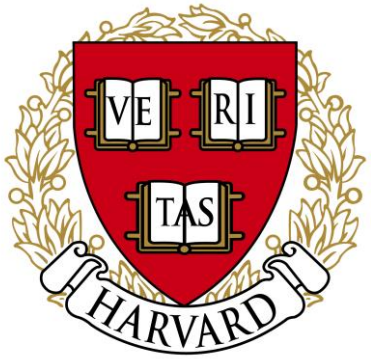
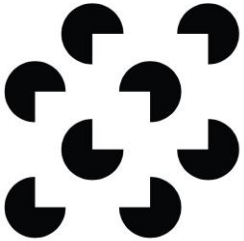




Vision Sciences Laboratory

The social mind

Professor Ken Nakayama

Department of Psychology

Harvard University

Question

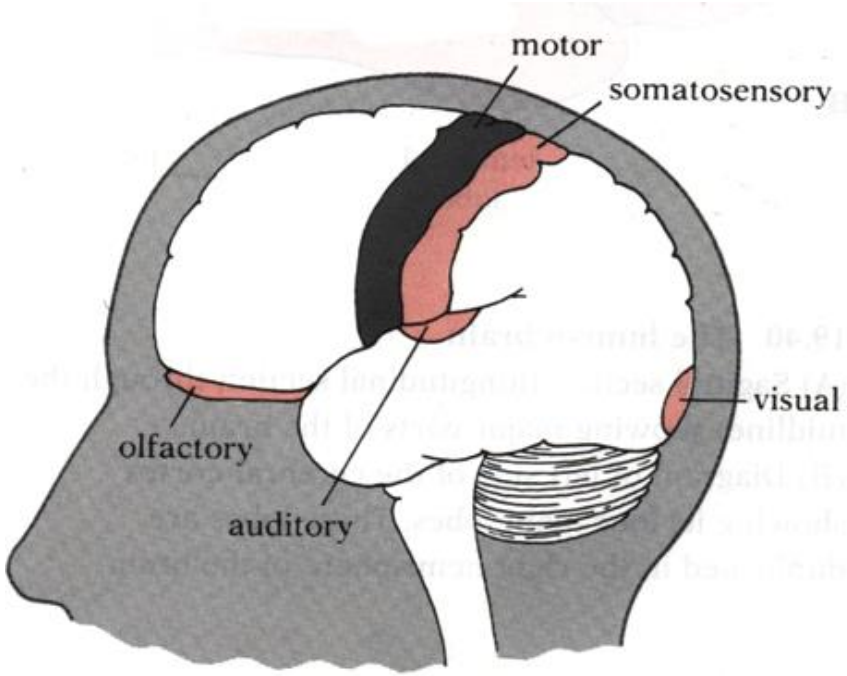
On the origin of human intelligence?
(mathematics, language,
episodic memory)?

background

- My training and career - vision
  - Not social psychology
- Reductionism
- Primacy of social processing
- Many ways to study it

Expansion of the visual system

classical view of brain



1950s

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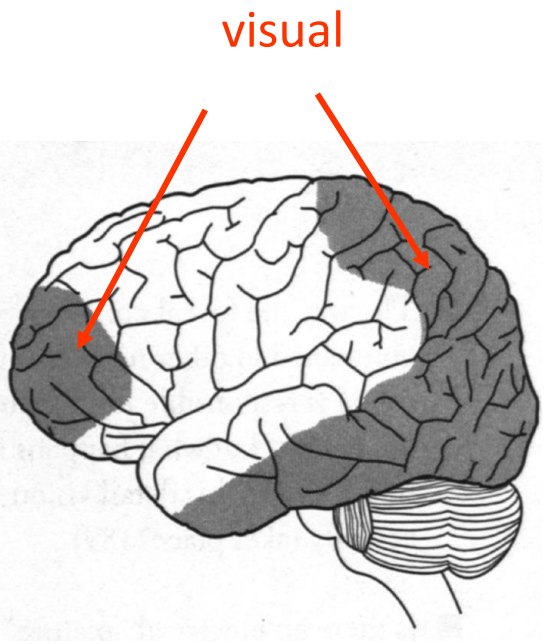
post 1970s view



1980s

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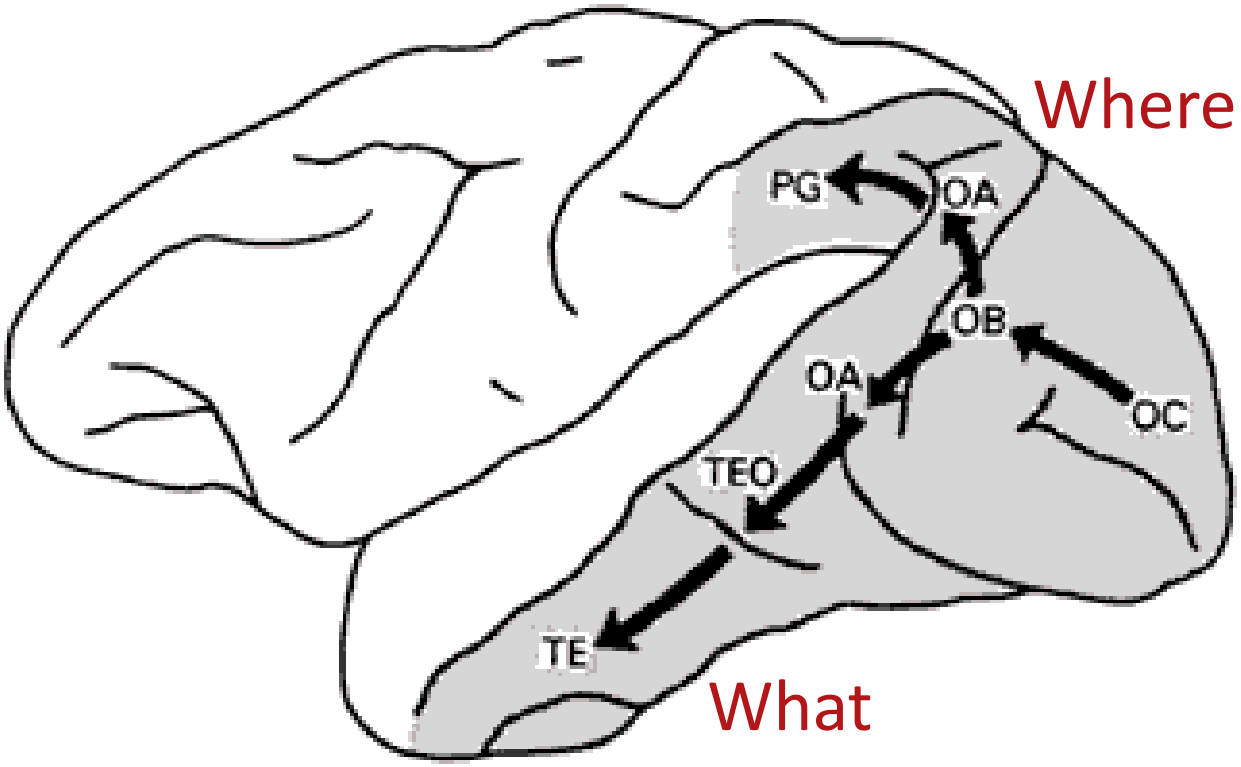
Half of primate brain and substantial fraction of human brain devoted to vision

Vision is "*determining what is where by looking*" -David Marr (1980)



Ungerleider and Mishkin (1982)

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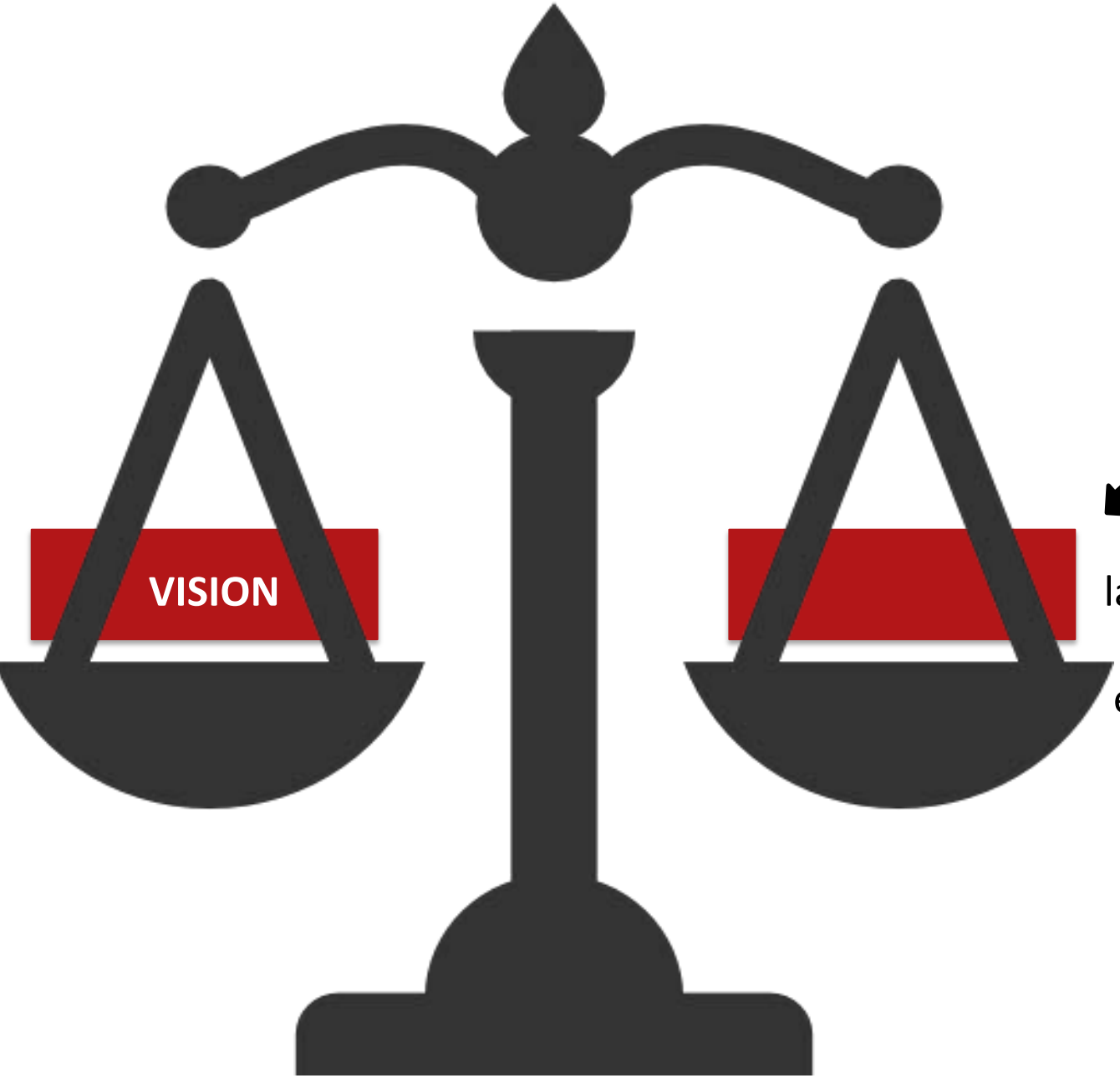
Source: Mishkin, Mortimer, and Leslie G. Ungerleider. "Contribution of striate inputs to the visuospatial functions of parieto-preoccipital cortex in monkeys. "Behavioural brain research 6, no. 1 (1982): 57-77.

Figure removed due to copyright restrictions. Please see the video.
Source: Van Essen, David C., Charles H. Anderson, and Daniel J. Felleman."Information processing in the primate visual system: An integrated systems perspective." Science 255, no. 5043 (1992): 419.

Enormity of vision (in primates)



EVERYTHING ELSE

language, abstract thoughts
greed, sex, power,
empathy, humor, literature
music, addiction, choice…

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Must be other visual functions that we are ignoring

more than

Vision is **Λ**"*determining what is where by looking*"

-David Marr (1980)

Must be other visual functions that we are ignoring

- Action (visuo-motor control)
- Navigation

- **Social perception and behavior**

9

The social function of intellect

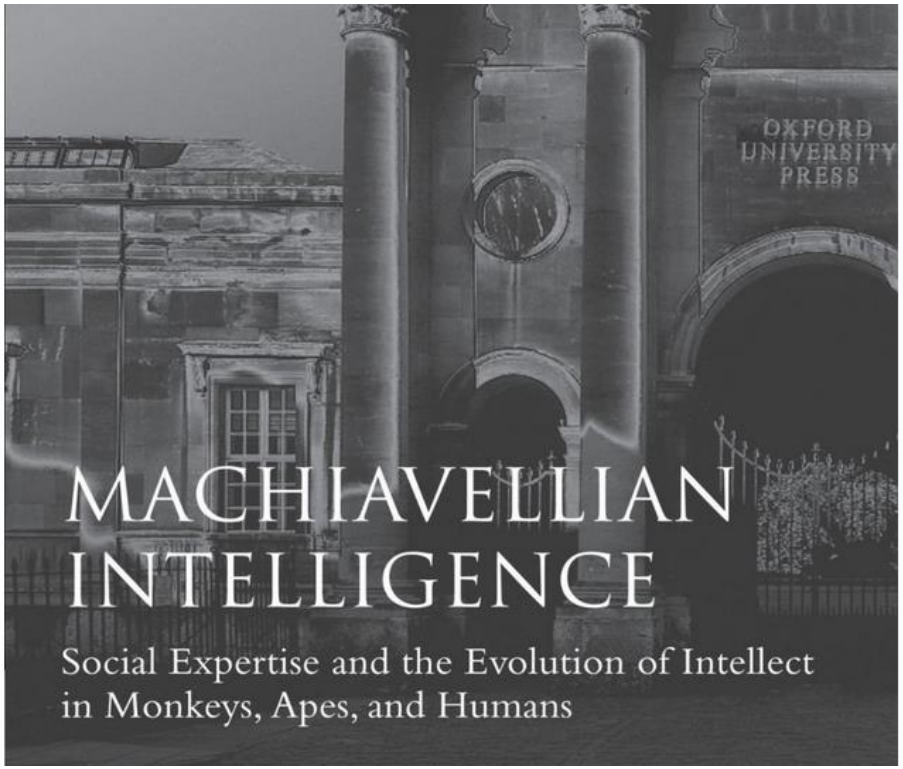

Image of Nicholas Humphrey removed due to copyright restrictions. Please see the video.

