Inverted gravity, not inverted shape impairs biological motion perception

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Introduction

Biological motion point-light displays produce a strong inversion effect (Sumi, 1984) which shows similarities to the well known inversion effect in face recognition (Thompson, 1980). In face recognition, the inversion effect has been interpreted in terms of a distinction between configural processing and featural processing. There is evidence that turning faces upside-down hinders configural processing (Diamond and Carey, 1986).

Is the inversion effect for biological motion also based on

impaired configural processing?

Scrambling a point-light display completely disrupts configural structure. Scrambling should therefore impair perception even more than inversion. Upright and inverted scrambled motion should have similar effects.

or ...

Another explanation is based on recent findings that assumptions about the direction of gravity play a role in interpreting biological motion (Shipley, 2003). Is the cause of the inversion effect

inverted gravity?

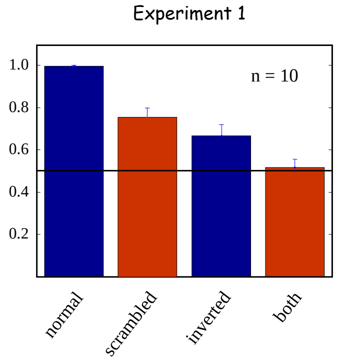
If this is the case upright scrambled motion should produce less effects than intact but inverted motion. Inverted scrambled motion should impair recognition more than upright scrambled motion.

Experiment 1 directly compares the effects of inversion and scrambling of biological motion displays.

Experiment 2 looks specifically at the role of the feet as they show more vertical motion than other body parts. Inversion therefore affects the feet more than most other marker points.

Diamond, R. & Carey, S. (1986) JEP: General 115, 107-117.
Shipley, T. F. (2003) Psychological Science 14, 377-80.
Sumi, S. (1984) Perception 13, 283-286.
Thompson, P. (1980) Perception 9, 483-484 .

Results

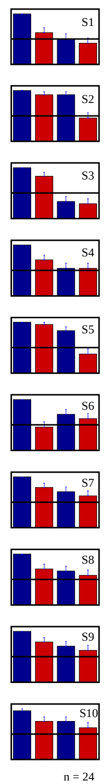


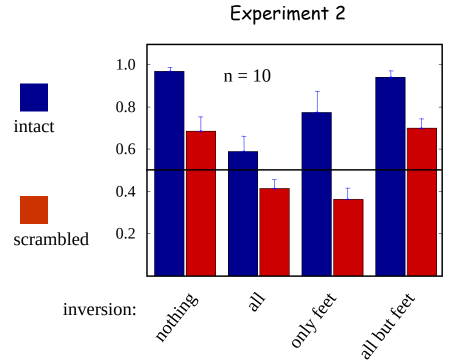
SRC	SS	df	MS	F	p
scr	0.3835	1	0.3835	86.065	0.000 ***
ss/	0.0401	9	0.0045		
inv	0.8028	1	0.8028	38.320	0.000 ***
is/	0.1885	9	0.0209		
si	0.0210	1	0.0210	1.069	0.328
sis/	0.1769	9	0.0197		

Type of creature and sex of participant had no effect.

Inversion impairs biological motion perception more than scrambling!

Inversion also effects scrambled biological motion!





SRC	SS	df	MS	F	p
scr	0.3889	1	1.3889	37.155	0.000 ***
ss/	0.2990	9	0.0374		
inv	1.5480	3	0.5160	17.289	0.000 ***
is/	0.7163	27	0.0298		
si	0.1341	3	0.0447	2.344	0.098
sis/	0.4575	27	0.0191		

Type of creature and sex of participant had no effect.

It's in fact the feet! Inverting their trajectories has the largest effect.

This is particularly true for scrambled motion where they seem to be responsible for the full effect.

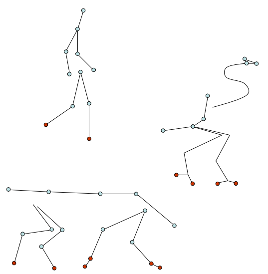
Discussion

Our visual system is equipped with an efficient and reliable sensory filter that responds to animate motion. Animate motion is loaded with information, but one of the most import issues is to determine if another creature is moving towards or away from us. The anticipation of an attack or the decision to take the chance to catch prey provide vital constraints for the evolution of our visual system. The typical pattern of motion created by the periodic dissipation of energy against the constant force of gravity seems be used by the visual system to detect an animal and its direction of locomotion.

Methods

Stimuli:
Point-light displays of stationary walking animals (profile view) in a random dot mask (100 dots, lifetime 170 ms)

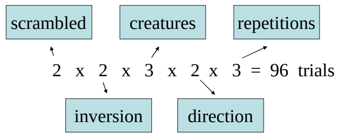
1. Human
   frequency: 0.9 Hz
   # points: 11
2. Pigeon
   frequency: 1.6 Hz
   # points: 11
3. Cat
   frequency: 1.8 Hz
   # points: 18



Modifications:
Inversion: Either the whole stimulus or only parts of it were presented up-side down.
Scrambling: Each point's trajectory was randomly displaced.

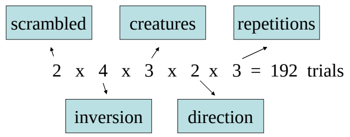
Task: Is the creature going left or right?

Design: Experiment 1



5 male, 5 female participants

Experiment 2



5 male, 5 female participants