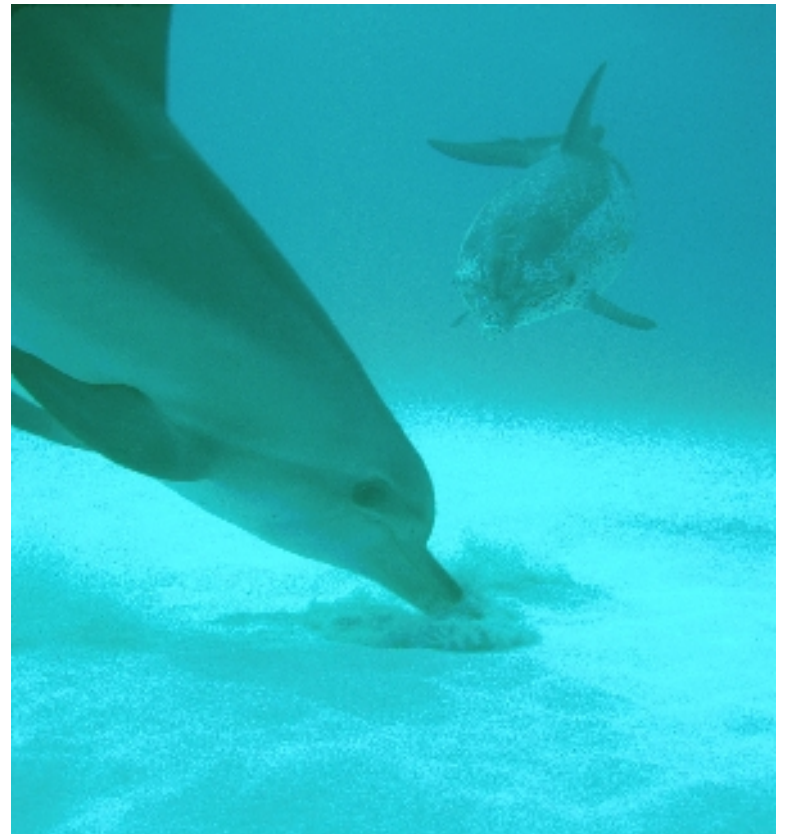
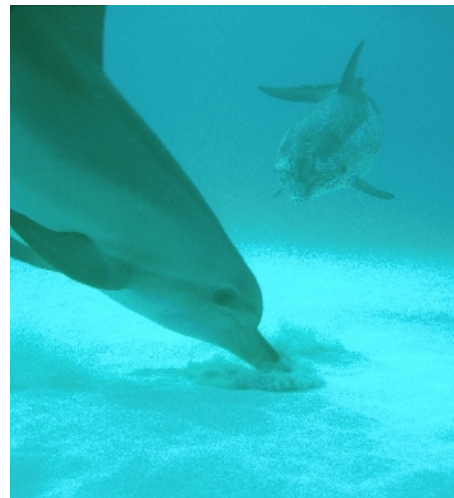
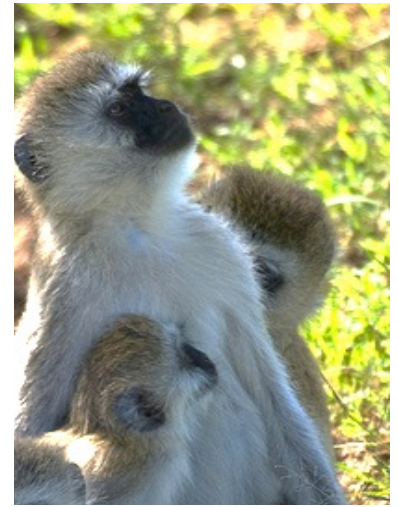


Social Attention



Paying attention to attention . . .

- Can provide significant payoffs in multiple domains
 - Predator defense
 - Identifying, finding food
 - Skill learning
 - Social negotiations



Gaze Following

- Gaze Following develops in children between 9-18 mos



- Frequently observed in primates

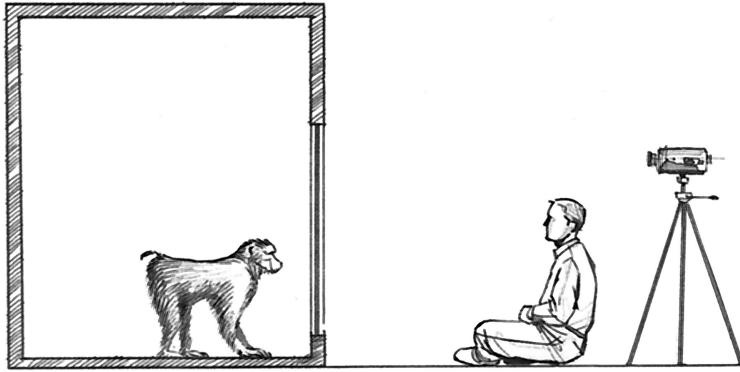


Female sees male's head turn...