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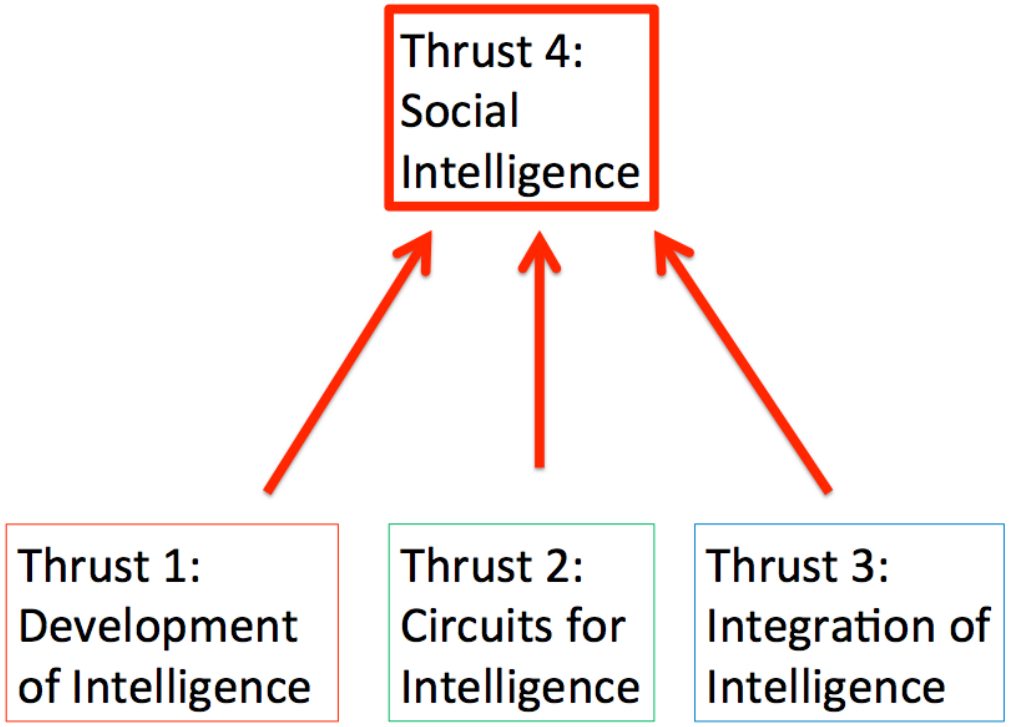
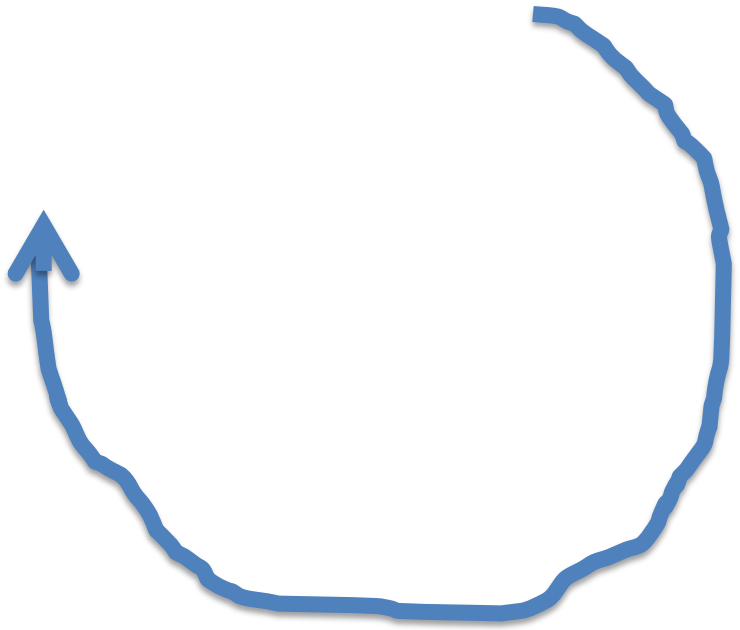
Experimental psychologists in Britain have tended to regard social psychology as a poor country cousin of of their subject . . . (Humphrey, 1976)



CBMM



Turning psychology
Upside down ?

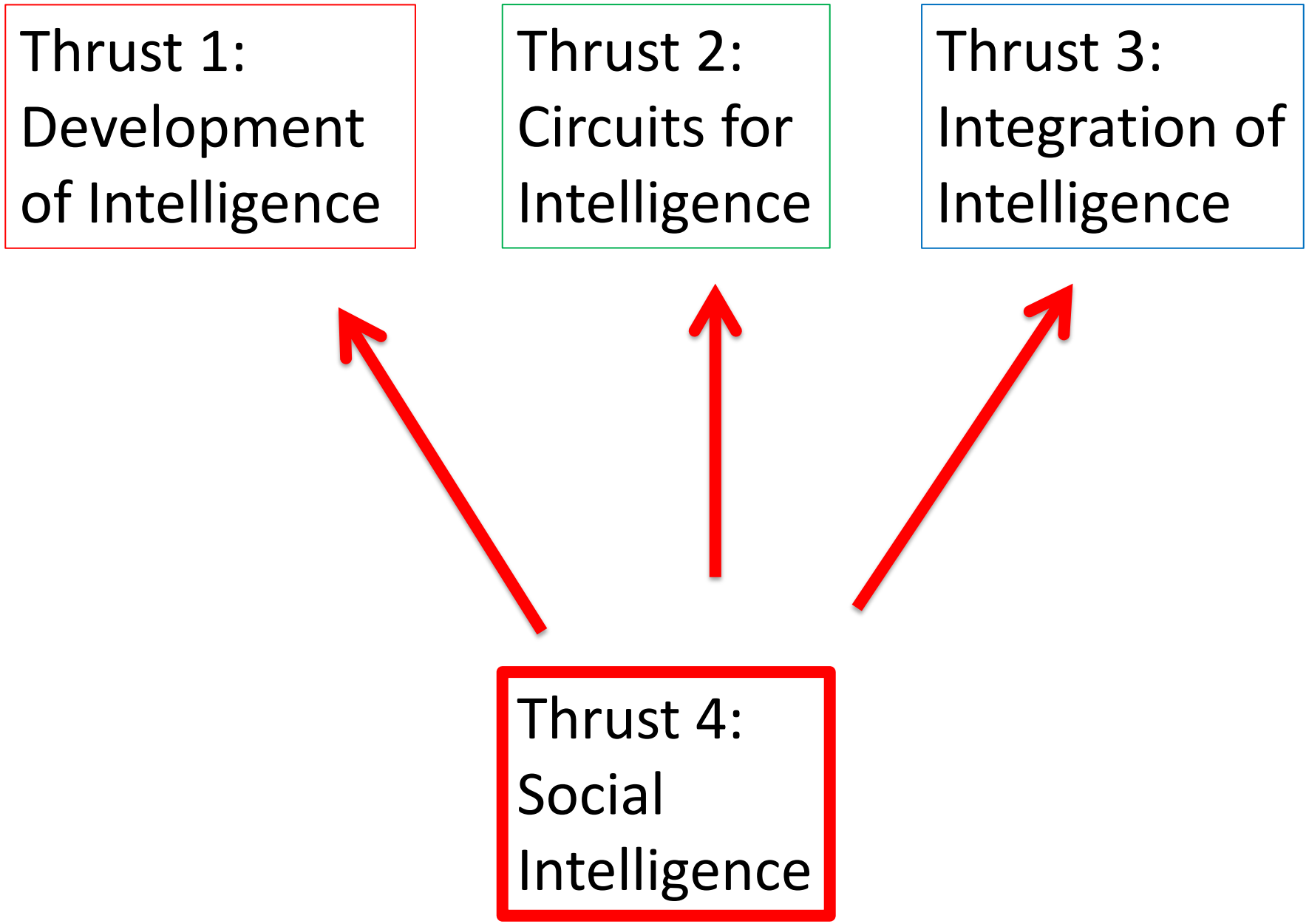
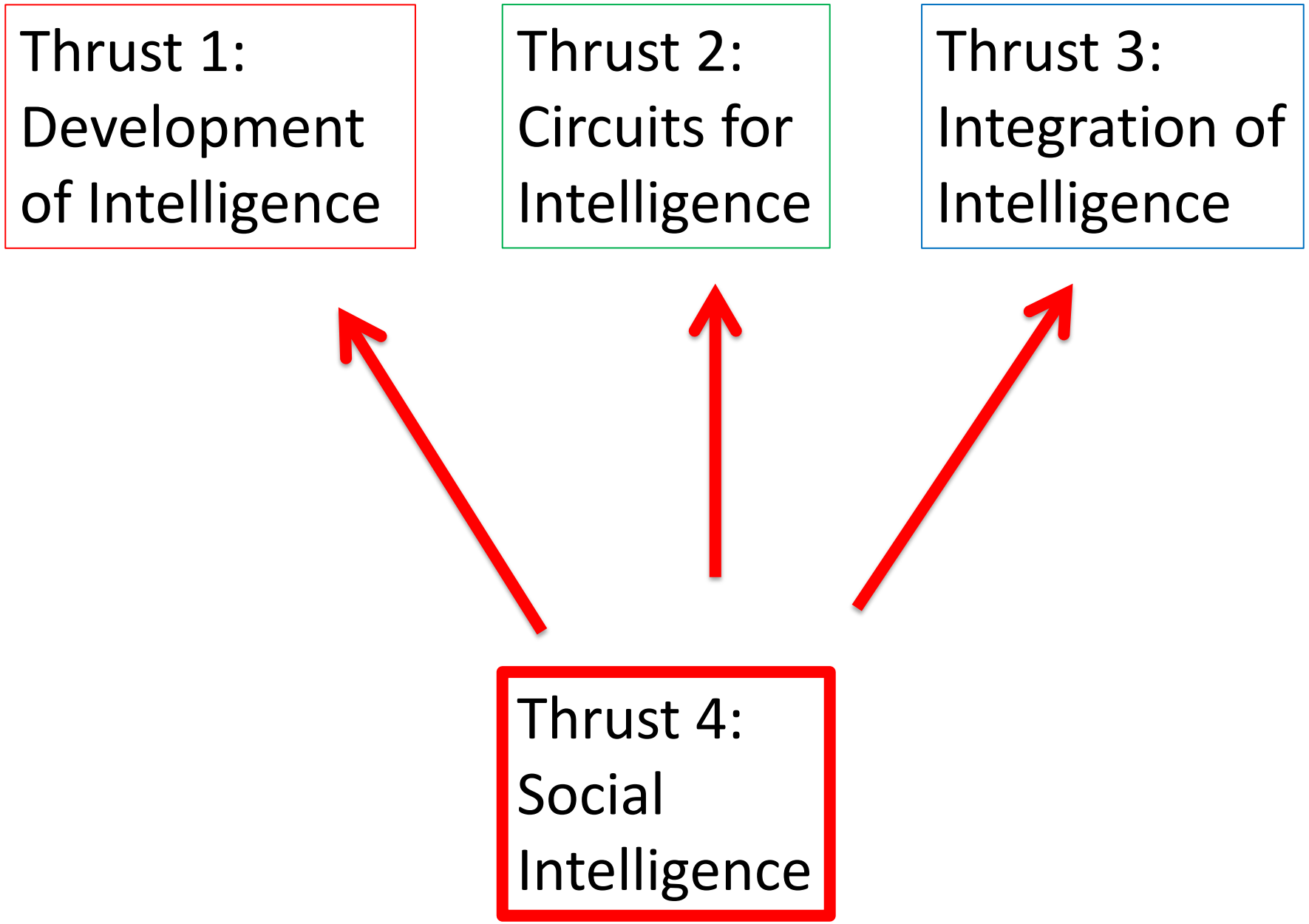

Thrust 1: Development of Intelligence
Thrust 2: Circuits for Intelligence
Thrust 3: Integration of Intelligence
Thrust 4: Social Intelligence

Figure removed due to copyright restrictions. Please see the video.
Source: https://www.bloomberg.com/news/articles/2013-01-10/the-dunbar-number-from-the-guru-of-social-networks

An upside down psychology?

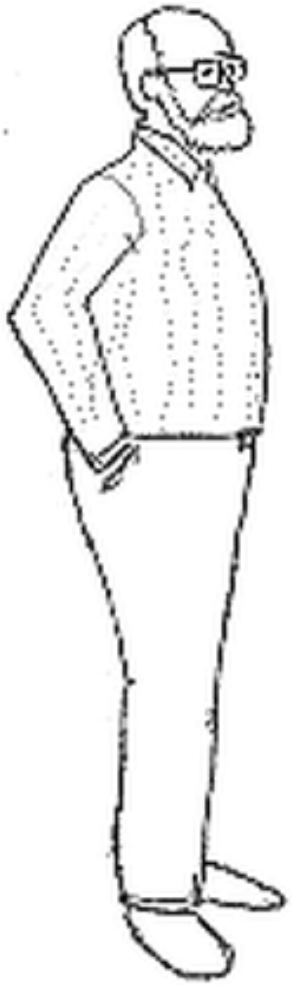
. . . the intellectual faculties of primates have evolved as an adaptation to the complexities of social living. For better or worse, styles of thinking which are primarily suited to social problem-solving colour the behavior of man and other primates even towards the inanimate world. (Humphrey, 1976)

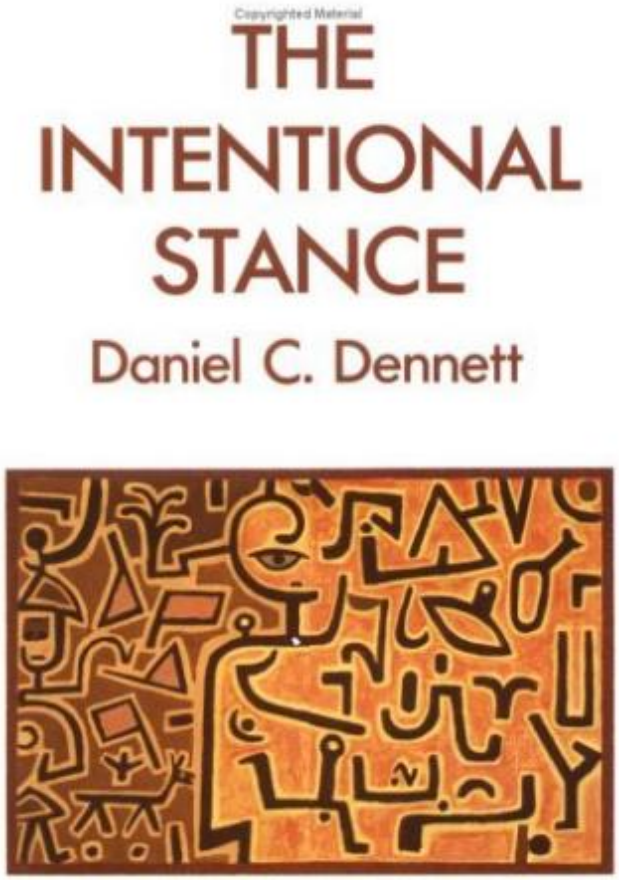

Thrust 1: Development of Intelligence
Thrust 2: Circuits for Intelligence
Thrust 3: Integration of Intelligence
Thrust 4: Social Intelligence

Prediction
a characteristic of science?

What is more predictable?

- Physics – balls dropping, rock rolling, positions of particles
- Machine – alarm clock
- Biological - birds, monkeys, humans





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Recognizing and acting on beliefs and desires of of others

Dennett's 3 levels for predicting behavior

- Physical stance – physics/chemistry
  - gravity, water
- Design stance – biology and engineering
  - Vehicle, Coffee maker,
- Intentional stance – for minds to understand other minds
  - beliefs, desires

Non-reductionistic approach to the social realm is gaining some legitimacy

- So how to proceed, what to study?

What about in the social realm?

