing an **incidental task:** one that required explicit attention to aspects orthogonal to emotion, and not the emotional content itself. This indicates that both **context and body contribute to even the implicit perceptual processing of emotion content.** Thus, this study provides promising evidence for embodied and predictive theories of emotional processing.

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