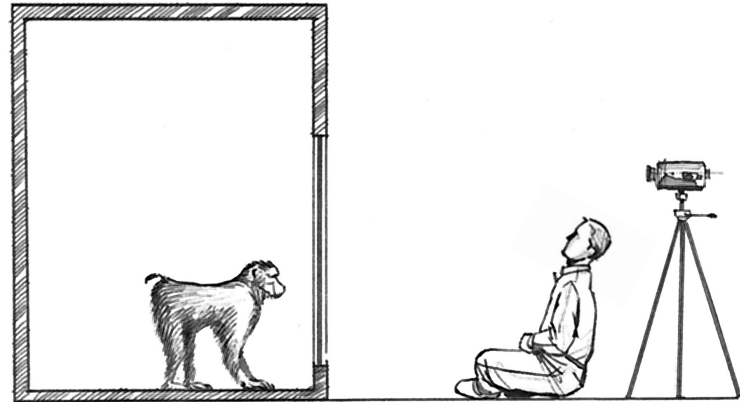
...She looks same direction

Gaze Following in the Lab

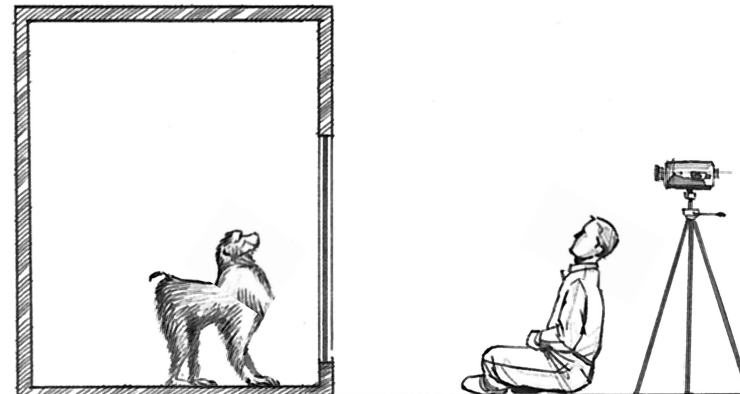


All higher primates tested
can follow head turn
(Tomasello et al 1998)

Most could NOT use
eyes-only as a cue

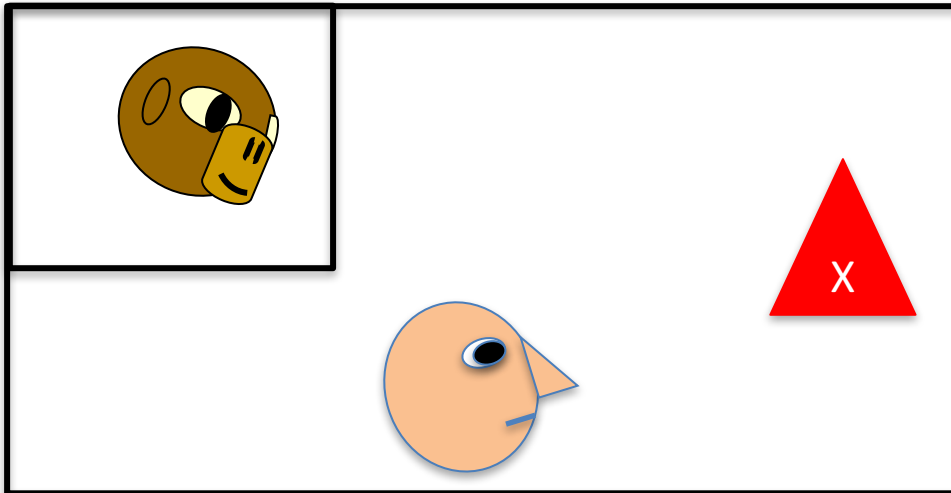


(But, contrived lab setting
may underestimate the role of eyes)