Identify unexamined core common things and then explore them

Human social behavior

- Striving for dominance (hierarchy)
- Prosociality - Affiliation, succor, group support

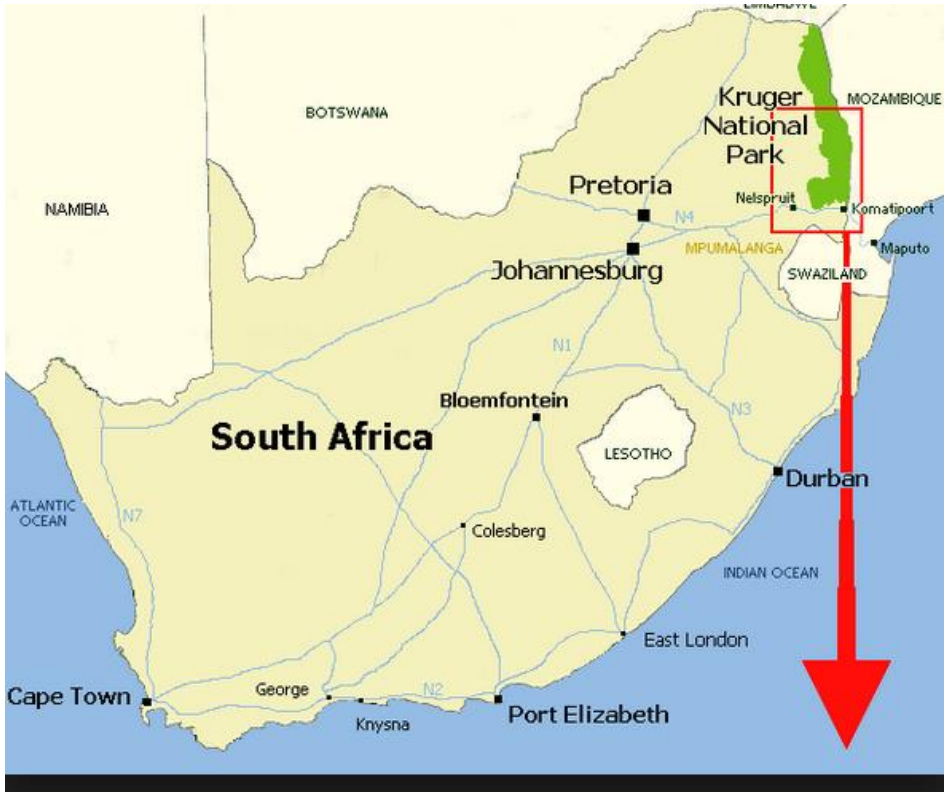
Caring, teasing, laughter, revenge, warfare

Share with animals ?

If so, then we have a treasure trove from biology

Incipient links to biology

- Similar to humans? -
- Common design
- Intentional stance?



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Canon ZR50MC camera

Battle at Kruger

https://www.youtube.com/watch?v=LU8DDYz68kM

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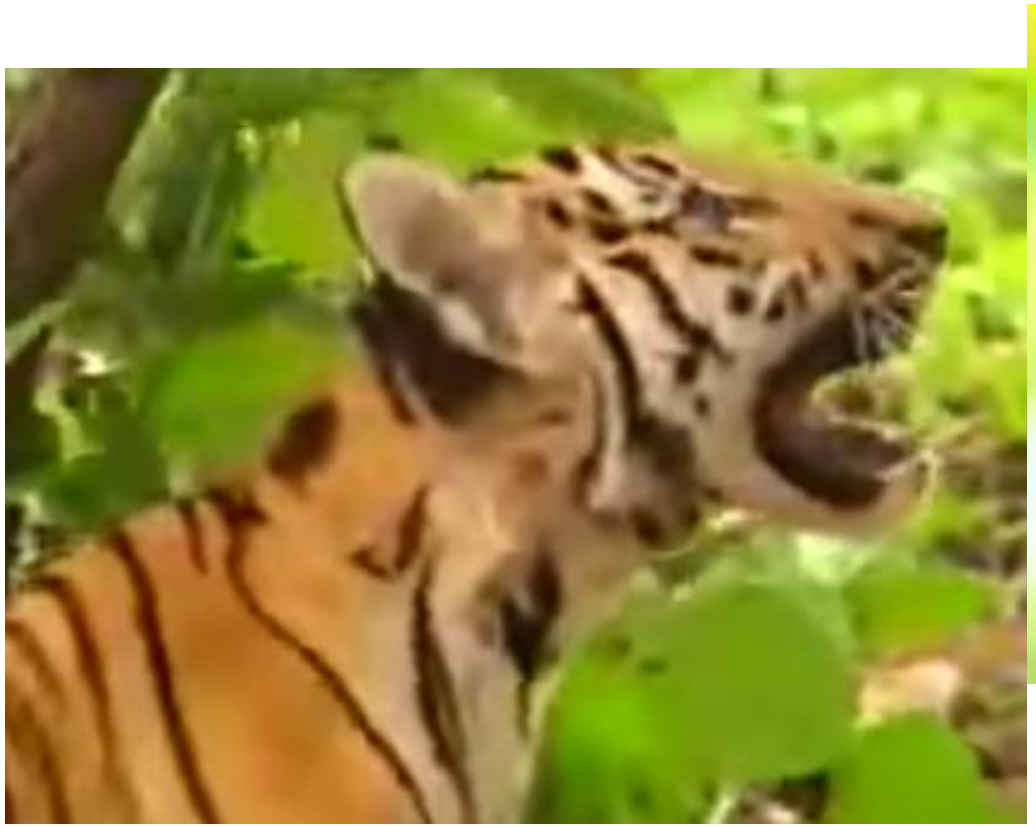
Collective support

https://www.youtube.com/watch?v=LU8DDYz68kM

Teasing

http://www.dailymotion.com/video/x2ithut

https://www.youtube.com/watch?v=5qqdovHOgvU&feature=kp



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Play (tickling)

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https://www.youtube.com/watch?v=j-admRGFVNM

Jaak Panksepp

WAR

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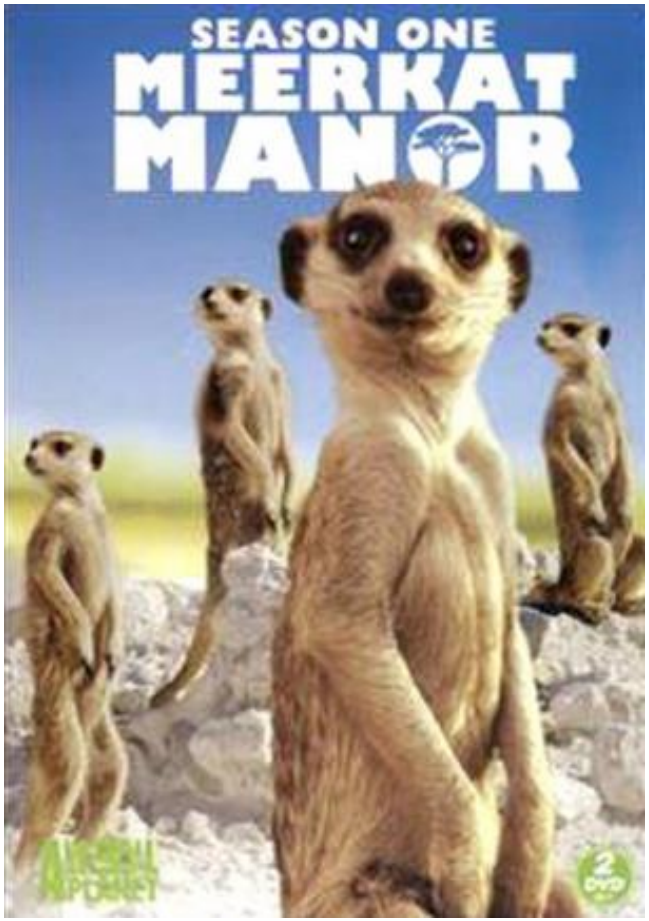

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Timothy Clutton-Brock

Meerkats

- 12 inches, 1 sq Km range, burrowing, foraging
- Kalahari desert
- Most studies social animal
- Troops of kin, led by alpha females
- Resist territorial infringement (have implicit concept of private property) - WAR

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Source: 2nd Royal Munster Fusiliers at Hulloch, WWI by Fortunino Matania.

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Human social processing

Social Perception

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Nalini Ambady

"Thin slices" of Behavior:

A few seconds of a silent video of an unfamiliar person reveals rich social info:

- Teacher Effectiveness Ratings:

Viewing 30 seconds silent video of a prof teaching predicts end-of-semester teaching effectiveness ratings (independent of physical attractiveness).

"Hence, a full semester's worth of teaching performance was presaged by naïve strangers who viewed only 30-seconds of teacher nonverbal behavior. "

- "Gaydar": Viewers are more accurate than chance at guessing a persons's sexual orientation from a one-second video clip (but not a snapshot) of a person talking about something unrelated to their s.o.
- From a 15 -second silent clip of two people talking viewers can correctly infer whether they are lovers, friends, or strangers.

We perceive the social world in rich multidimensional social technicolor.
What cognitive and neural mechanisms underlie this ability?
What are the components of this ability?
Work in progress

Face recognition

Prosopagnosia

Faceblindness,
a face specific deficit ?

Acquired prosopagnosia

- Brain lesion -right temporal-occipital junction
- Onset often obvious and dramatic
- Upper field loss (left quadrant)
- Achromotopsia , Topographagnosia
- ~100 cases (meta-analysis) Bouvier & Engel, Cerebral Cortex, 2005

Developmental prosopagnosia

- Until recently, thought to be very rare

- Can be as serious as acquired cases
- Leading to crippling social disabilities
  - Adults, children
- No identifiable brain injury

- Duchaine and Nakayama, Current Opinion in Neurobiology, 2006

Our website to educate and recruit persons suffering from prosopagnosia

~ 6000 registrants

Hundreds tested

www.faceblind.org

Some testimonials

JK, age early 30s, female, recent PhD (DP)

“This week I went to the wrong baby at my son's daycare and only realized that he was not my son when the entire daycare staff looked at me in horrified disbelief.”

Lost Friendships

Many a friendship was lost or damaged. It was bewildering to me to have a person quit speaking to me while saying that I had been extremely rude and personally having no idea what I had done.

If we had kept in touch, I would be able to explain, but of course many of them have long quit speaking to me

Female, PhD in mathematics

depression

“ . . I think prosopagnosia has worsened my current depression, if not the root cause of it. . . I prefer to be a recluse because I can’t confidently function any other way. “

Primarily a visual cognitive problem
not a psychiatric deficit

Stealth trait/condition

- No point of comparison during development
- Nothing comparable to acuity, color, reading tests for kids
- Standard clinical face tests not diagnostic
  - Benton face perception test
  - Warrington face memory test
  - Compensating strategies

Preface

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Source: http://www.choisser.com/faceblind/.

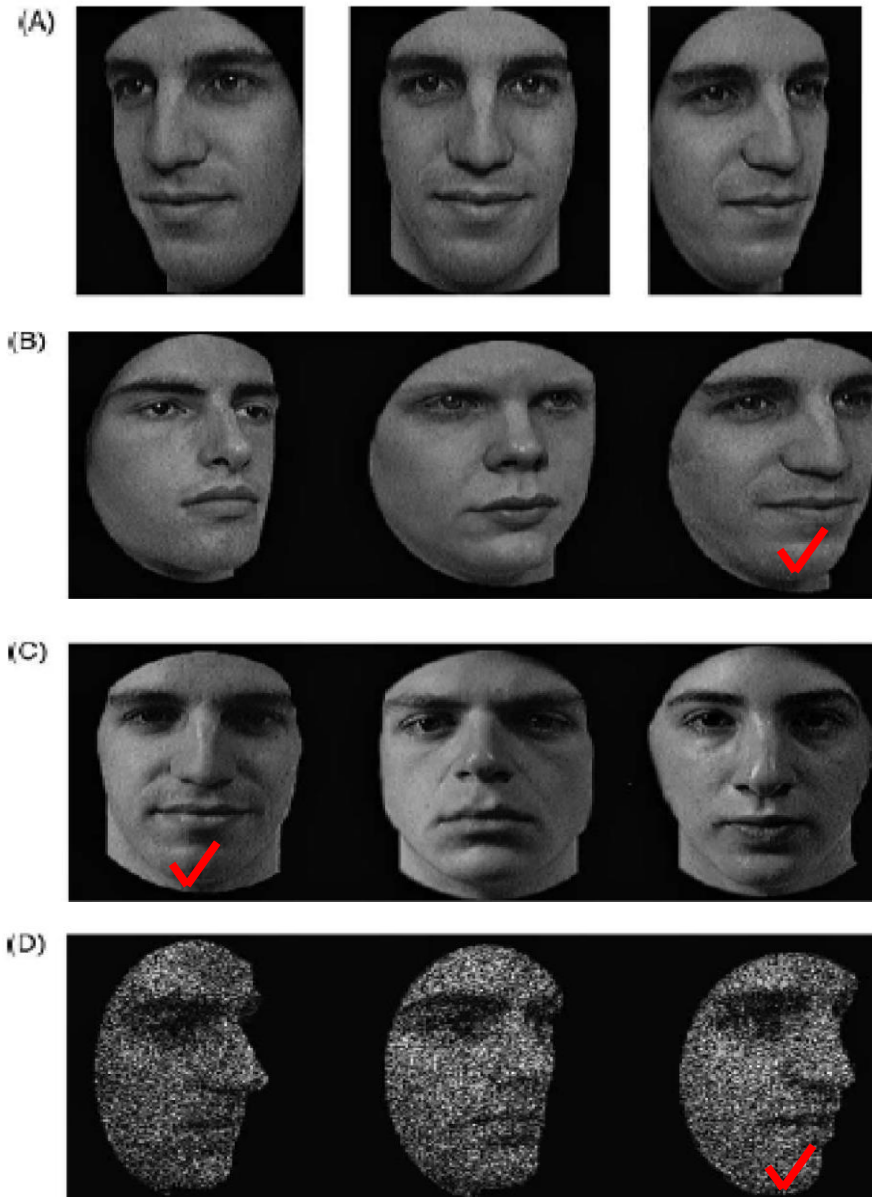
Testing for prosopagnosia

- Personal history
- Need for better objective tests
  - **Cambridge Face Memory Test (CFMT)**
  - Cambridge Face Perception Test
  - Abstract Art Test
  - Objects and Scenes
  - Verbal Paired Associate Memory
  - Age, Gender, attractiveness tests

Cambridge Face Memory Test

Must learn 6 New faces

Mimics real life
Discourages feature Matching
Has graded items
Neuropsychologia 2006



face to learn

identical (easy) test

harder

hardest

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Source: Duchaine, Brad, and Ken Nakayama. "The Cambridge Face Memory Test: Results for neurologically intact individuals and an investigation of its validity using inverted face stimuli and prosopagnosic participants. "Neuropsychologia 44.4 (2006): 576-585.

Extraordinary face memory super-recognizers

Russell, Duchaine and Nakayama, 2009

In their own words

“I have a photographic memory for faces. It has been my entire life, but it doesn't matter how many years pass, if I've seen your face before I will be able to recall it. It happens only with faces.”

“I often pick out the bit part actors, able to place them from brief roles in movies and television I have seen ten and fifteen years prior.”

“I have to pretend that I don’t remember people, because it seems like I stalk them, or that they mean more to me than they do when I recall that we saw each other once walking on campus four years ago in front of the quad!

Face Recognition Tests

"Before They Were Famous" Test

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Source: Russell, Richard, Brad Duchaine, and Ken Nakayama. "Super-recognizers: People with extraordinary face recognition ability." Psychonomic bulletin & review 16, no. 2 (2009): 252-257.

Nature – nurture?

