Cardiac phase affects distractor suppression and motor inhibition

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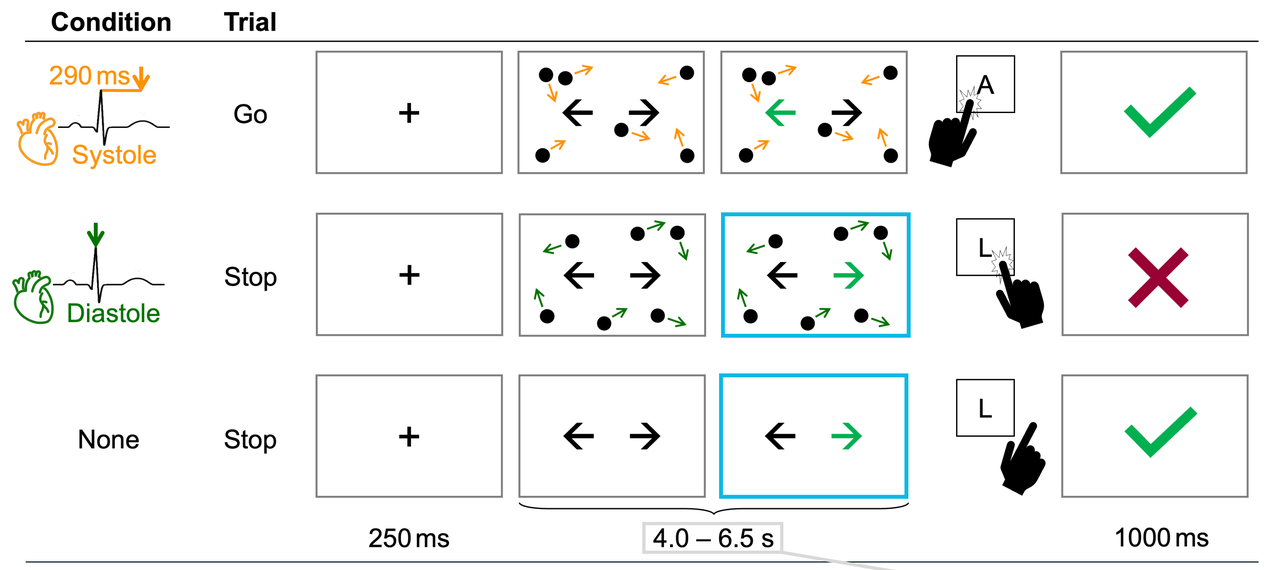
INTRODUCTION

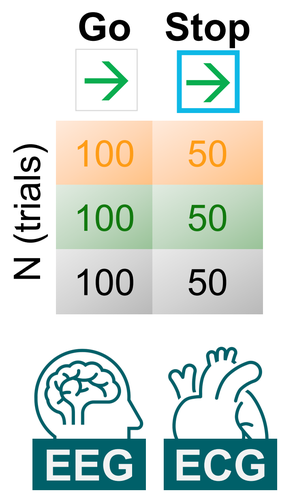
- The interplay of exteroceptive and interoceptive processing affects perception and action [1,2]
- **In the motor domain**, studies have evidenced links between **systolic baroreceptor firing** and **inhibition efficiency** [3] (however, see [4]) as well as **deliberate execution** [5]
  - **For that**, **relevant exteroceptive cues**, e.g. stop-cues, **need to be selected** from irrelevant distracting information **to perform efficiently** [6]
- Previous work in the field of **perception** hints to **cardiac phase dependent fluctuations** in **selection efficiency under perceptual conflict, favouring systole** [7,8], and in **perceptual sensitivity, favouring diastole** [9].

How does the temporal alignment of distracting visual information to different cardiac phases (systole vs. diastole) impact upon motor inhibitory performance?

Hypothesis: distractor signals moving at cardiac diastole (vs. systole) are cancelled out less efficiently with negative downstream effects on task performance

DESIGN & DEMOGRAPHICS





Onset: randomly between **3rd to 5th heartbeat (i.e. dot movement)**

Onset: stop-signal delay [min = 200 ms; max = 750 ms; 50 ms steps] adjusted trial-by-trial (approx. 50% stop-signal performance)

Gender: 18 F, 0 D, 22 M
Age (years): 25.3 ± 3.9
Ø life-time neurological/ psychiatric condition
Ø medication affecting neural physiological function

Self-report: depressive symptoms & state/trait anxiety < cut-off scores

→ **N = 40**

Statistics:

Repeated-measures ANOVA, Factors:
- **Distractor type** systole, diastole, none for cardiac & visual cortical processing (HEP/ VEP), also:
- **Heartbeat/ movement number** 1,2,3

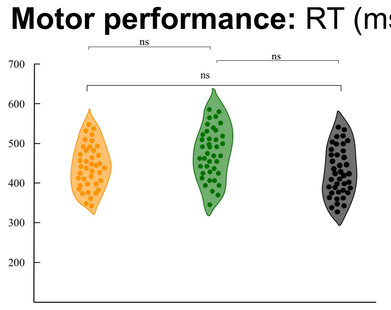
Effects, if applicable, Greenhouse Geisser corrected; Posthoc tests Bonferroni corrected. Cohen's *d* reported.