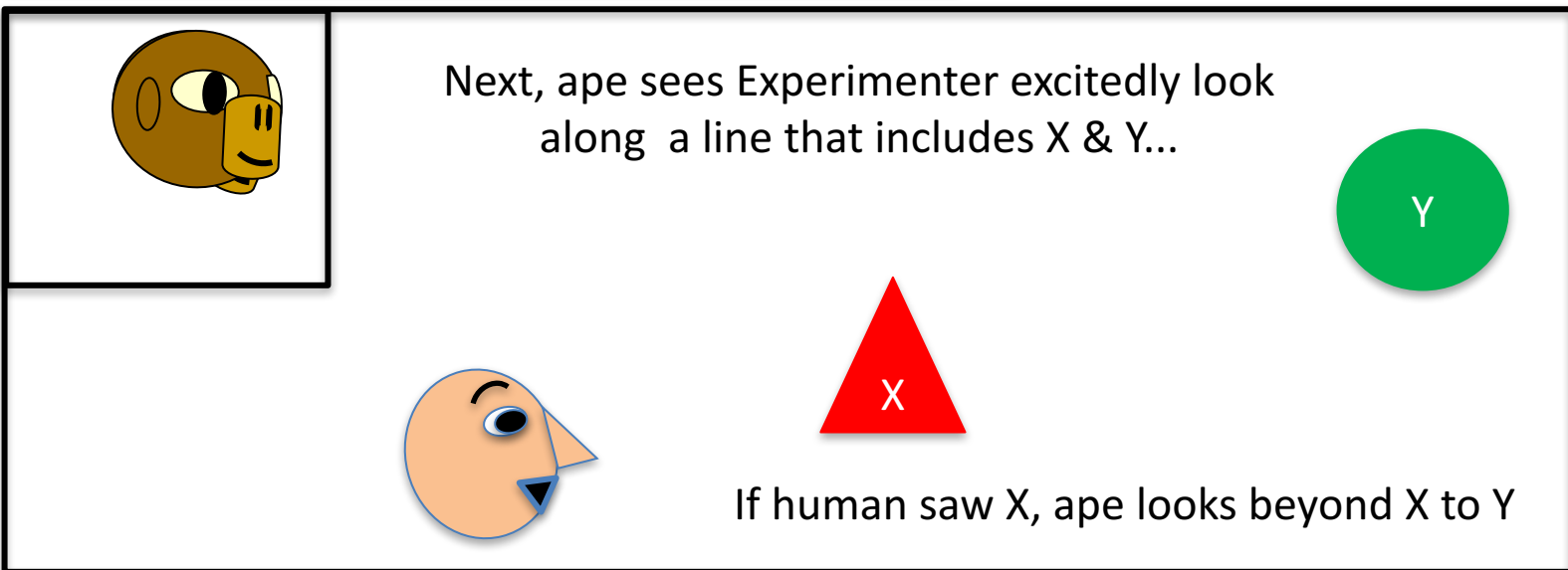


Now being tested for
(and found!)
in many other social species

Gaze Following – How sophisticated can it get?



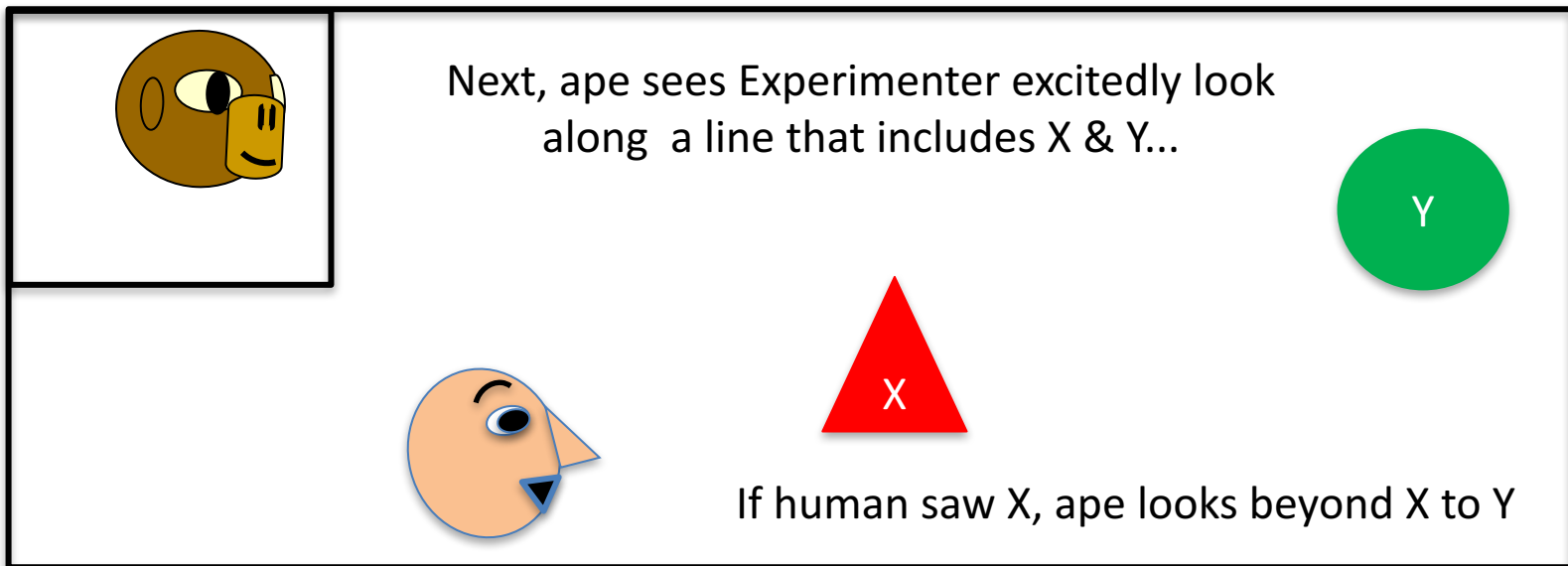
- Apes, like 18 mo old humans, can use Gaze Following to guide ...
 - Search behind self
 - Search behind barrier
- *MacLean & Hare 2012*, studied *Pan*
 - Subject first sees Experimenter see (or not see) Object X