Human face recognition ability is specific and highly heritable

Jeremy B. Wilmer[a,1], Laura Germine[b], Christopher F. Chabris[c], Garga Chatterjee[b], Mark Williams[d], Eric Ken Nakayama[b], and Bradley Duchaine[f]

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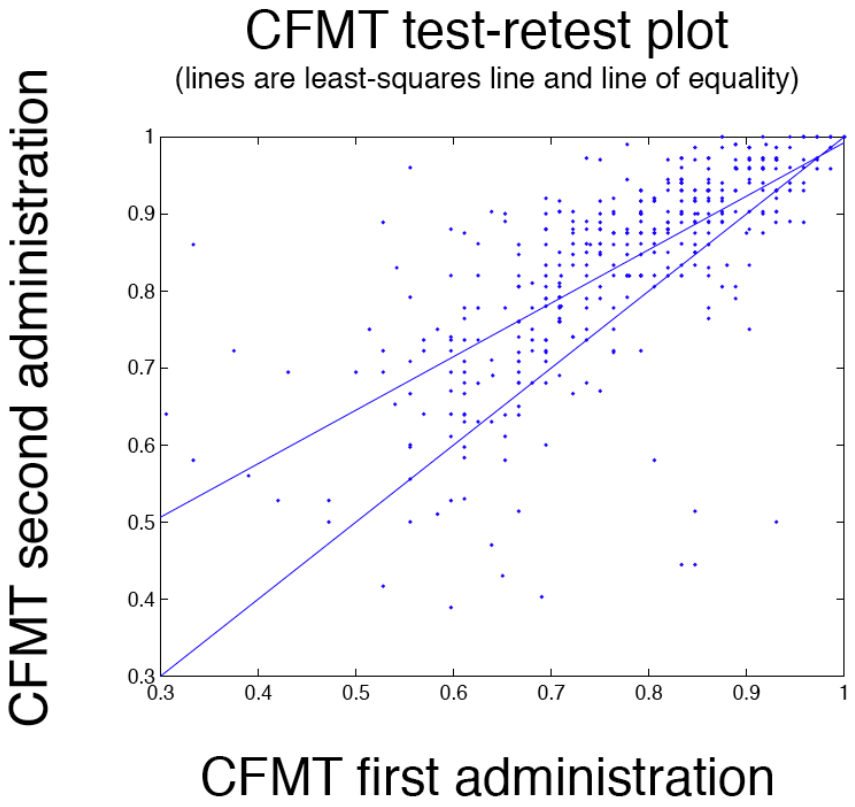
Source: Wilmer, Jeremy B., Laura Germine, Christopher F. Chabris, Garga Chatterjee, Mark Williams, Eric Loken, Ken Nakayama, and Bradley Duchaine. "Human face recognition ability is specific and highly heritable." Proceedings of the National Academy of sciences 107, no. 11 (2010): 5238-5241.

5238–5241 | PNAS | March 16, 2010 | vol. 107 | no. 11

Test reliability

Test – re-test correlation



r= .70

N = 350

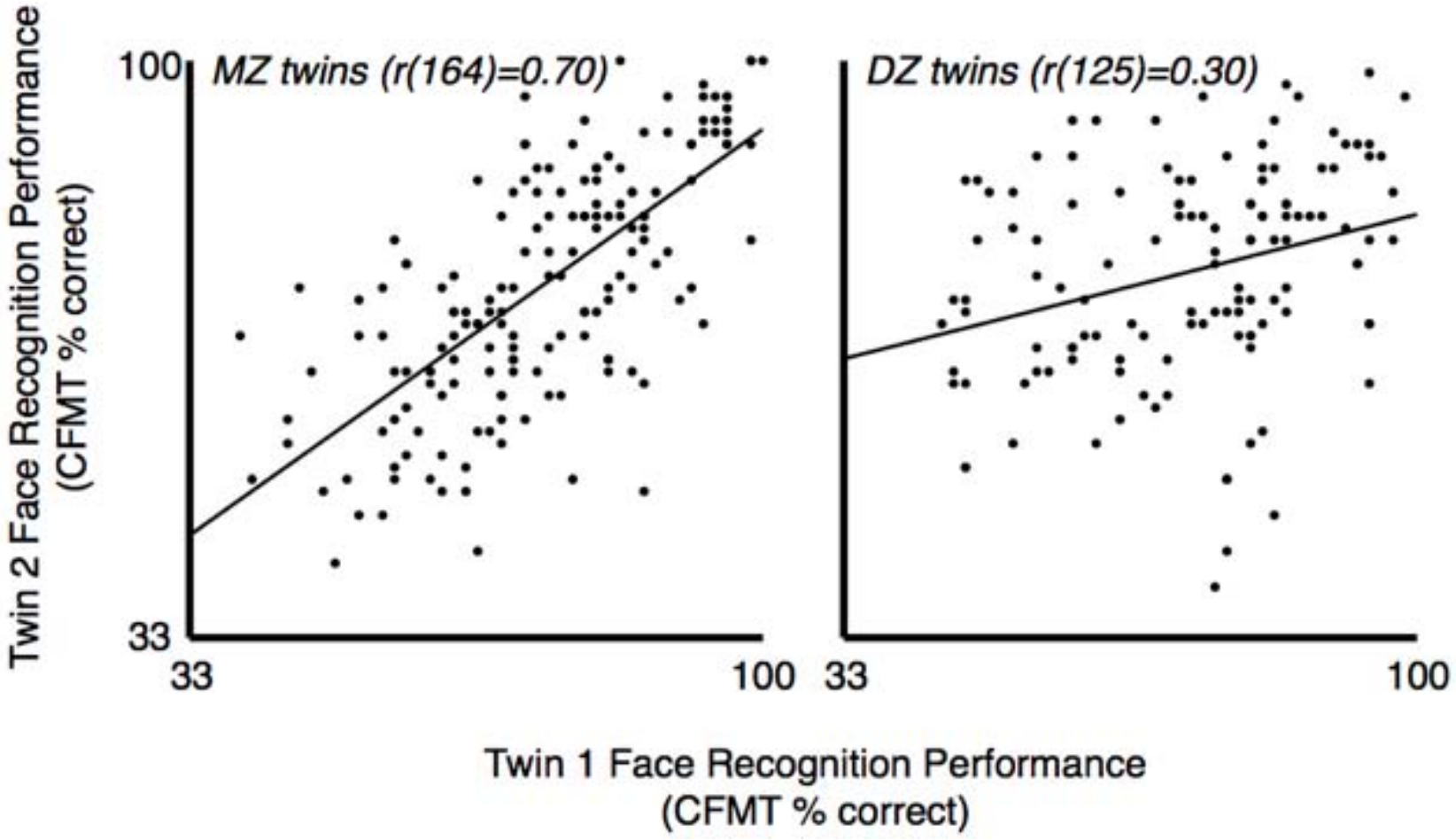
Interval: 3-12 months

Compare correlation of scores between MZ and DZ twins

- Australian Twin Registry
  - 164 Pairs MZ twins
  - 125 Pairs DZ twins

r = .7 (test re test)
sets upper bound

Australian Twin Registry



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Source: Wilmer, Jeremy B., Laura Germine, Christopher F. Chabris, Garga Chatterjee, Mark Williams, Eric Loken, Ken Nakayama, and Bradley Duchaine. "Human face recognition ability is specific and highly heritable. "Proceedings ofthe National Academy of sciences 107, no. 11 (2010): 5238-5241.

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Facial attractiveness

- Judgments are surprisingly consistent across observers (college age)
- averageness
- Masculinity-femininity

single

single

pair

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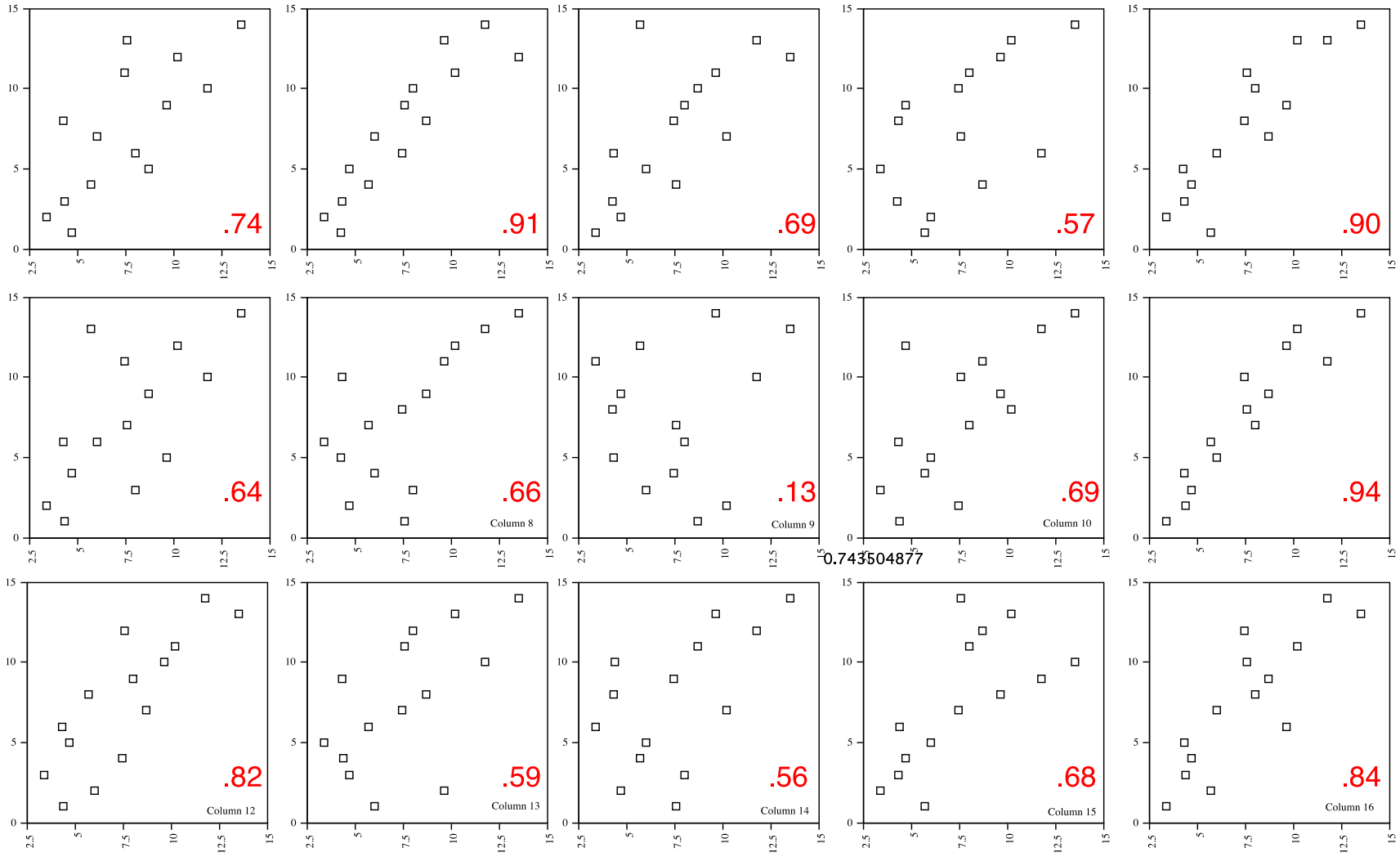
Individual subject (each scatter plot) ratings of faces vs mean ratings of faces

Ambady class, correlations with the mean ratings (first 15 subject slight blur condition s)



from excel file 'faces under blur data' <correlations slight blur>

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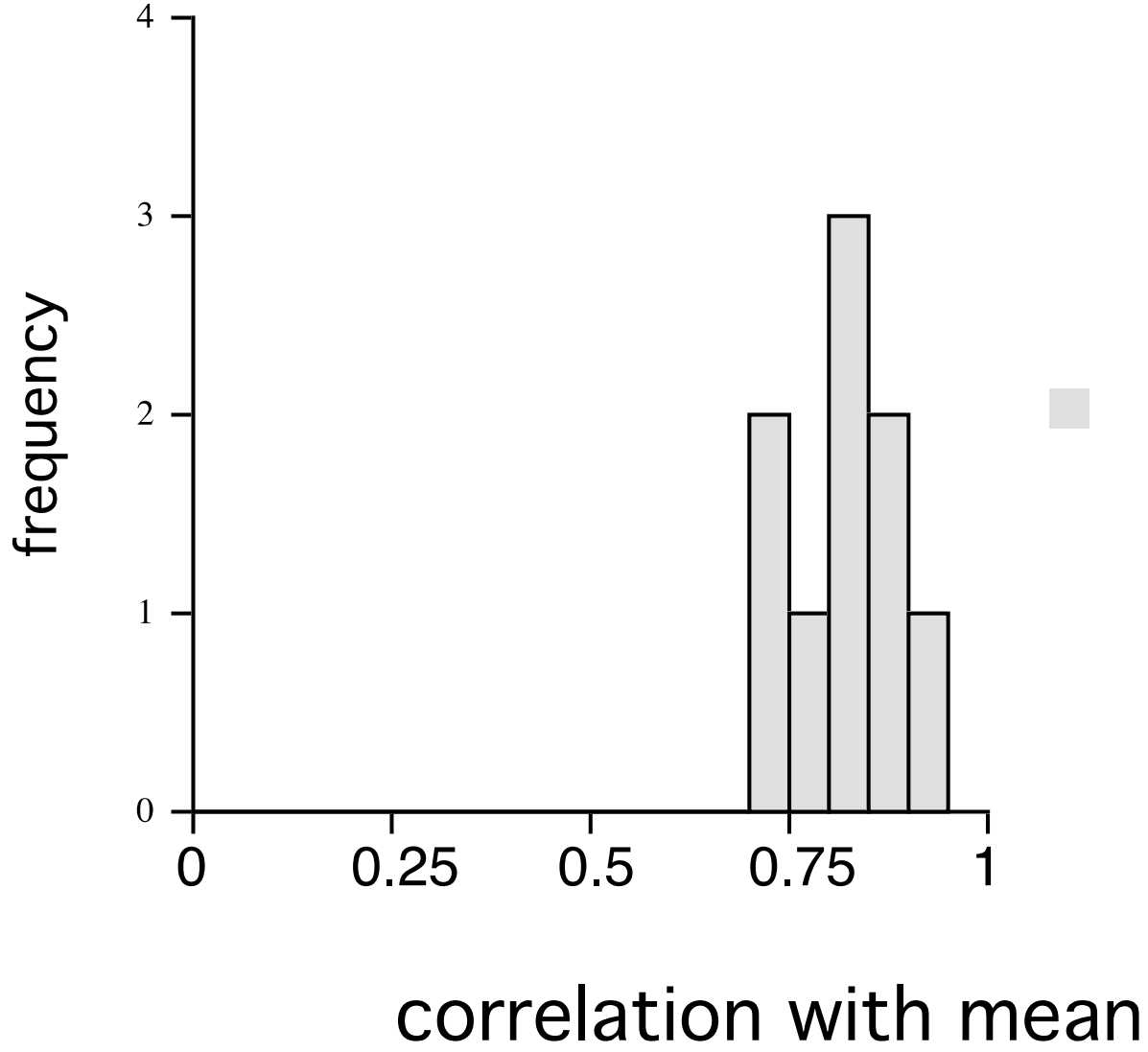
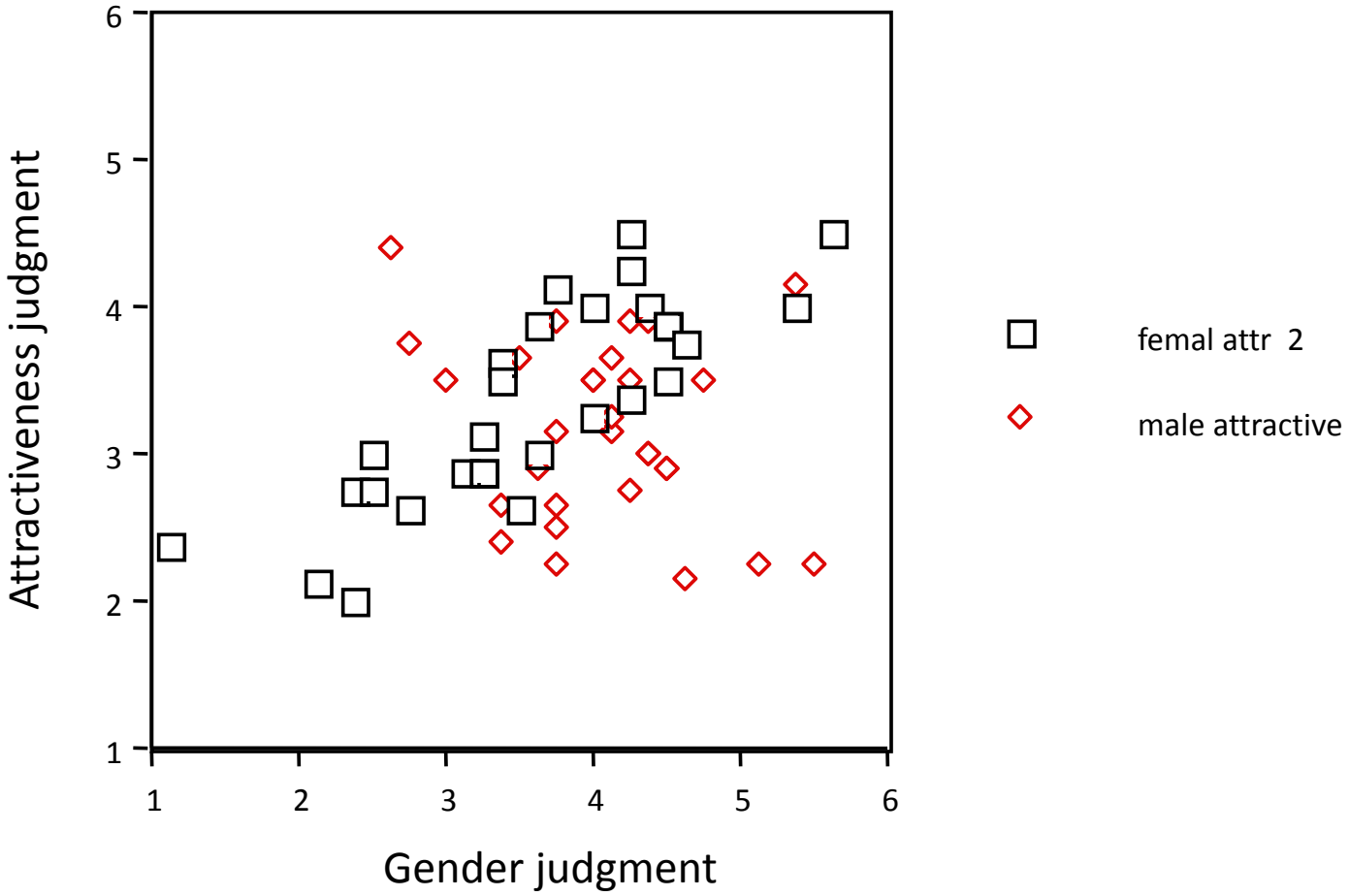
Red number represents correlation coefficent


