Neural visual evidence accumulators demonstrate a mechanism for salience orienting

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Is contextual regulation modeled in neural accumulators?1,2

• The lateral occipital complex (LOC) and the dorsolateral prefrontal cortex (dLPFC) are both considered evidence accumulators.1,12,13
• LOC is primarily involved in object recognition, and faster identification of objects may be one mechanism that allows it to orient faster to salient items1,2.
• dLPFC has been widely involved in many literatures regarding decisions, both perceptual and higher order.1,2
• Cognitive diffusion models have shown a relationship between the slope of accumulation (drift rate), rate of accumulation onset, and object characteristics (both visual and contextual).2,3
• Accumulation in the dLPFC is primarily associated with sensory and reward information, and found to better explain neural results than inhibitory hypotheses.4,5
• Indicates perceptual decisions and higher-order decisions may share a similar mechanism.

It would be expected that:
Evidence accumulation in the LOC and dLPFC will be more steep (faster) for more visually salient objects.

Methods

Data Collection

• Subjects: 17, aged 18-55 years, 12 female (not health conditions, previous experiences, or surgical implants that made them unsuitable for MRI).
• Removed color blindness, near-normal or corrected to normal vision.

Data Collection Instrument

• Siemens Magnetom Trio 3-T whole body MRI with a 64-channel phased array head coil operating under syngo_MR_E11.
• A 30-Ch, 3-Tesla head coil was used for image acquisition. Some of the early visual (Occipital Pole), LOC (Inferior Lateral Occipital Cortex), and dLPFC (Walle Frontal Gyrus).

Preprocessing

• Used preprogrammed pipeline implemented in-house based on scripts remotely running on SIB’s supercomputing cluster.
• Several confounding time-series were calculated based on the preprocessed SLOD and represented in the signal at the run level: transverse displacement (TD), DVARS, three region-wise computing cluster signals. Global signals, and rotation and translation motion parameters.
• All data was then detrended at the subject level.

Primary Analysis

• Two trials were then sorted by condition (color, grayscale, and interpolated based on mean-reducing across the condition).
• A Forte Inclusive Response Filter (FIRF) was applied to the time series.
• Slopes and areas under the curve were compared for the three ROIs.

Procedure

• Each trial was a single image of a hand or foot.
• The images gradually appeared on the screen.

Results

• The Early Visual Cortex shows the profile of a sensory ROI—that is, it responds directly to amount of visual information available. This indicates that while dLPFC provides an example of how in-.

Conclusions

Visual salience can be captured by neural time series

(1) Visual salience does affect accumulation by increasing the speed at which evidence is processed.
(2) Accumulation slopes in the LOC may be diagnostic of the subjective salience of information, and provide a mechanism for salience orienting.

The results confirm the LOC and dLPFC as accumulators, show that accumulation slopes reflect context (salience in this case), and provide a baseline for future work.

Acknowledgements

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References

4 Starns, J. J., Ratcliff, R., & White, C. N. (2012). Diffusion model drift rates can be influenced by decision context (salience in this case), and provide a baseline for future work.

Fig. 1.

Fig. 2.

Fig. 3.

Fig. 4.

Fig. 5.

Fig. 6.