- So, Subject must be taking more than head orientation into account . . .

MacLean & Hare 2012

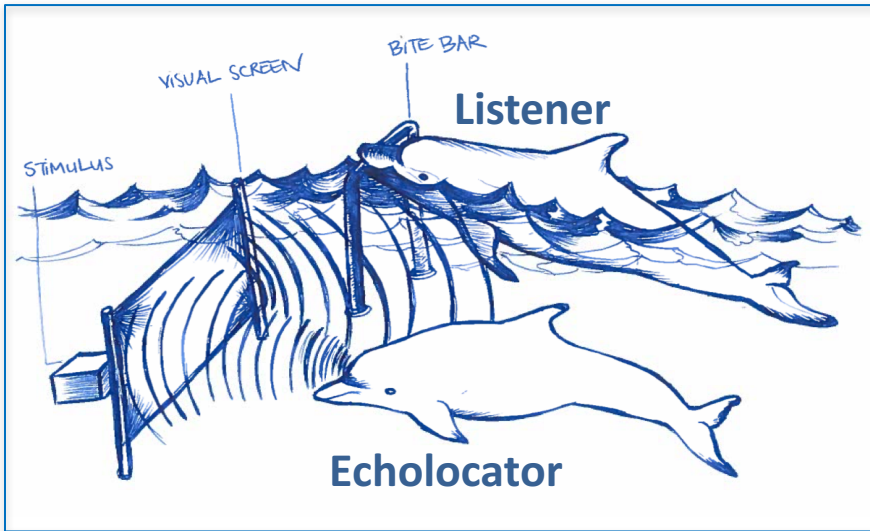
- Ape “attributes” familiarity/novelty (knowledge states) to Human
 - To accomplish task, A needed to track what B did *and* did not see, under changing conditions (i.e. which objects, when)
 - i.e. “Familiar” = object there when B looked earlier & “Novel” = object new
 - *And*, A expects B is more likely to show attention to “Novel”



- So, Subject must be taking more than head orientation into account . . .

Dolphins??

As ever, very little relevant data . . .



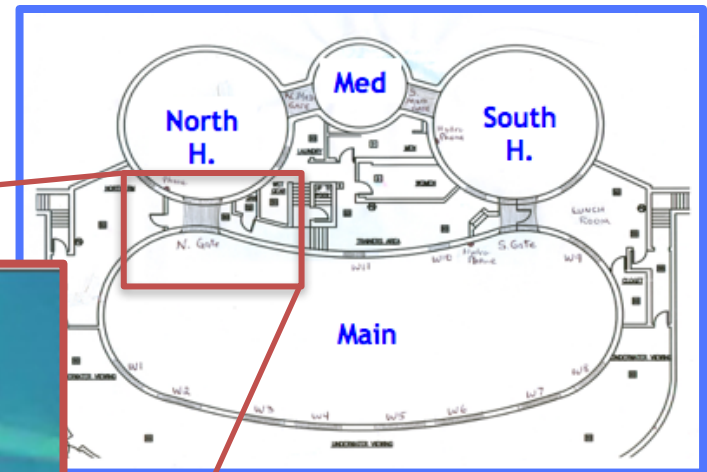
- Do show **“Eavesdropping”** – Listening-in on the echolocation of others
- Since beam also directed socially, could learn about relationships from such attentional acts
 - Attending the attention of others likely useful in these cooperative hunters

Spontaneous Attention-Following in Bottlenose Dolphins



Currently underway --

- A study of “attentional acts”
 - UW video from pool complex at Brookfield Zoo, Chicago
- If one animal turns its head such that it gains better acousti-visual access to a back pool...
- ...Will an animal that had access to that act then also act to increase its own access?



i.e. Do dolphins use head turn as a cue that something worth observing is likely along an extrapolated line...