frequency
4
3
2
1
0
0
0.25
0.5
0.75
1
correlation with mean

Gender vs attractiveness

Attractiveness vs gender



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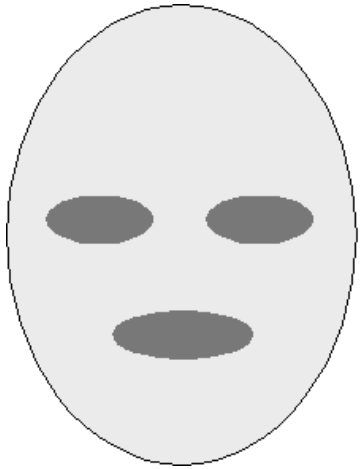
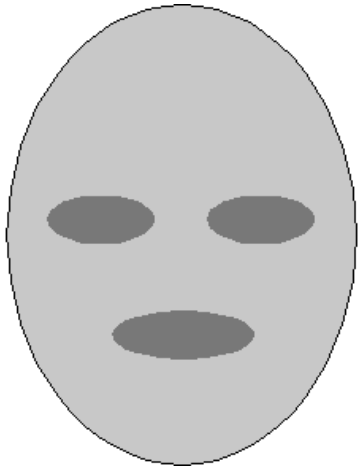
Russell, R (2009) A sex difference in facial contrast and its exaggeration by cosmetics. *Perception*



Female average



Male average

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Source: Russell, Richard. "A sex difference in facial contrast and its exaggerationby cosmetics." Perception 38, no. 8 (2009): 1211-1219.

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Source: Russell, Richard. "A sex difference in facial contrast and its exaggerationby cosmetics." Perception 38, no. 8 (2009): 1211-1219.

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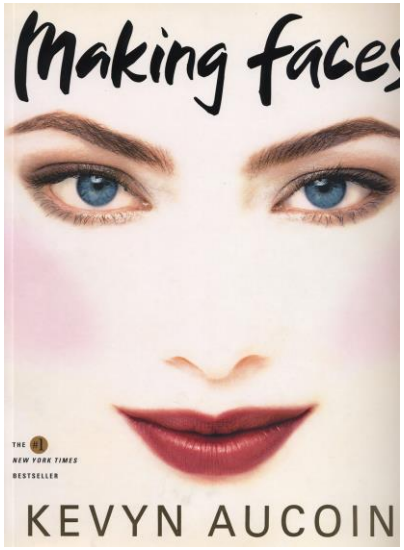

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Some social perception is much more rapid

- Working assumptions –

- Revealed only through motoric actions
- Too fast to be explicitly (consciously) perceived?

Commuters in a hurry

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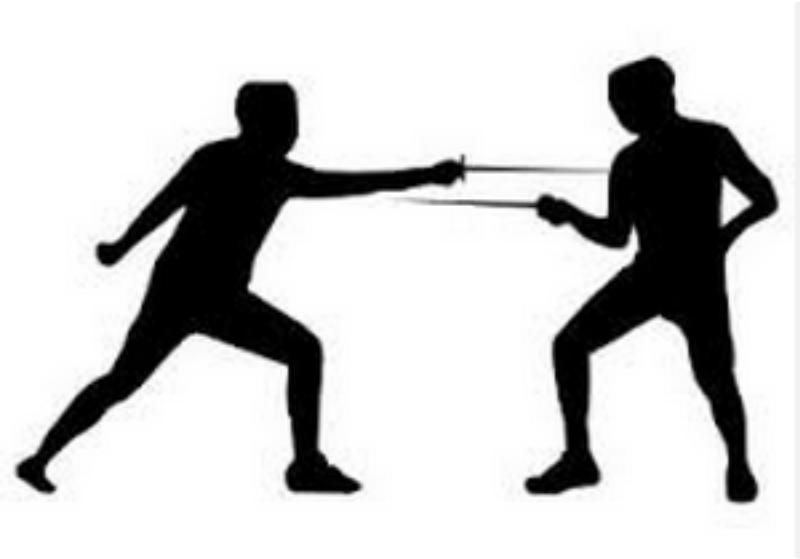
https://www.youtube.com/watch?v=6NLe4syTWgQ



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Rapid Visual Social Perception

How can we study it?

discrete events

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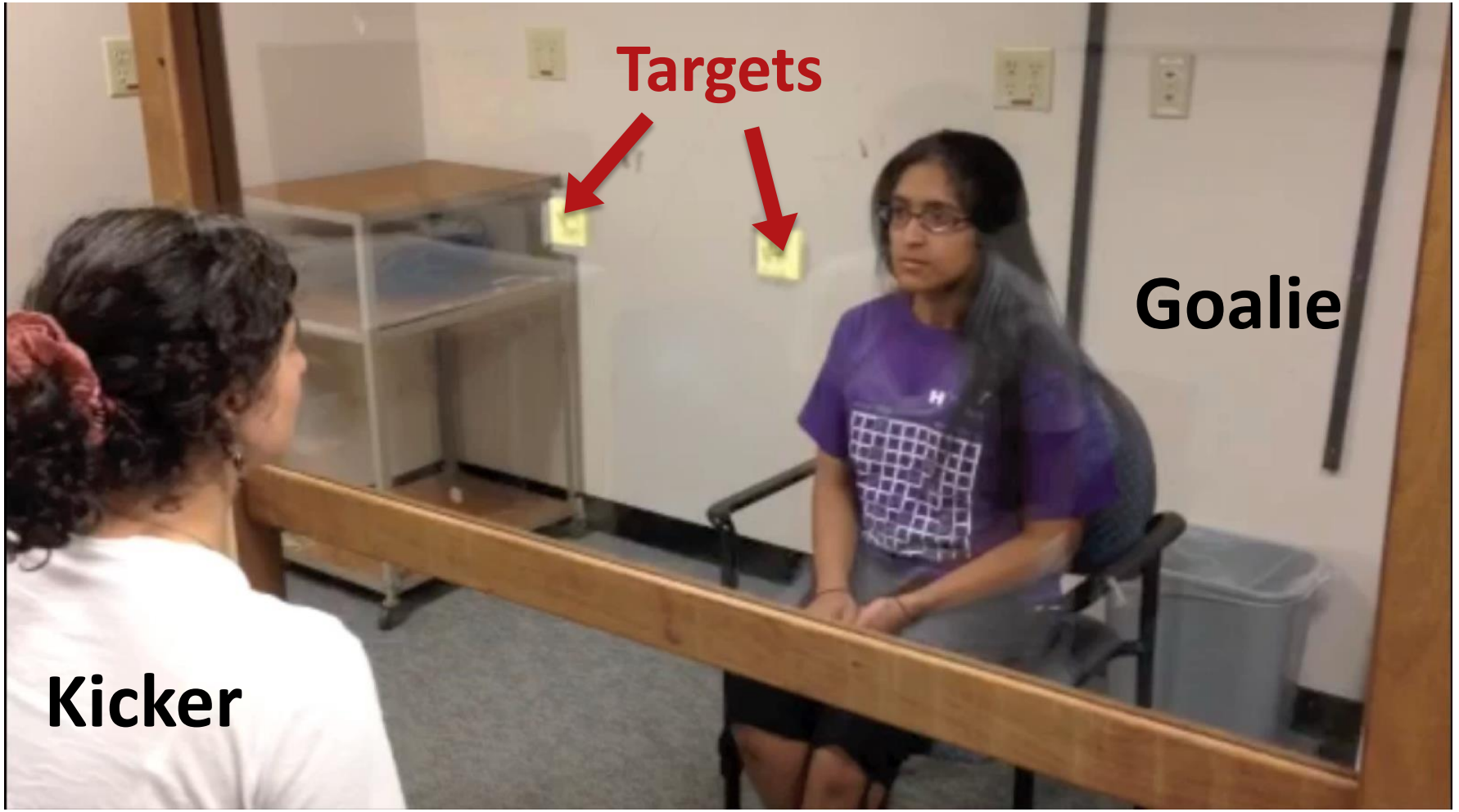
Kicker vs Goalie

Lab Version



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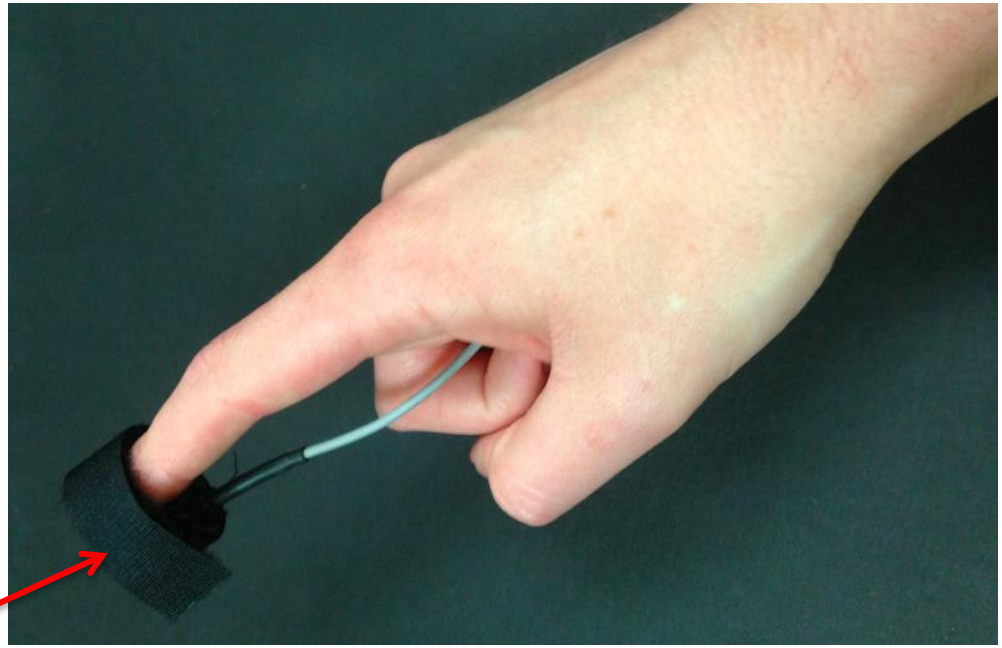
Goalie block is effective if they reach kicker target with short delay ~ 150 milliseconds

Measure finger position of kicker and goalie

Specs:
- XYZ Position
- 240 Hz
- ~1 mm precision

Magnetic sensor on each subject's finger



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Experiment 1:

