

## CONTEXT-DEPENDENT INFLUENCES OF CARDIAC PHASE AND EMOTION ON PERCEIVED DURATION AND VISUAL CORTICAL ACTIVITY

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**Background:** Perception of time is inherently malleable and shaped by both emotional and bodily states. Previous behavioural work showed that brief stimuli presented during cardiac systole — the phase of maximal baroreceptor firing — are perceived as shorter than those presented during diastole, suggesting that heartbeat-linked interoceptive signals can transiently contract subjective duration.

**Aims:** We examined how such cardiac-phase effects are instantiated at the neural level and whether they interact with emotion. Specifically, we asked whether systole-related contraction reflects suppression of sensory processing, as EEG and fMRI studies suggest, or a redistribution of attention or arousal at later decision stages. To test this, we combined real-time cardiac-phase manipulation with EEG to investigate how heartbeat timing and emotional valence shape perceived duration and its neural correlates.

**Methods:** In Experiment 1 ( $n = 40$ ), neutral visual stimuli (Gabor patches) were presented during systole or diastole to assess phase-dependent changes in stimulus-evoked activity and their relation to individual duration biases. In Experiment 2 ( $n = 40$ ), we tested whether cardiac influences interact with emotional valence (fearful vs. neutral faces). Both experiments applied stringent controls for ECG-related artifacts to isolate genuine cardiac–brain coupling.

**Results:** Across experiments, heartbeat-linked modulations of visual processing were subtle and easily overshadowed by emotional valence. Fearful faces contracted perceived duration and enhanced the N170, indexing heightened perceptual engagement. Across conditions, shorter perceived durations consistently corresponded to reduced cortical activity, though without clear phase specificity.

**Conclusions:** Heart's role in shaping our experience of time has drawn increasing attention. Our findings provide a realistic account of the fragility of heartbeat-linked modulations in visual EEG paradigms. If present, such effects appear highly context dependent — emerging sporadically under neutral conditions but diminishing when emotional arousal dominates perceptual processing. Instead, fearful faces induced temporal contraction rather than the expansion typically reported for arousing stimuli, aligning with studies showing that anxiety-inducing contexts may divert attentional resources away from temporal monitoring.

**Keywords:** Duration perception, Temporal bisection, Emotion, Heart, Cardiac phases

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