Gaze Following

- So, basic skill here is to extrapolate primate line-of-sight, or dolphin beam direction, from head & body orientation
- Sometimes referred to as: “**Perspective Taking**”
since appears to require discriminating between other’s view & one’s own.
 - But, given how widespread gaze-following is, may sometimes be reflexive
 - The more *flexible* the use, the more higher cognition is likely involved
- So ask, how is Perspective-Taking USED...?

Using Perspective Taking

Sollicitous

Asking for or offering something



- Dolphins "solicit following" from humans (i.e. look to destination, then back to human, repeat)
- Only if humans attending (oriented toward them)

Xitco et al., 2001; 2004



i.e. Appear sensitive to human line-of-sight

But further interpretation requires caution –

Are they “showing” human where to go (i.e. "pointing") or just checking to see if human following???

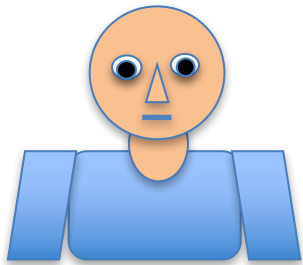
Using Perspective Taking

Begging

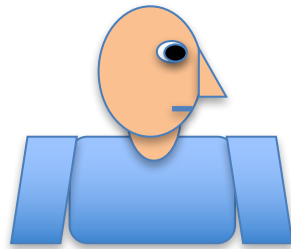
Solicitous

Asking for or offering something

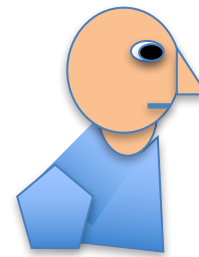
Experimenter's head and body orientation systematically varied



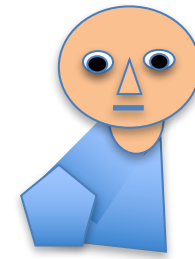
Body & Head
Toward



Body Toward &
Head Away



Body & Head
Away



Body Away &
Head Toward

How will an ape direct its begging?



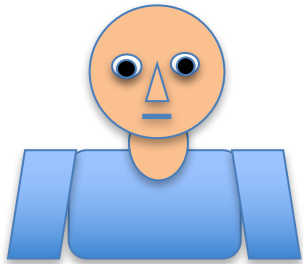
Using Perspective Taking

Begging

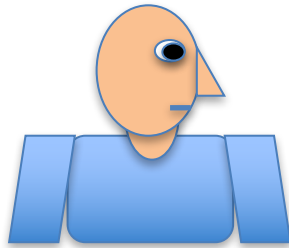
Solicitous

Asking for or offering something

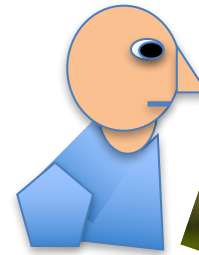
Experimenter's head and body orientation systematically varied