- Kicker decides when and where to move

Z,X and Y Positions

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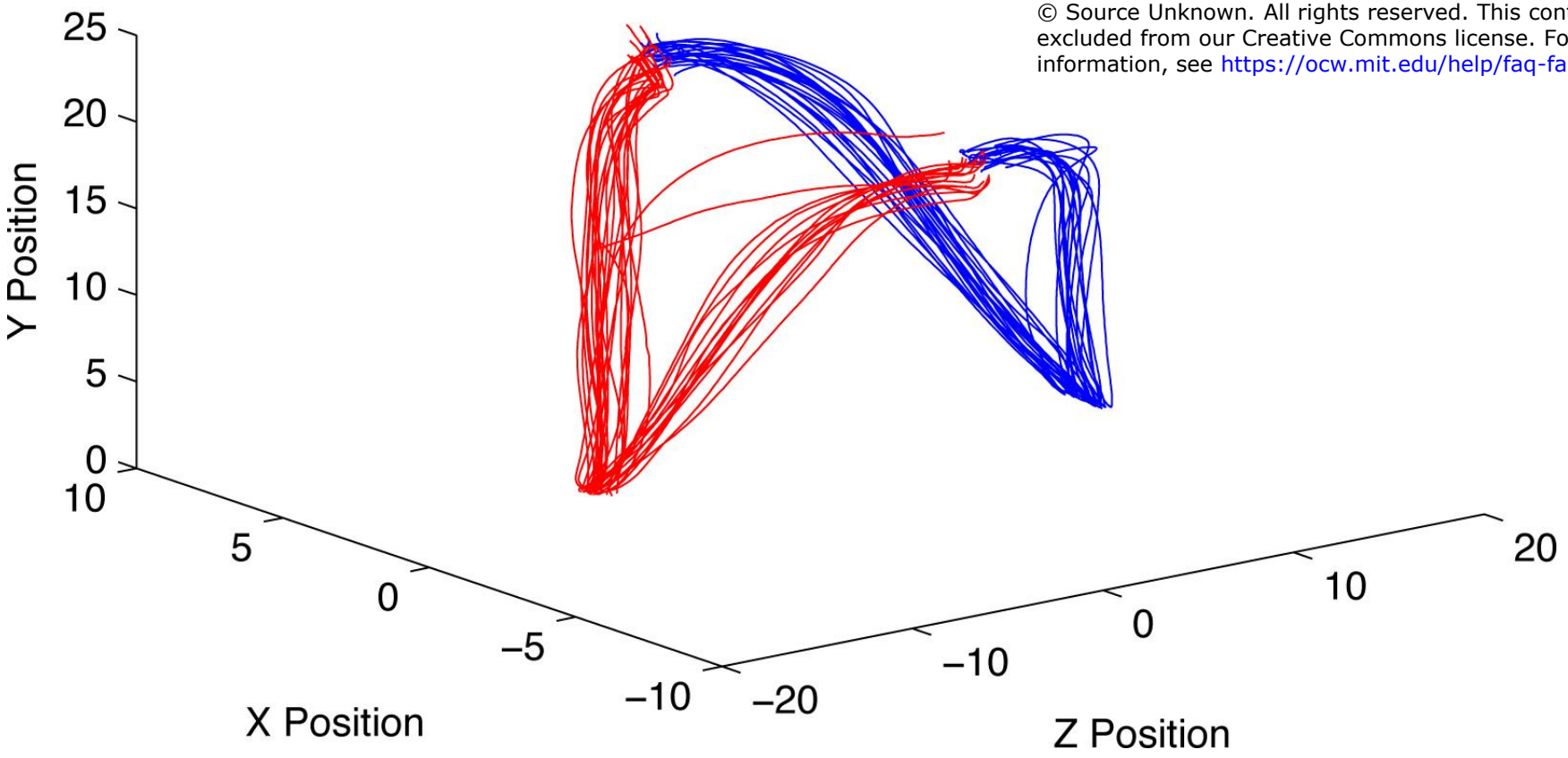
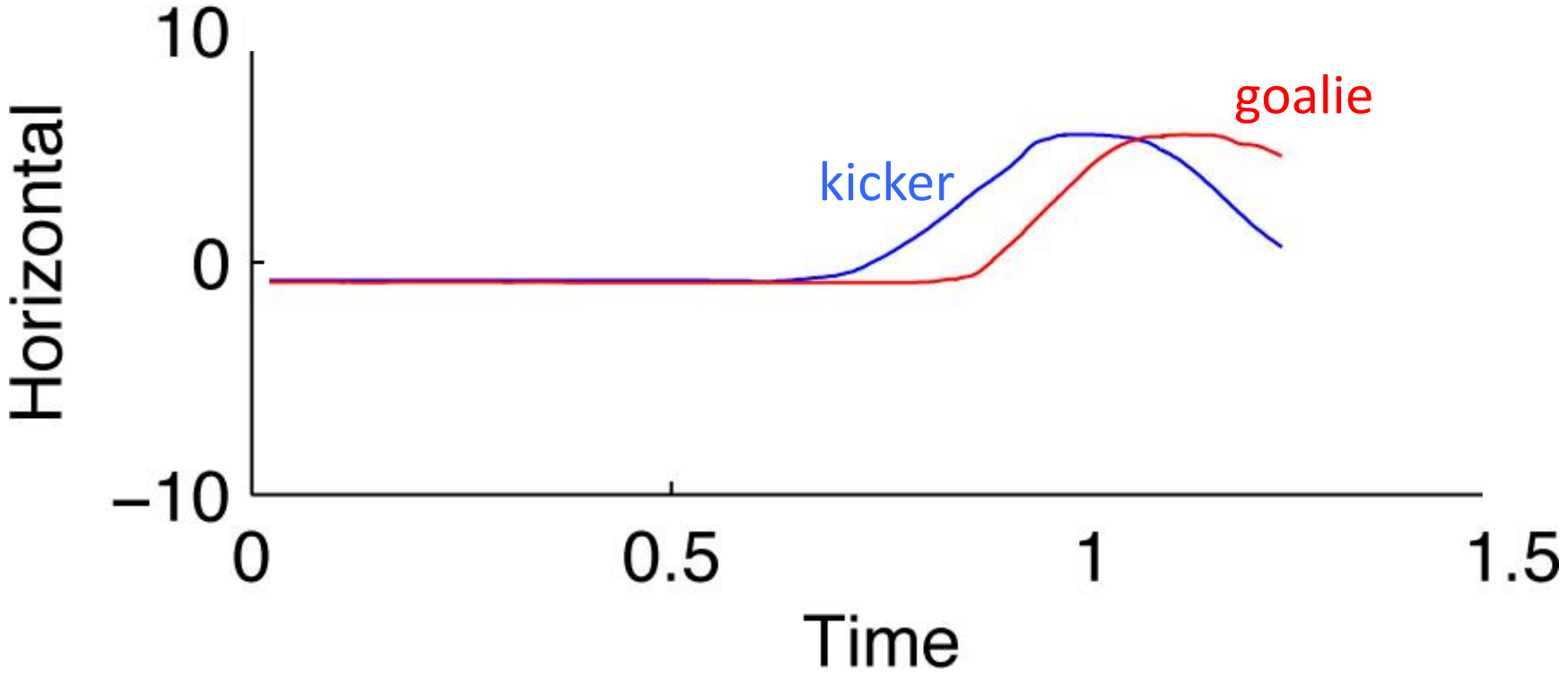
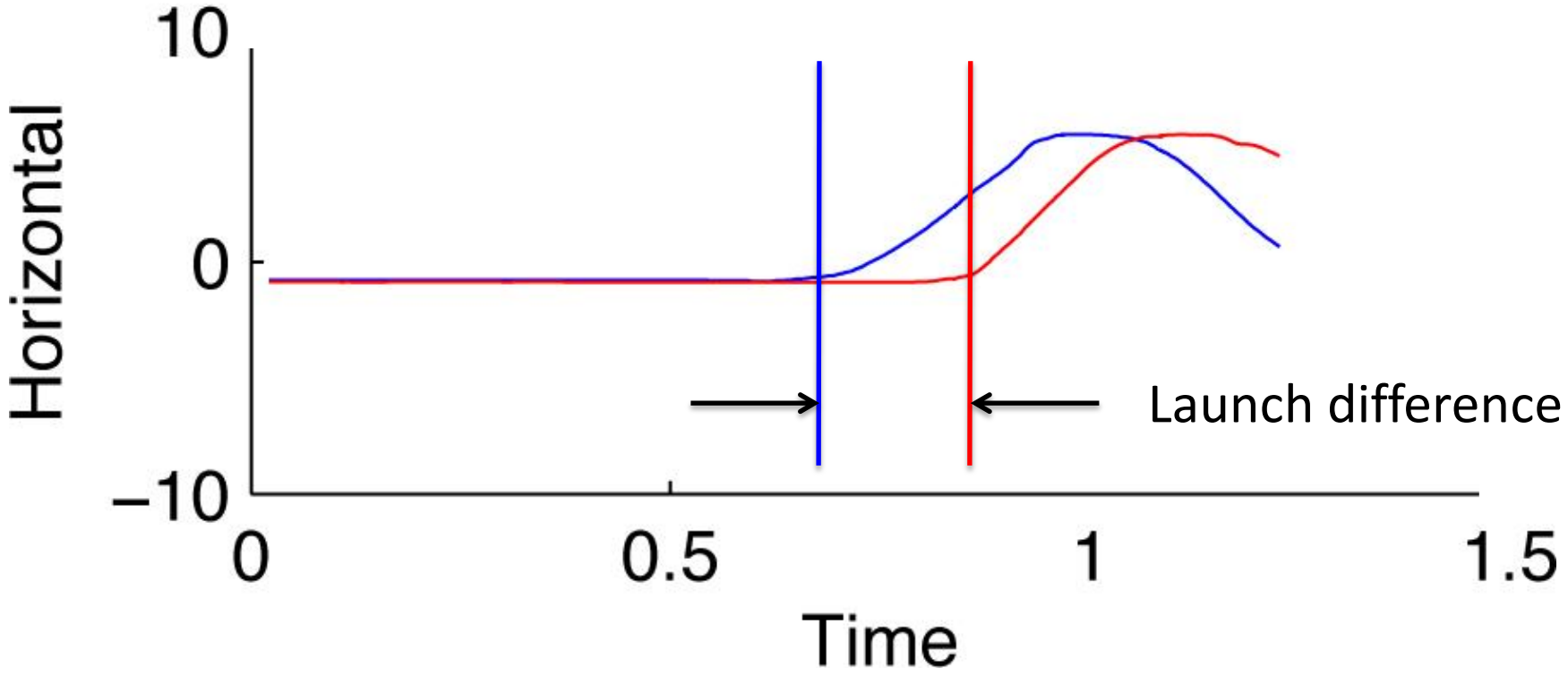


Comparing movement initiation times

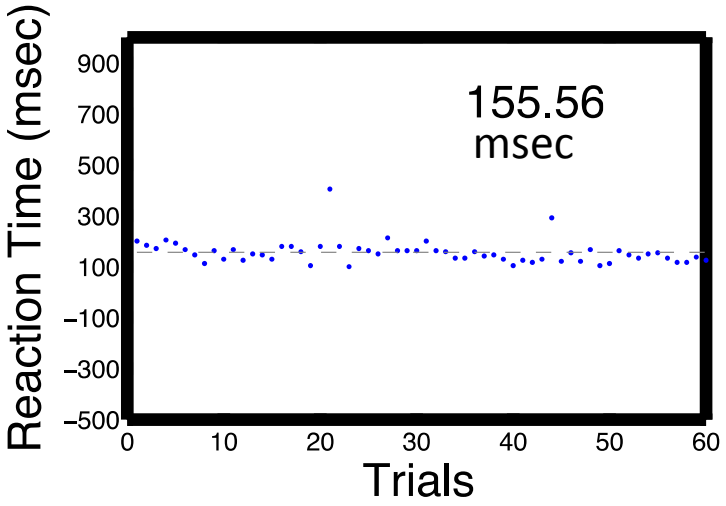


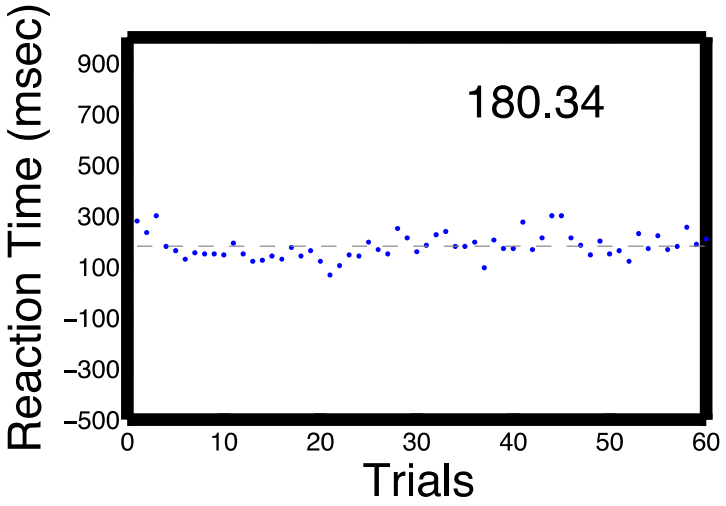
Launch Points: speed threshold

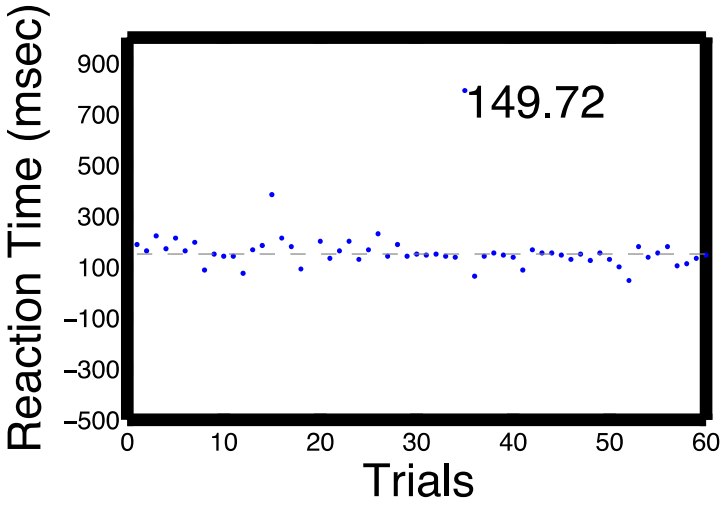


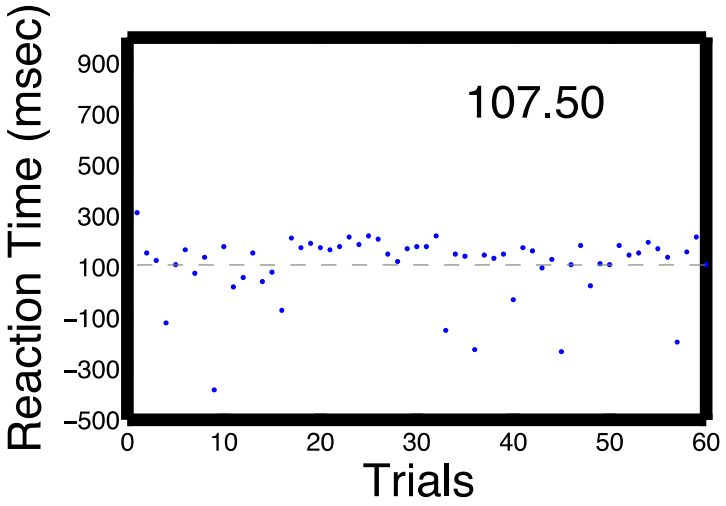
RT over many trials is short and constant

- 60 trials plotted for 4 Kicker/Goalie pairs



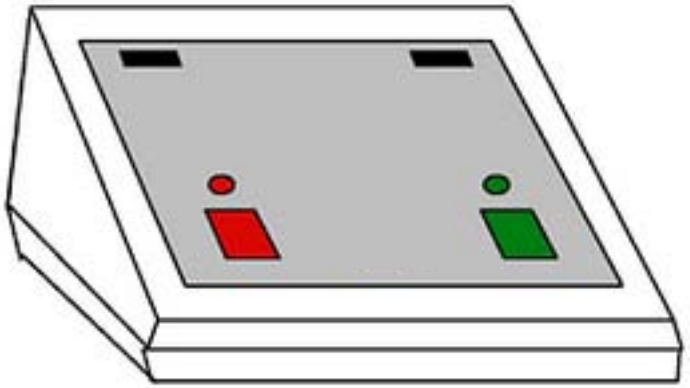




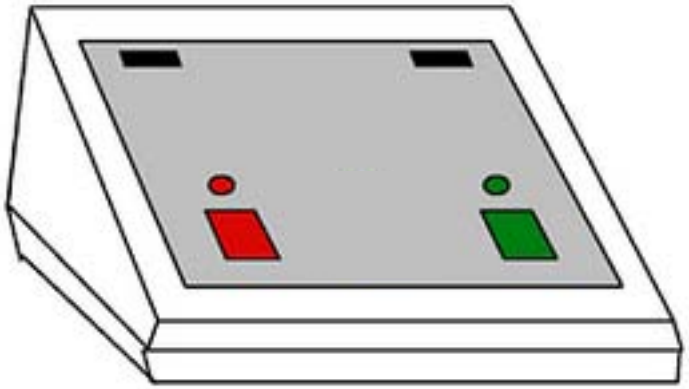


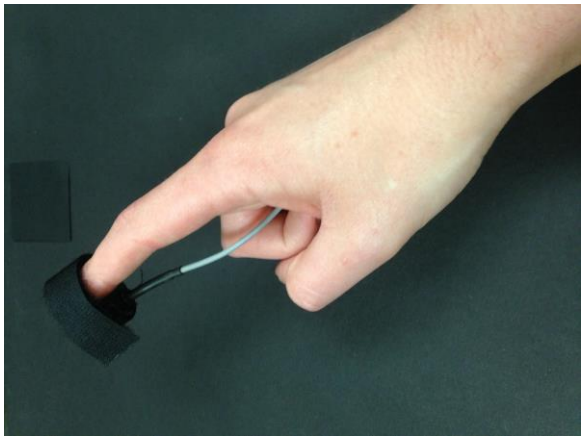
Launch difference is fast compared to:

2-choice reaction times
250-400 msec



Is key press two choice reaction time a fair comparison?





