Project Prakash

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How the Brain Learns to See Biological Motion After Recovering from Visual Deprivation

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Introduction

- Enhanced sensitivity to biological motion appears early in human development [1] and is found even in newly hatched chicks, reared and hatched in darkness. [2]
- According to studies with sight-restored subjects tested years after recovery from congenital blindness, this skill[3] and its neurophysiological signatures[4] are resilient to visual deprivation and spared even after long periods of blindness.
- This has led to questioning if visual experience is at all required for development of visual systems for specialized processing of biological motion.
- We addressed this question by testing biological motion perception of individuals with early onset profound visual deprivation, before treatment with sight-restoring surgery and immediately following it.

Methods [5]

Experiment 1 - **Walking Direction Discrimination**

- Point light walker in sagittal view
- **"What direction the person is walking towards?"**
- Gate cycle continuously shown until response
- 16 trials

Experiment 2 - **Biological Motion Discrimination from Human Action**

- Short clips of a point-light action (e.g., running, kicking, sitting down, throwing)
- Coherent versus Manipulated versions of the same action
- Manipulated: spatially scrambled / phase scrambled / inverted
- **"Which was the person?"**
- 8 action types x 3 actors x 3 manipulations = 72 trials

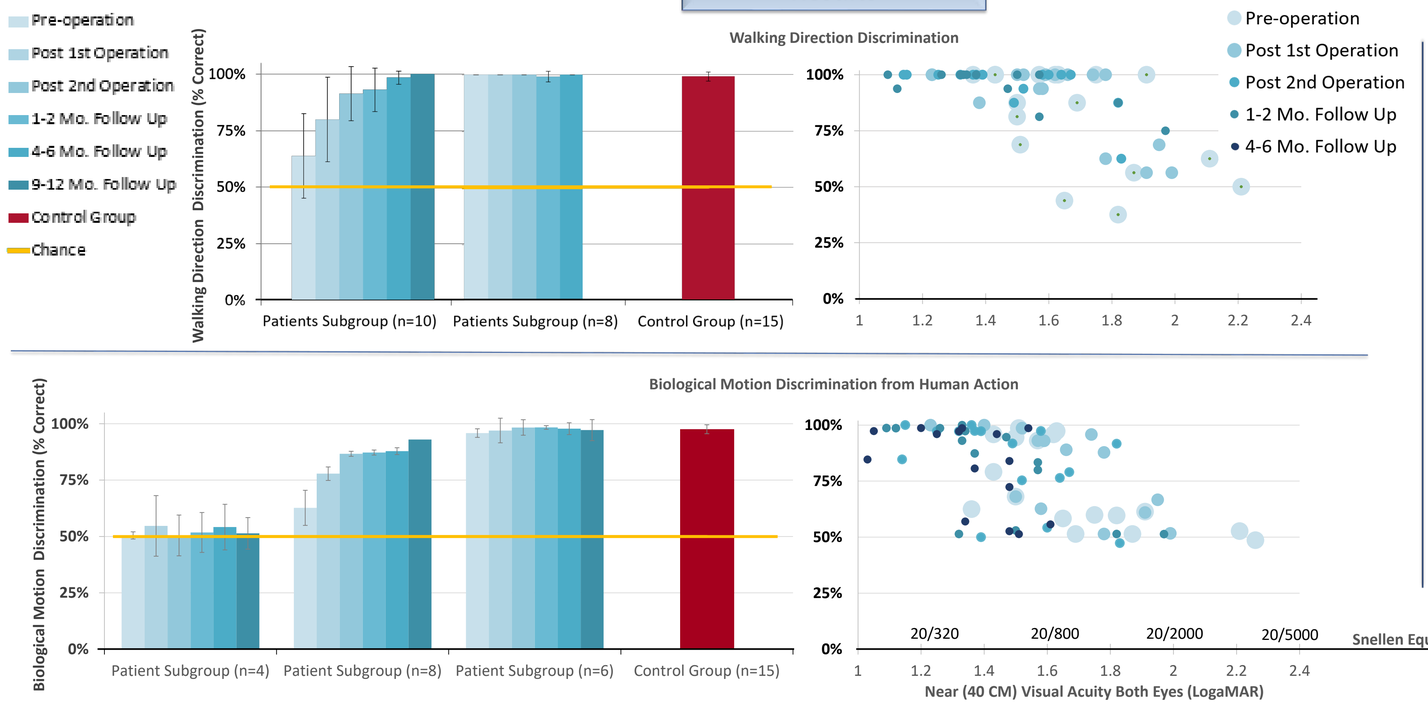
Participants

- 18 sight restored subjects age 11 years ± 3.6
- 15 control subjects age 12.6 years ± 1.1, tested with simulated acuity reduction

Sight restored patients

- Born with dense bilateral cataracts considerably occluding sight
- Treated with sight-restoring cataract-removal surgery - www.projectprakash.org
- Legally blind prior to treatment Acuity range 20/457 - 20/3661
- Markedly improved after treatment 20/178 -20/809
- Visual acuity stabilized in the months after treatment

Results



Performance on the two tasks correlated, at each testing time-point:

✓ With visual acuity at the time of testing (see plot).

✓ With pre-treatment visual acuity.

This correlation persisted up to a few months post surgery (up to 2 for walking direction and 6 for biological motion discrimination).

- No such correlation in controls (p=0.12, 0.82)
- No correlation between performance in Experiment 1 and 2.

Conclusion

- Biological motion perception can develop in the absence of early visual input.
- Visual experience plays a significant role in the emergence of this skill.

Follow-up Questions

- What types of information were used by subjects to perform discrimination of walking direction?
- What is the neural underpinning of differences in performance between individuals?
- What can differences in performance between the tasks be attributed to?

References

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