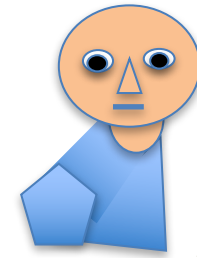
Body & Head
Toward



Body Toward &
Head Away



Body & Head
Away



Body Away &
Head Toward



Orangutans & Gorillas
beg to the human's BODY

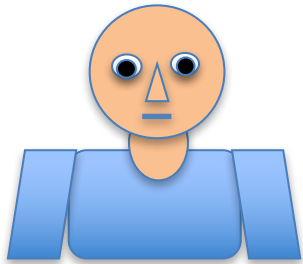
Using Perspective Taking

Begging

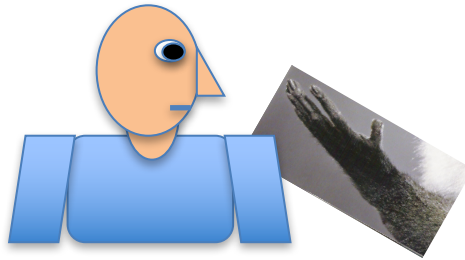
Solicitous

Asking for or offering something

Experimenter's head and body orientation systematically varied



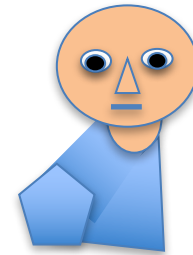
Body & Head
Toward



Body Toward &
Head Away



Body & Head
Away



Body Away &
Head Toward



Chimps & Bonobos
beg to the human's FACE



Using Perspective Taking

Begging

Solicitous

Asking for or offering something

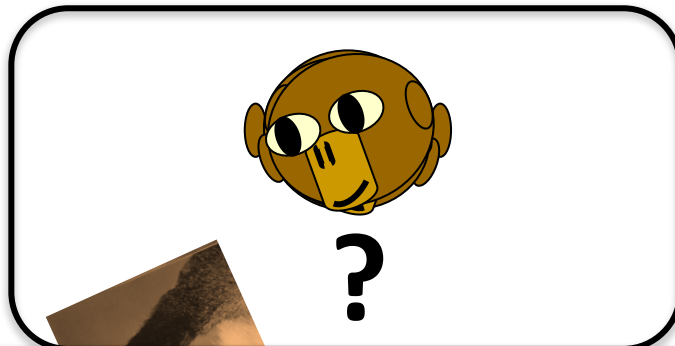


Using Perspective Taking

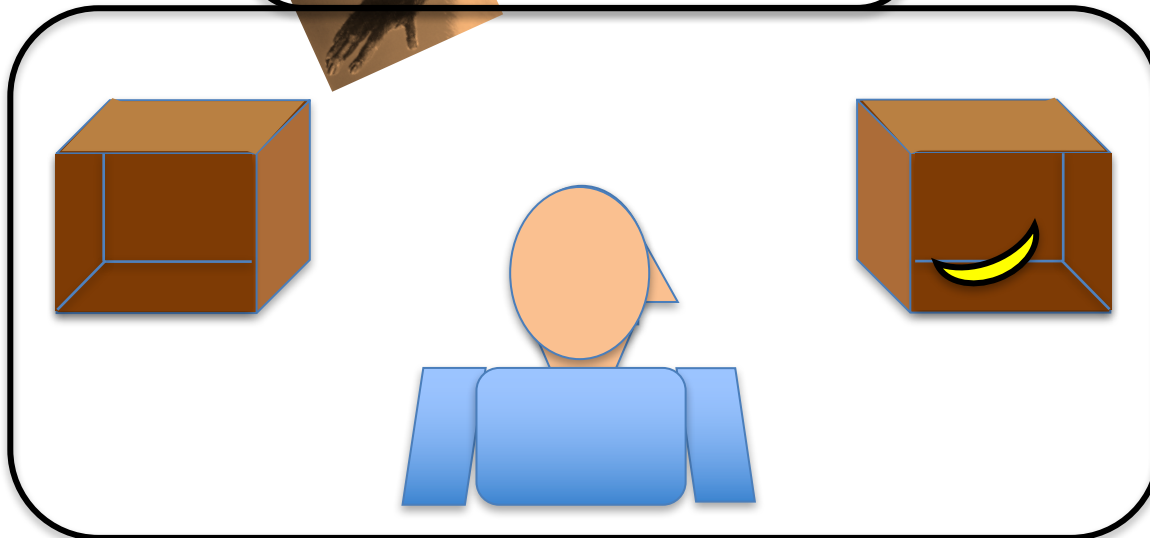
Solicitous

Asking for or offering something

- “Show-to-Share” Tasks
 - Indicate some limitations on perspective-taking in primates...
 - Experimenter attends (head turn, eyes turn, point) to baited (vs. not baited) container
 - Subject can't see reward; Must select which box to request the Exp to open



- Despite their gaze following skills, chimps are remarkably POOR at such tasks!



- Perhaps less ecologically valid for chimps, who do not themselves “show to share”??

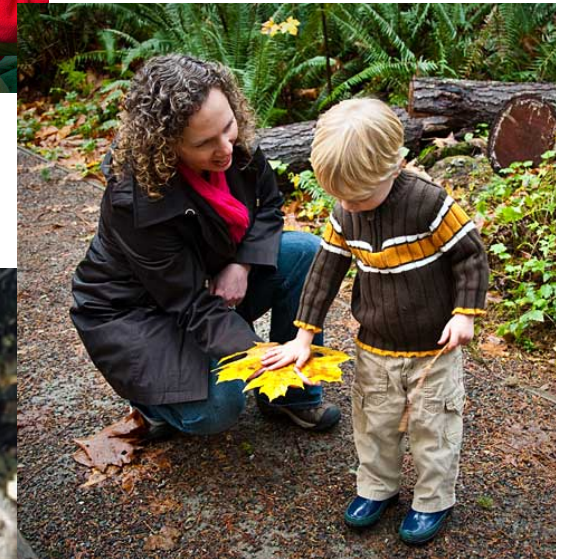
(Altho do give “food calls” if resource plentiful --)

Note **Humans**

(and human-enculturated apes)
are the only primates that “point”



Important in many
Human-specific activities
such as teaching,
language learning.