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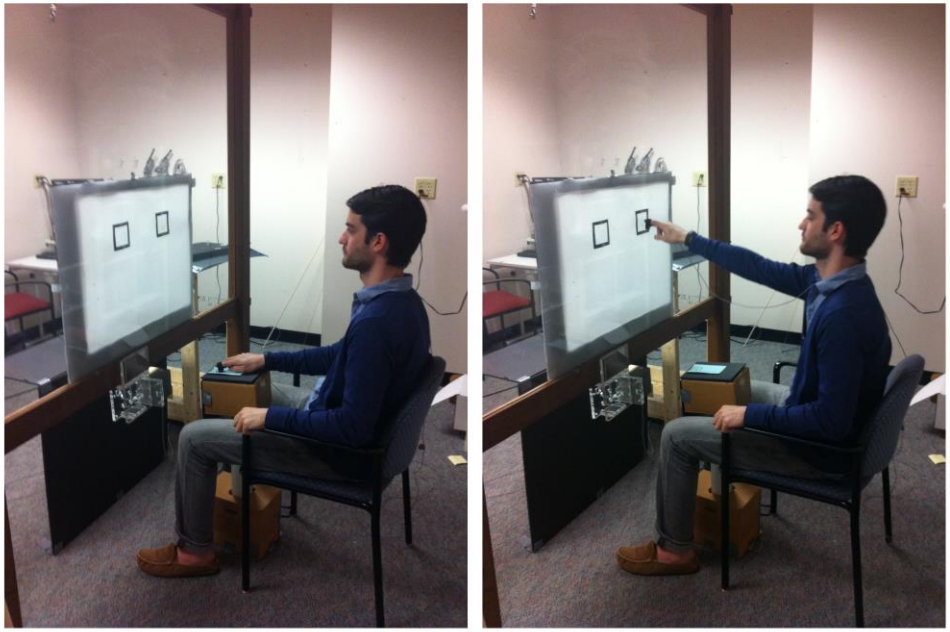
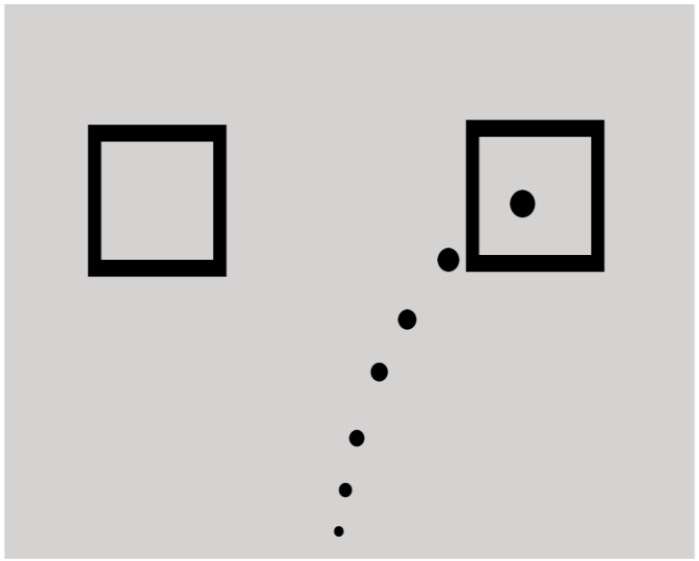
Experiment 3: Playing human vs computer in same apparatus

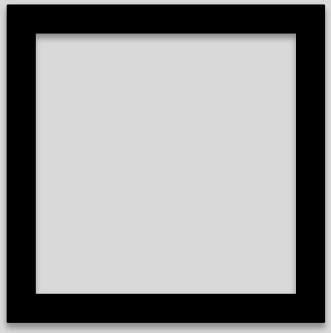
- 20 random motion paths taken from Kicker data in previous experiment projected on screen

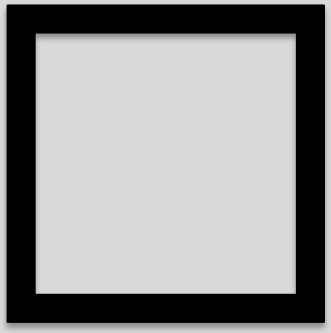
Playing against a computer-reconstructed human finger movement



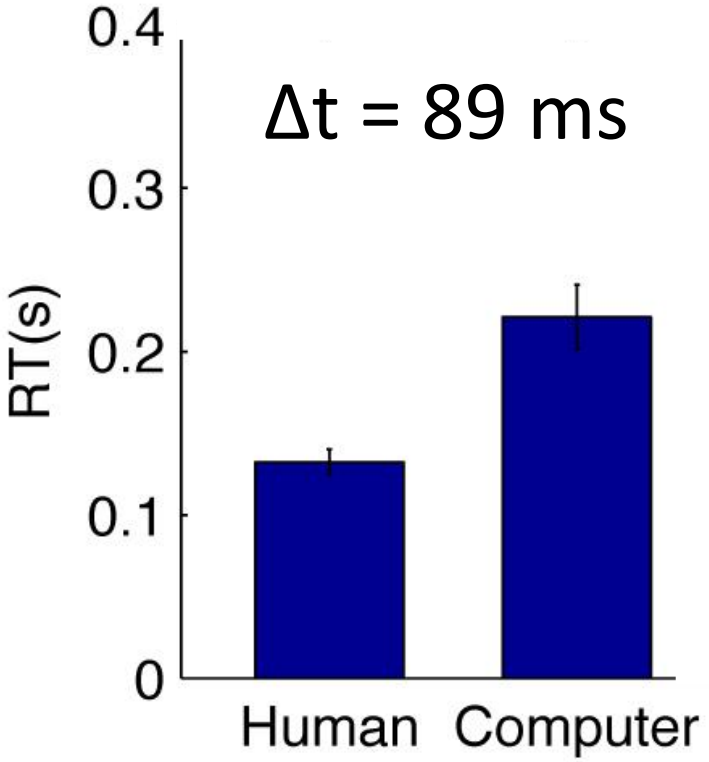


Screen display seen by subjects

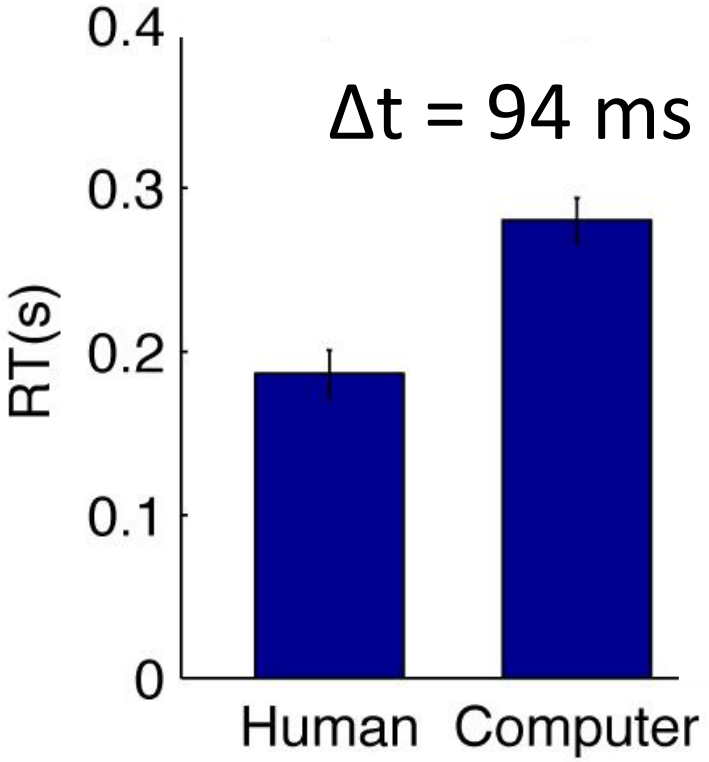




Human vs Computer opponent

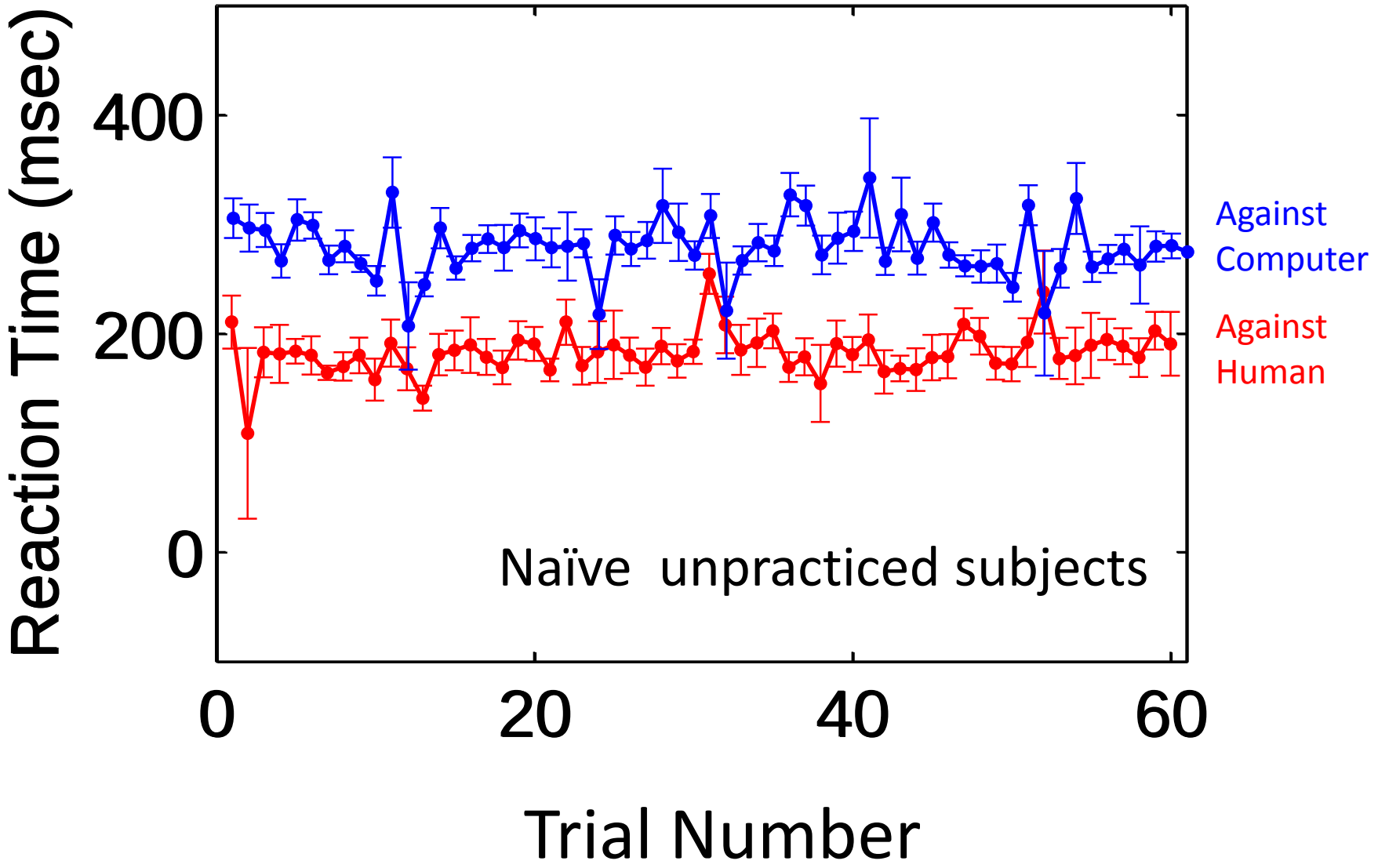


Constant timing

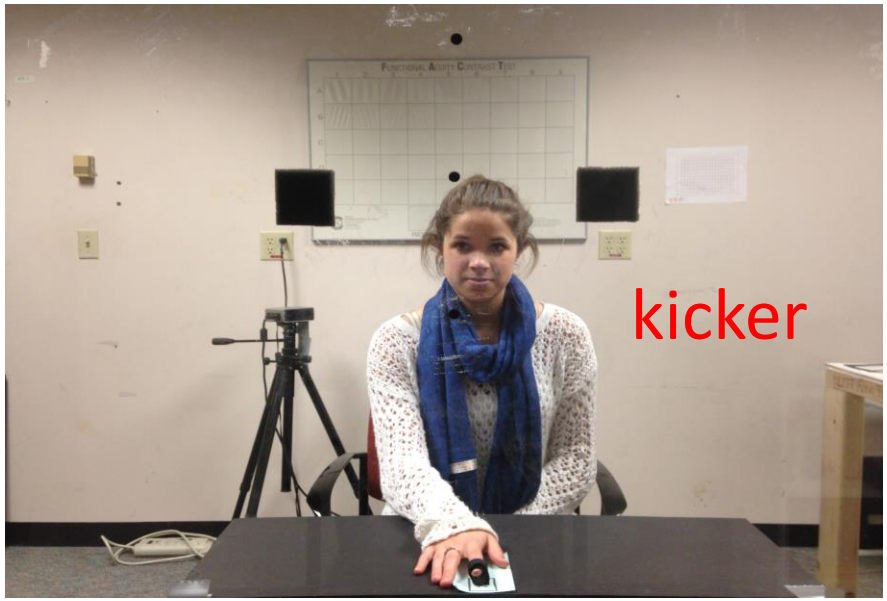


Variable timing

No learning


Reaction Time (msec)
400
200
0
0
20
40
60
Trial Number
Naïve unpracticed subjects
Against Computer
Against Human

What's going on?



incidental preparatory movement exists and is accessible to goalie ~90 ms before the finger moves

Experiment 4

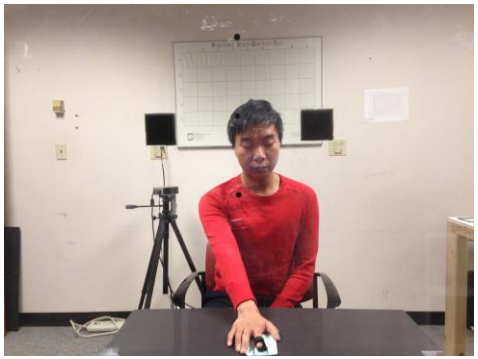
What section of the body is informative?