RESULTS

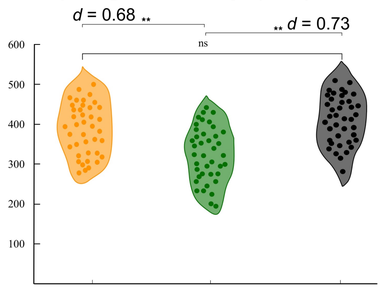
Systole-bound distractors
Diastole-bound distractors
Ø distractors

Behaviour

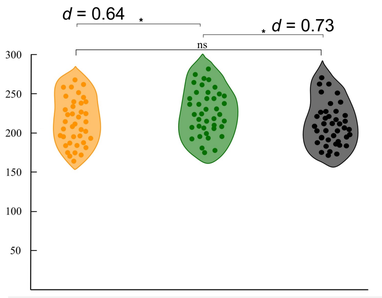
Motor performance: RT (ms)

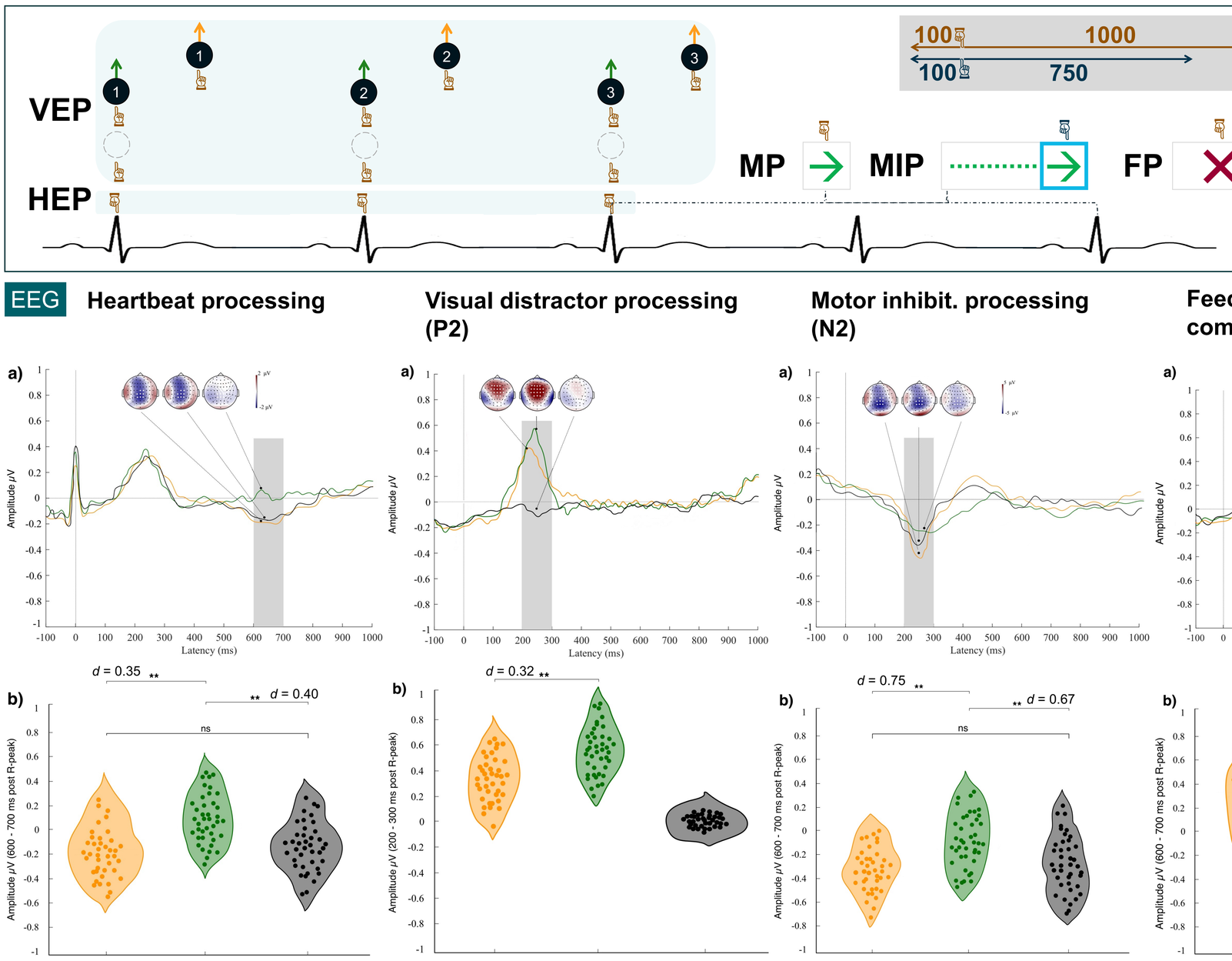


Motor inhibit. performance:
Stop signal delay (ms)



Stop signal RT (ms)
using integration method [10]





- **Poorer inhibitory performance** under **diastole bound distraction**
- compared to **systole bound** or **no distraction**

Weaker cardiac processing under **diastole bound distraction**
- compared to **systole bound** or **no distraction**

Stronger visual processing (P2) of **diastole bound distraction**
- compared to **systole bound distraction**

Weaker motor inhibit. processing (N2) in response to the stop signal under **diastole bound distraction**
- compared to **systole bound** or **no distraction**

Stronger processing of negative feedback (P2) in stop trials coinciding with **systole bound distraction**
- compared to those coinciding with **diastole bound** or **no distraction**

No evidence for a difference between experiencing **distracting dots moving at systole** and experiencing **no distraction** at all.

CONCLUSION

Motor inhibition performance improved when distracting information co-occurred with arrival of cardiac feedback to the brain, i.e. at systole.

Similar pattern of behavioural and neurophysiological markers between (a) when distractors occurred at cardiac systole to (b) when there was no distraction at all: High efficiency in disregarding irrelevant sensory input during cardiac systole

Stronger expression of visual processing during cardiac diastole (compared to systole) aligns with weaker expression of cortical heartbeat processing at cardiac diastole (compared to systole).

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