Perception of Animacy from a Single Moving Object

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Introduction

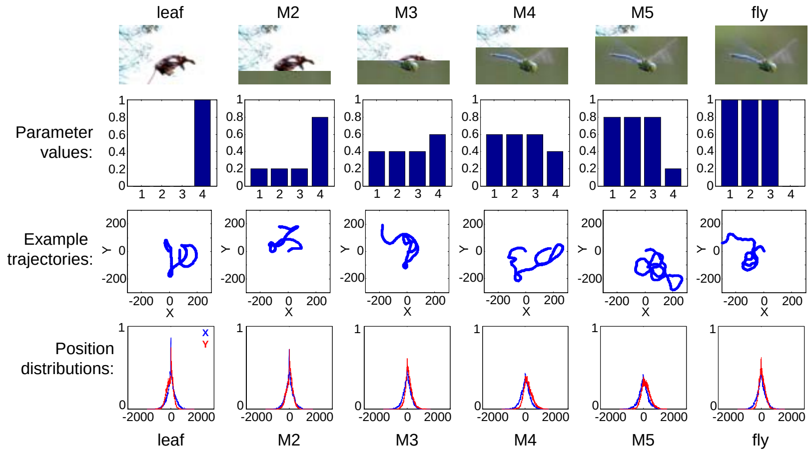
Detecting animate entities in the environment is necessary to identify and interact with predators, pray or mates (1). The percept of animacy (aliveness) can be evoked from impoverished visual displays of "biological motion": moving objects appearing self-propelled (e.g.: point-light walkers (2), animated squares and triangles (3)).

Most studies of biological motion use multi-dot displays which contain structural information (shape-from-motion); thus, discounting the role of structural information is difficult. Use a single dot?

Can a single moving dot appear animate?

Is the posterior STS involved in detecting biological motion when only a single dot moves?

Stimuli: animate & inanimate single-dot motion and morphs in between



2 prototype trajectories (modeled on a "fly" and a "leaf drifting in the wind") animating a white dot on a black background.

One algorithm controlling object motion direction and speed.

"Simple" cues such as position distribution, average speed, average movement direction should NOT carry the animacy information.

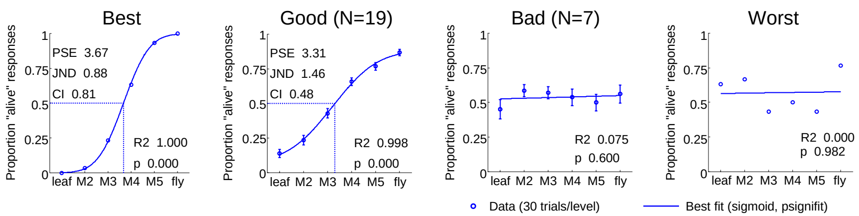
Minimal instructions to engage the natural animacy-detection system: "Imagine you are looking through a window at objects moving outside. Half of them are alive, half of them are not. Both are shown as a white dot, but they differ by their movement. Please decide for each object whether it's alive or not." 10 samples for practice, but no feedback or additional explanations.

Algorithm:

Direction = constant + oscillation1 * param1 + oscillation 2 * param2 + noise * param3 + wind * param4

Speed = constant + noise + wind * param4

Experiment 1: psychophysics (N=26)



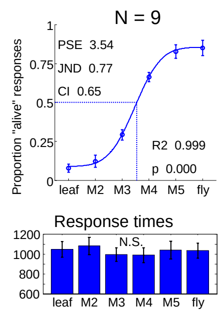
¾ have performance significantly explained by fitted sigmoid. Group stats (median and quartile deviation): JND = 1.84 (0.53), PSE = 3.3 (0.41), CI = 0.58 (0.12).

CI = Categorization Index = (Σ (resp means left of PSE) - Σ (resp means right of PSE)) / Σ (all resp.

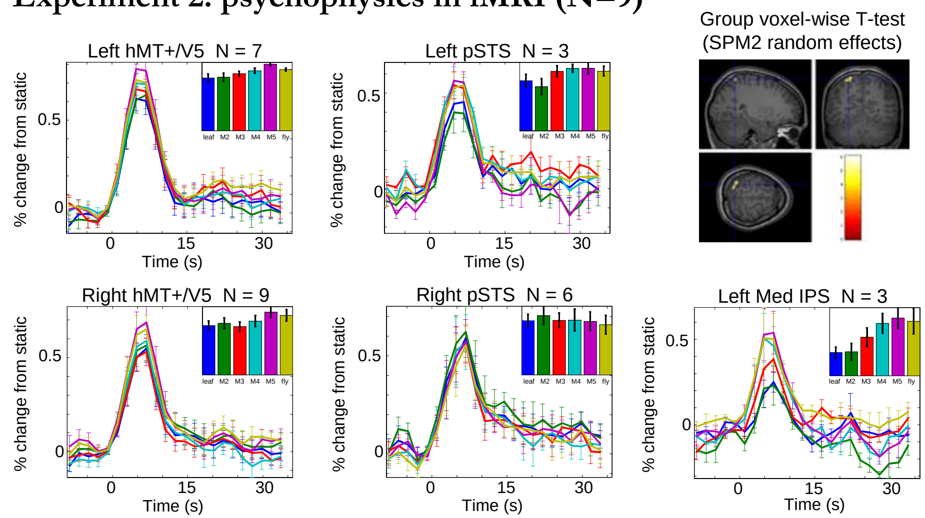
Conclusion

We created animate and inanimate single-dot movement trajectories and intermediary morphs that were discriminated as we hoped by ¾ of our subjects. Preliminary fMRI data shows that activity in left medial parietal cortex changes with the morph level controlling the animacy percept. Surprisingly, this profile was not found in posterior superior temporal sulcus (pSTS). If confirmed in more subjects, these results could indicate that pSTS is only sensitive to biological motion when displayed by articulated motion or interacting objects.

Experiment 2: psychophysics in fMRI (N=9)



Subjects with desired psychophysical effects were scanned. Stats: (medians & QD): JND = 1.18 (0.54), PSE = 3.76 (0.23), CI = 0.69 (0.11).



Activity in left medial parietal cortex changes with perceived animacy and morph level. Surprisingly no effect in posterior superior temporal sulcus (pSTS)! As expected, almost no change in hMT+/V5.

References:

1) Baron-Cohen, S. *Mindblindness: An essay on autism and theory of mind.* Cambridge, MA: MIT Press; 1995

2) Johannson G. Visual perception of biological motion and a model for its analysis. *Perception and Psychophysics.* 1973; 14: 201–211.

3) Heider, F. and Simmel, M. An experimental study of apparent behavior. *American Journal of Psychology.* 1944; 57: 243–259

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