Valence-related modulation of visual cortex is dependent on valence strength prior to high-level affective processing

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Introduction
1) The valence continuum is bounded by strongly valenced objects; everyday objects occupy a central “neutral” region
2) “Micro-valences” lie near the center of the valence continuum

- Generally, affective perception research uses stimuli that lie at extreme ends of the valence continuum, while stimuli without obvious valence are treated as “neutral”
- Most nominally-neutral everyday objects elicit valence at very small magnitudes: “micro-valence”
- fMRI work found valence and valence strength encoded in lateral occipital complex (LOC) and prefrontal cortex (PFC) – canonical object and affect processing regions
- We contend that valence is intrinsic in object perception

- Research question: does LOC encode valence prior to the “high-level” affective processing associated with PFC?
- Canonical models of affective vision are sequential, and assume that affect is a post-process perceptual process
- In contrast, a growing body of evidence suggests that high-level feedback informs even the earliest stages of cortical visual processing

Materials & Methods

Participants = 15 Pittsburghers
- 8 female, healthy, right-handed (age = 23.9 ± 2.8 years)
Stimuli – color photos of single objects
- A priori valence ratings
- Experiment: 120 micro & 120 strong-valenced objects
- Localizer: 87 strong-valence & 88 neutral objects shown intact & phase-scrambled

Tasks – active & passive affective perception
- One second stimulus presentation
- Independent stimuli sets
- Experiment: valence ratings after stimuli presentation & localizer: one-back identity task, response trials (10%) excluded from analyses

Representational Dissimilarity Analysis (RDA)
- RDA was performed on experimental stimuli using 128 features from Scale-Invariant Feature Transform
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
- ERP contrasts performed using Adaptive-Factor Adjusted multiple comparisons

Image Similarity Results

Valence & interaction effects not significant
- Robust strength differences
- Micro-Micro pairs are least similar
- Strong–Strong pairs are most similar
- Strong–Micro pairs have intermediate similarity

Valence continuum: robust strong- and micro-valence differences
Replicates a priori valence ratings used to bin stimuli into conditions

Discussion
70–200ms: Valence effects contained within visual cortex
- Significant strong-valence & strength differences
- Affect-related effects precede object-specific processing
- Directionality of contrasts flipped after object processing
- ERP results do not align with image similarity results
- Affect discrimination seen for intact and scrambled objects
- Early valence-related visual modulation may be akin to “bottom-up” visual attention for salient visual attributes

200–350ms: Onset of high-level processing & micro-valence
- Frontal affect discrimination seen only for intact objects
- Frontal N2 deflections ordered by valence
- Frontal N2 may reflect semantic-based affect appraisal
- Micro-valence effects arose in frontal N2 then visual N2
- Micro-valence appears dependent on high-level processing
- Affect effects for scrambled objects ceased in visual N2
- N2 may integrate high-level feedback in visual cortex

300–1000ms: Response processing & subjective experience
- P3, P4, and RP were most sensitive to task demands
- Selectivity for strong negative objects was most pronounced in response-related processing
- RP was selective for affect even during no-response trials
- Valence–strength interaction: motivational salience?
- Frontal SW valence effects: subjective valence?
- Late RP valence continuum: anticipated finger responses or valence encoding in motor & somatosensory cortices?

Conclusions
- Valence strength and strong-valence can be differentiated by visual cortex prior to object-specific and high-level processing
- Micro-valence appears dependent on high-level processing
- Strong negative objects generally elicit the largest responses
- Valence-related visual responses are not an aggregate of visual attribute differences
- Affect is integrated within visual processing

References

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