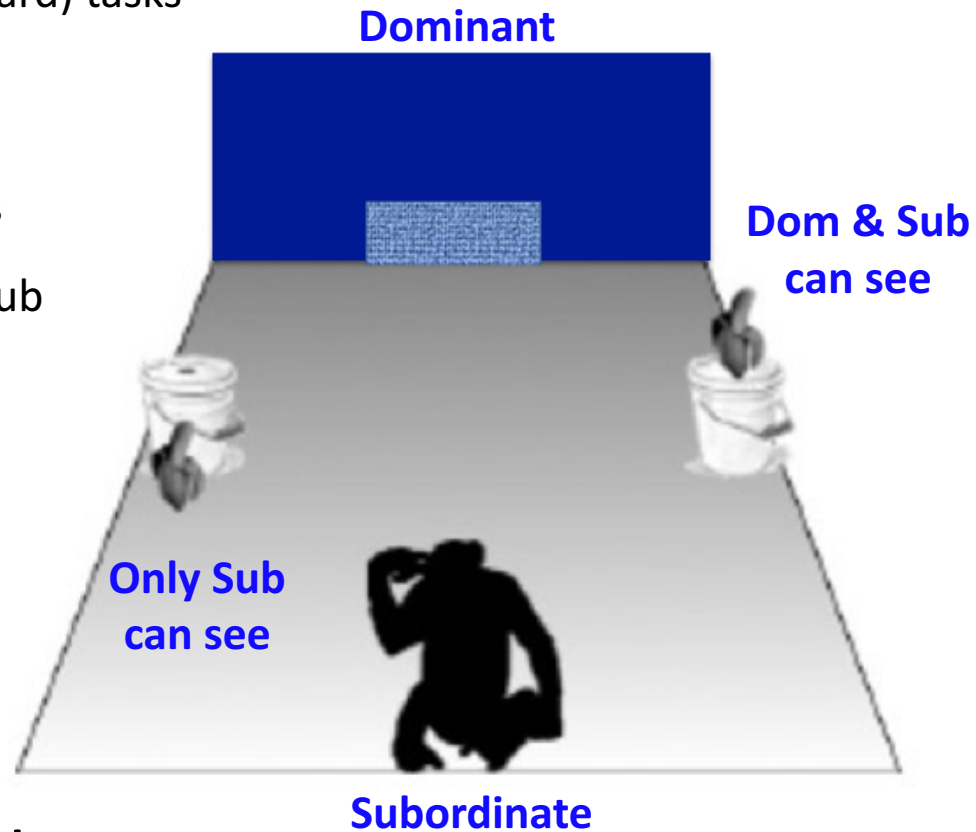
Among primates,
only Humans SHOW...

Using Perspective Taking

- Nonhuman-primates better at using Perspective Taking in **competitive** situations
 - They are largely competitive foragers (co-operative foraging rare)
 - And these are “foraging” (food reward) tasks --

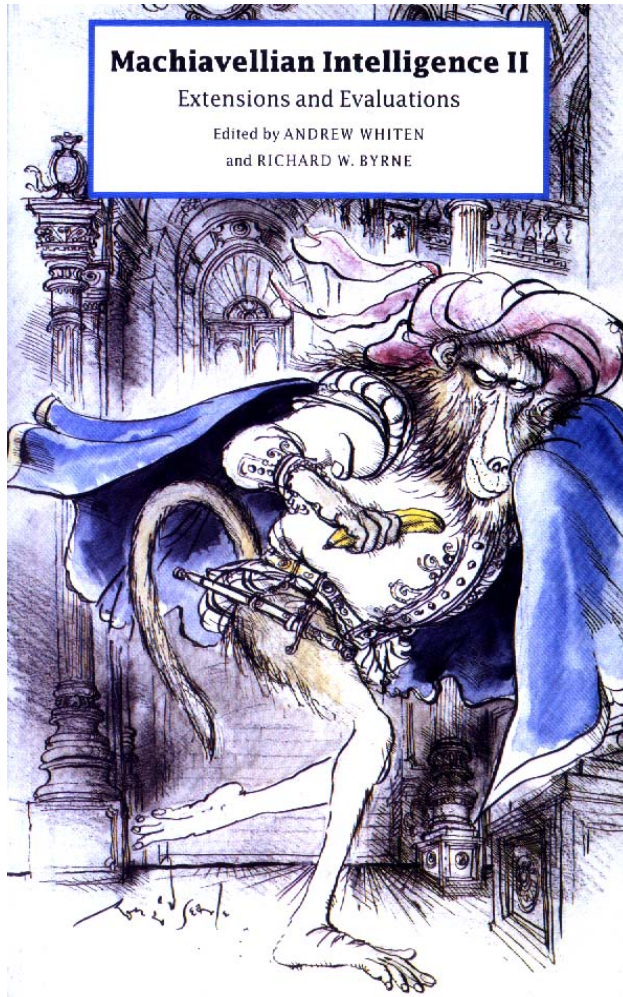
- **Hare et al. 2001** tested this in chimps
 - One treat visible to both Dom & Sub
 - Other only visible to Sub

