Valence-related visual encoding is dependent on valence strength prior to frontal affective processing

Kevin A. M. Tan & Michael J. Tarr
Center for the Neural Basis of Cognition & Department of Psychology, Carnegie Mellon University

Introduction

1) Strongly valenced objects bound the valence continuum; everyday objects occupy a central "neutral" region

2) Micro-valences near the center of the valence continuum

- Most nominally neutral everyday objects appear to elicit valence at minute magnitudes: "micro-valence"[1]
- Previous fMRI work[1] revealed valence and valence strength encoded in the lateral occipital (LOC) and prefrontal (PFC) cortices – canonical object and affect processing regions, respectively
- **Does LOC encode valence prior to the "high-level" affective processing associated with PFC?**
- **Are strong- and micro-valence consistent in their temporal and spatial dynamics?**
- Standard models of affective vision assume that affect is post-perceptual[2], while a growing body of evidence suggests that affect informs even early-stage visual processing[3]

Materials & Methods

Participants – 15 Carnegie Mellon community members

Stimuli – color photos of single objects

- Valence ratings from previous behavioral work[1]
- **Valence Task:** 120 micro- & 120 strong-valence
- **Localizer:** 87 strong-valence & 88 neutral objects shown intact & phase-scrambled

Tasks – explicit and implicit affective perception

- Independent stimulus sets, 1 second presentation
- **Valence Task:** post-presentation valence ratings
- **Localizer:** one-back identity task, response trials (10%) excluded from analyses

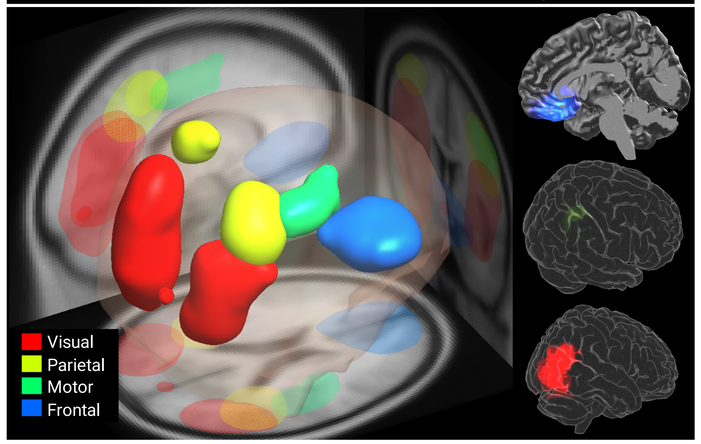
Representational Similarity Analysis (RSA)

- RSA was performed on valence task stimuli using Scale-Invariant Feature Transform (SIFT) features[4]

Electroencephalographic (EEG) Analyses

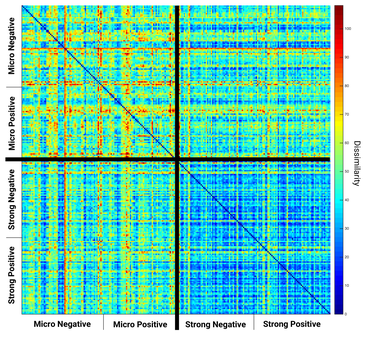
- BioSemi with 128 EEG, 7 EOG, & 1 ECG channels
- Event-related potentials (ERPs) were averaged from independent component (IC) activity
- IC ERPs were projected into source-space then clustered via Measure Projection Analysis[5]
- ERP contrasts were performed using Adaptive Factor-Adjustment mass multiple testing[6]

Source-Space IC ERP Clustering



Stimulus Exemplars

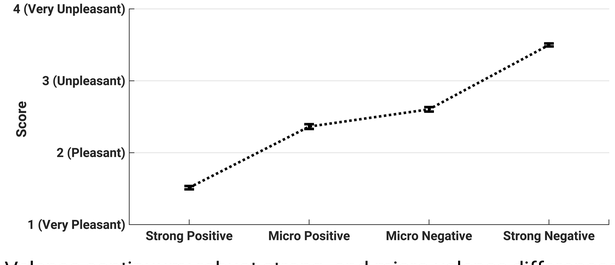
Image Similarity Results



Can ERP results be explained by differences in visual similarity?