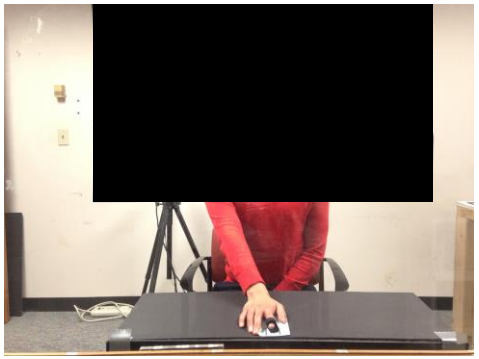
Method

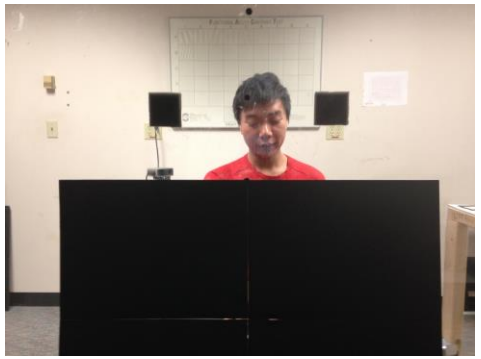
Limit the Goalie's visibility of body

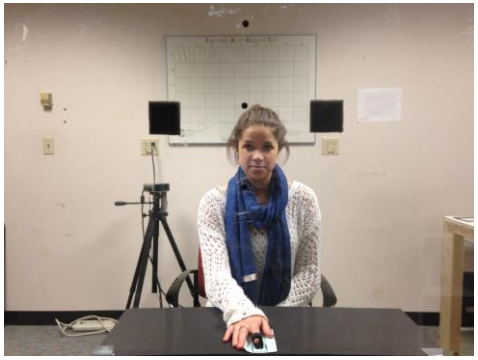
(variable inter-trial intervals)

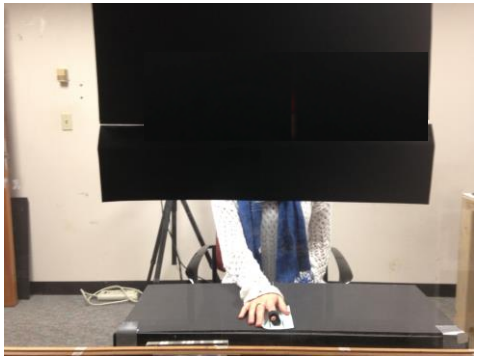
goalie view of kicker

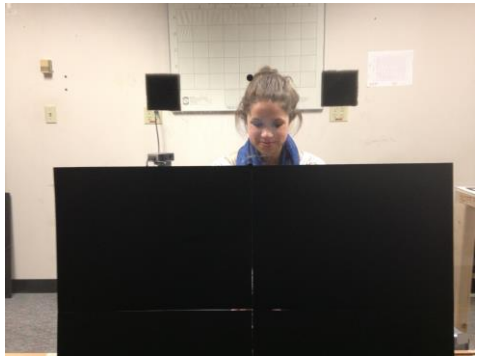










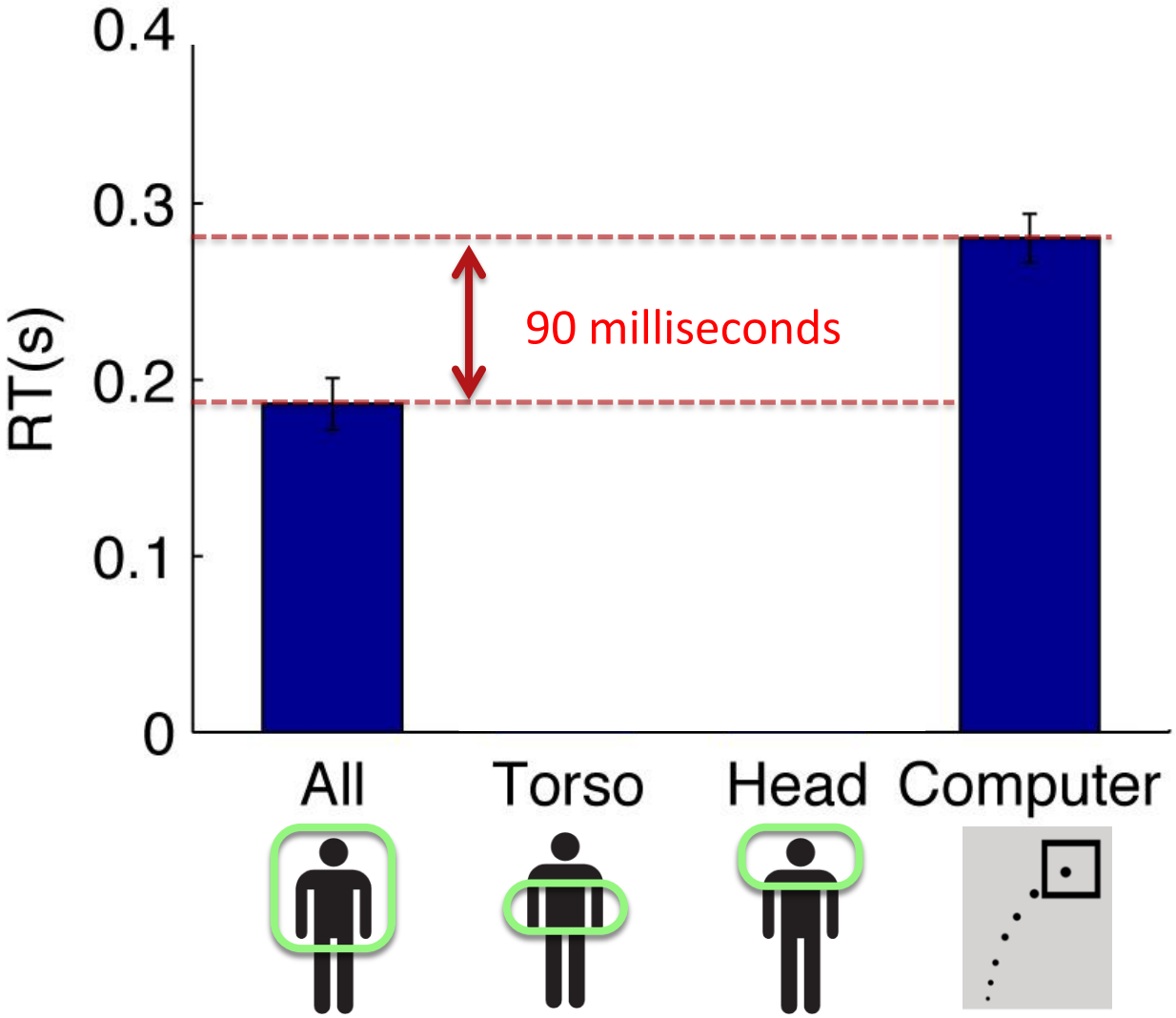


All

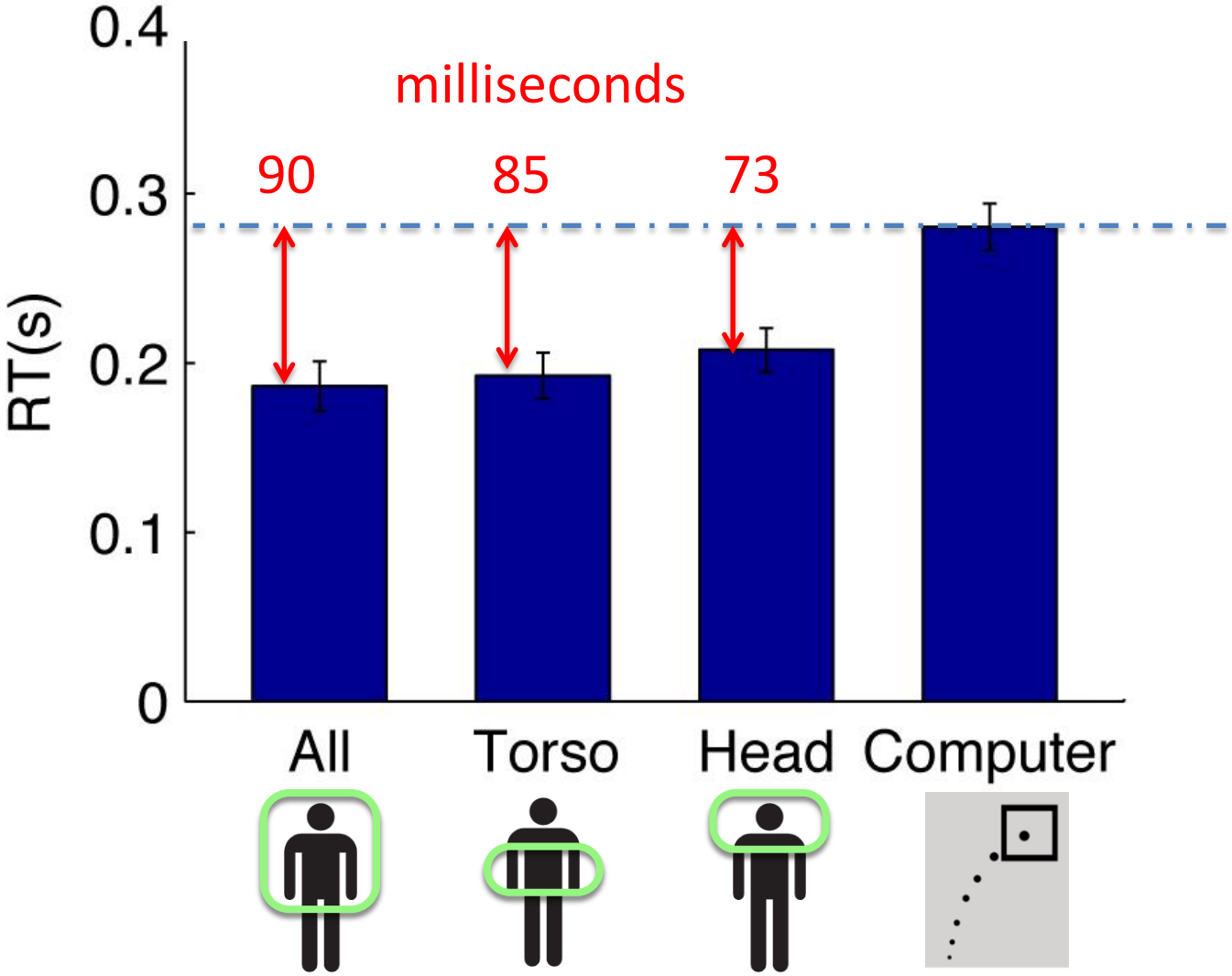
Torso

Head

Results



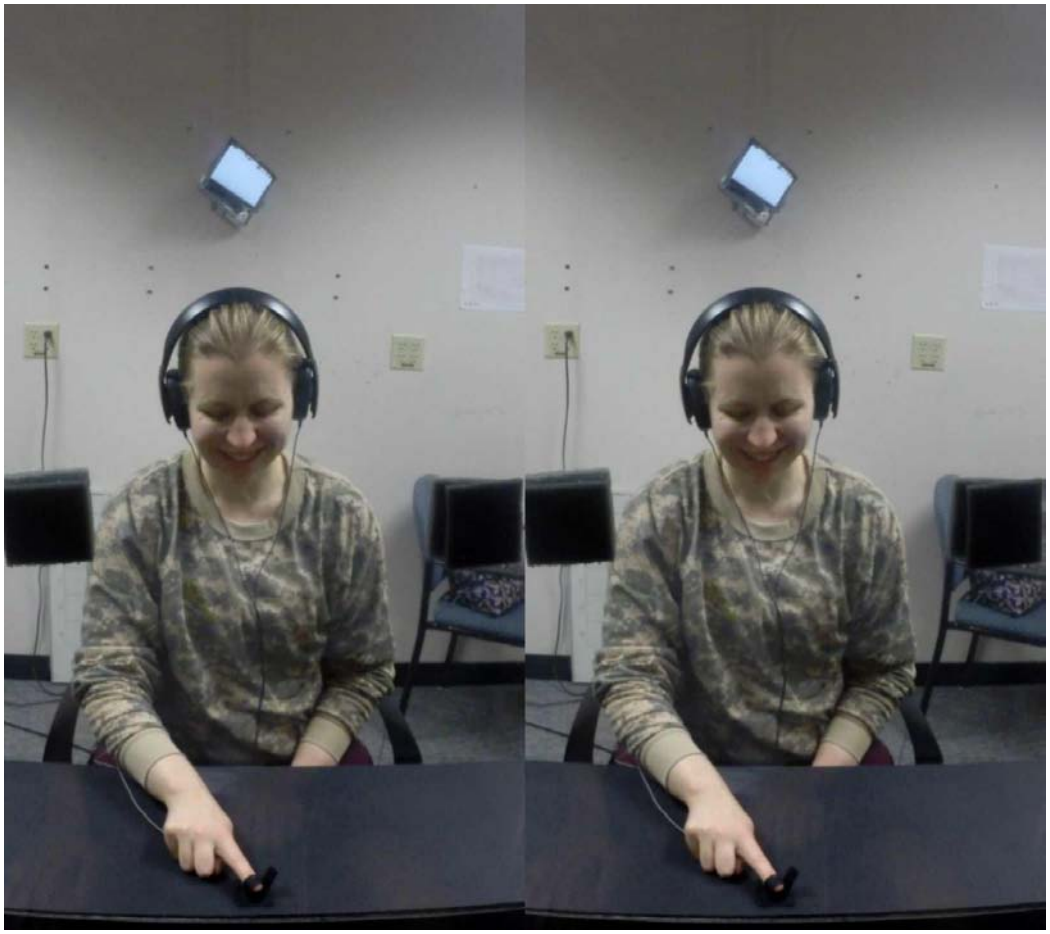
All sections convey predictive information

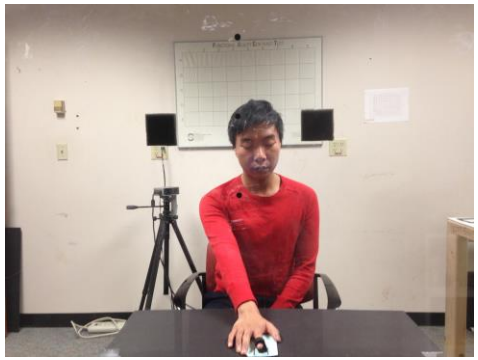
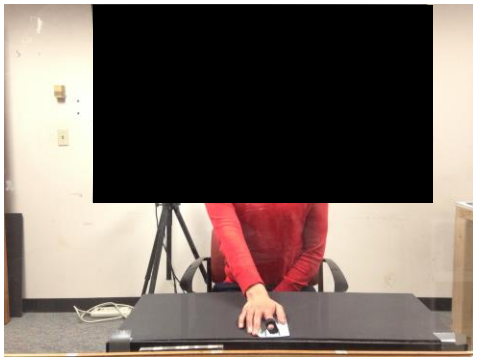
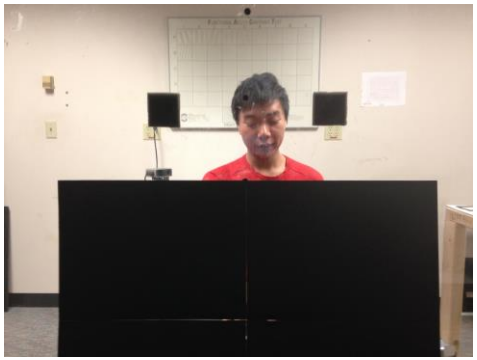
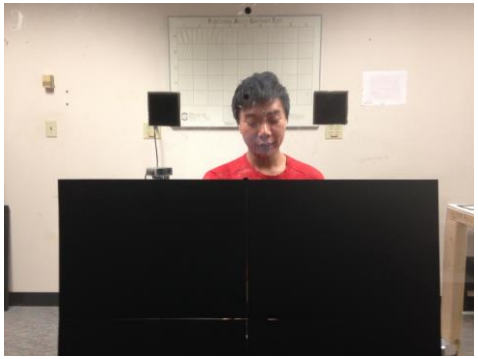
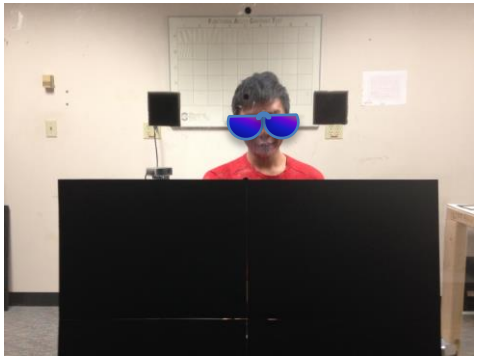
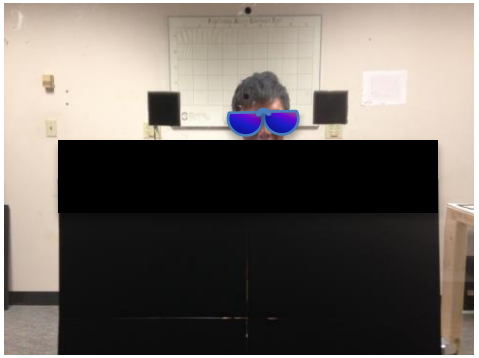


conclusion

- There must be some telltale preparatory movements

- Remove those putative pre-movements from video



Summary

- Finger movement initiation is fast in an interactive game with human opponents
- Predictive information exists prior to finger movement
- This information is distributed over the body
- Humans can extract this information right away, without learning

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Tomaso Poggio and Gabriel Kreiman

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