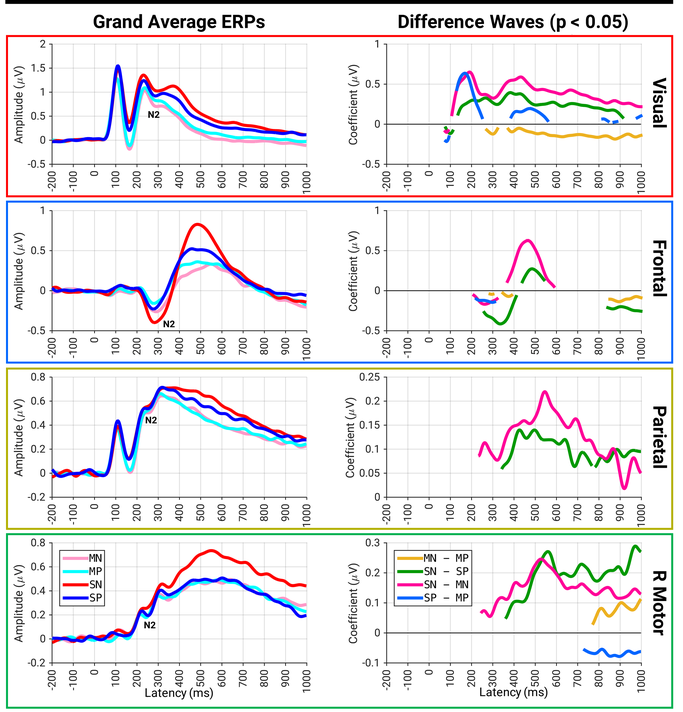
- Valence and interaction not significant; strength is robust
- Micro-valence is least similar
- Strong-valence is most similar
- Inter-strength contrasts have intermediate similarity

Valence Rating Results



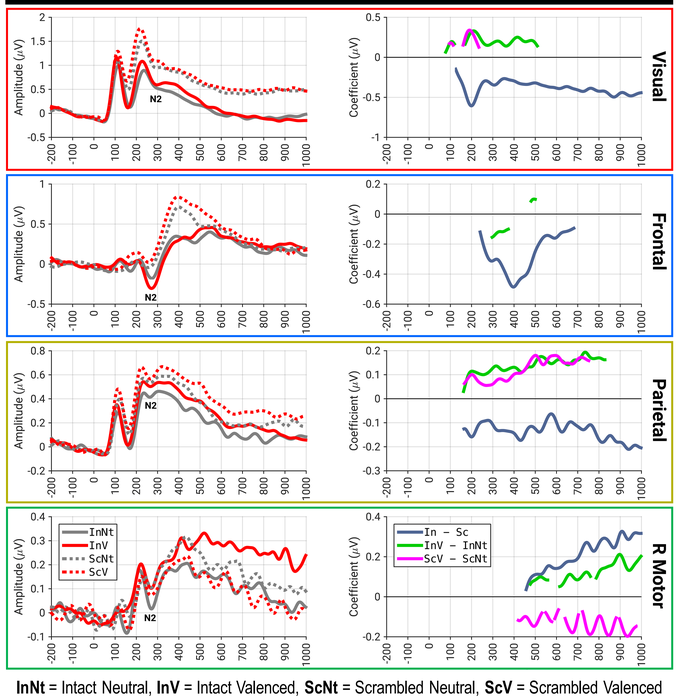
- Valence continuum: robust strong- and micro-valence differences
- Replicates previous valence ratings used to bin stimuli into conditions[2]

Valence Task ERP Results



MN = Micro Negative, **MP** = Micro Positive, **SN** = Strong Negative, **SP** = Strong Positive

Localizer ERP Results



InNt = Intact Neutral, **InV** = Intact Valenced, **ScNt** = Scrambled Neutral, **ScV** = Scrambled Valenced

Discussion

70–200ms: Valence encoding localized to visual cortex

- Strong-valence & strength encoded; micro-valence not encoded despite highest visual dissimilarity in SIFT RSA
- Affect-related responses evoked by intact & scrambled objects, began prior to object-level processing
- **Early valence-related visual modulation may be akin to "bottom-up" visual attention for salient visual features**

200–350ms: Onset of frontal affect & micro-valence

- Frontal N2 valence encoding only seen for intact objects
- Concurrent micro-valence onset in frontal and visual N2
- **N2 appears to integrate visual & high-level processing, a putative mechanism for the genesis of micro-valence**

300–1000ms: Response processing & subjective affect

- Selectivity for strong negative objects was most pronounced in response-related components
- Late valence effects in frontal & motor clusters: subjective valence or anticipated finger presses?
- Valence–strength interaction: motivational salience?

Conclusions

- Visual cortex can encode strong-valence and valence strength prior to object-level and frontal processing
- Micro-valence is not encoded until frontal processing
- Strong- and micro-valence appear to be differentially represented in visual cortex
- Early affective modulation of visual processing may originate in visual cortex
- Valence-related visual encoding is not an aggregate of visual dissimilarity as measured by SIFT RSA

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Correspondence: kevintan@cmu.edu

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