- Dom confined – Sub chooses treat first
- Results: Sub tends to choose treat that dominant can not see
- Discriminates treat based on whether it falls within **other’s line of sight**.



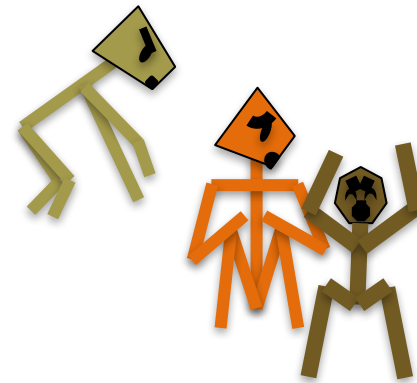
(Hare et al. 2001)

Machiavellian Intelligence



Byrne & Whiten 1988; Whiten & Byrne, 1997

- Individuals exploit other's behavior, perception, knowledge/ignorance etc. for own benefit
 - e.g. Social Tool Use
 - e.g. Human affairs, fictional & non



Machiavellian Intelligence

Deception

- M.I. proposes, for example, adapting to such interactions generated an evolutionary “arms race”
 - i.e. Deception selects for improved counter-deception, which selects for improved deception, etc...
- Probably played a significant role in HUMAN cognitive evolution (See Cogs 184!)
 - Esp with language-mediated lying...



Deception

- Many mechanisms!
 - Can be “built in”
- Eyespots on butterflies
 - Work by exploiting regularities in the world
 - i.e. Such stimuli tend to be correlated with Large Teeth (Predator!)



Deception

Eyes, across the phyla, predict direction of movement

Eyes tend to be on the leading edge of an animal's body



Again, deception exploits regularities in the world in ways that promote mis-interpretation

So, in fish, “eyespot” tend to be near the tail (vs the head), leading predators to erroneous predictions.



?

Tactical Deception

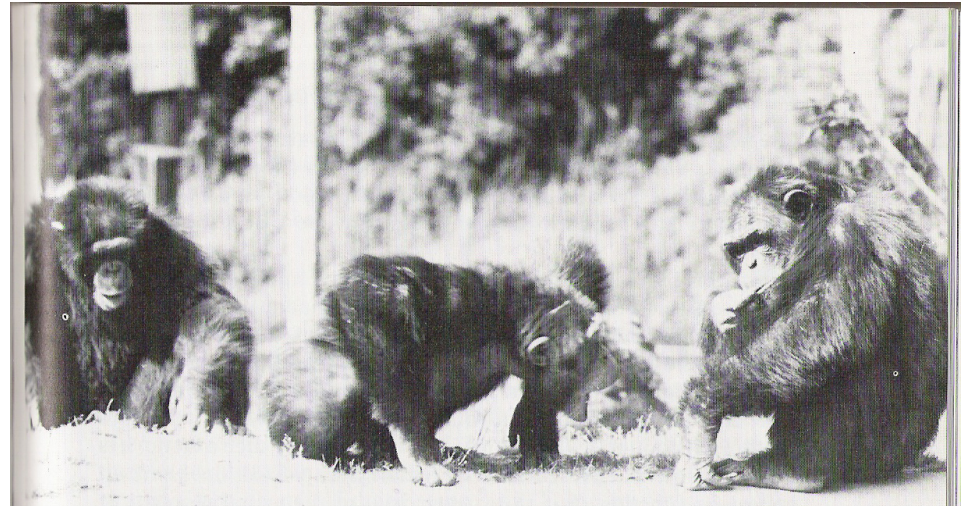
IN THE FIELD

- **“Tactical Deception in Primates”** (Whiten & Byrne, 1988)
 - Complied Primatologists’ examples, esp in Old World primates



- e.g. Move out of sight of dominant that might interfere before mating, eating etc.

- e.g. Look/move away from object of interest (“feign” indifference) possibly to distract/move competitor away



Tactical Deception

Gaze control often mediates



Tactical Deception

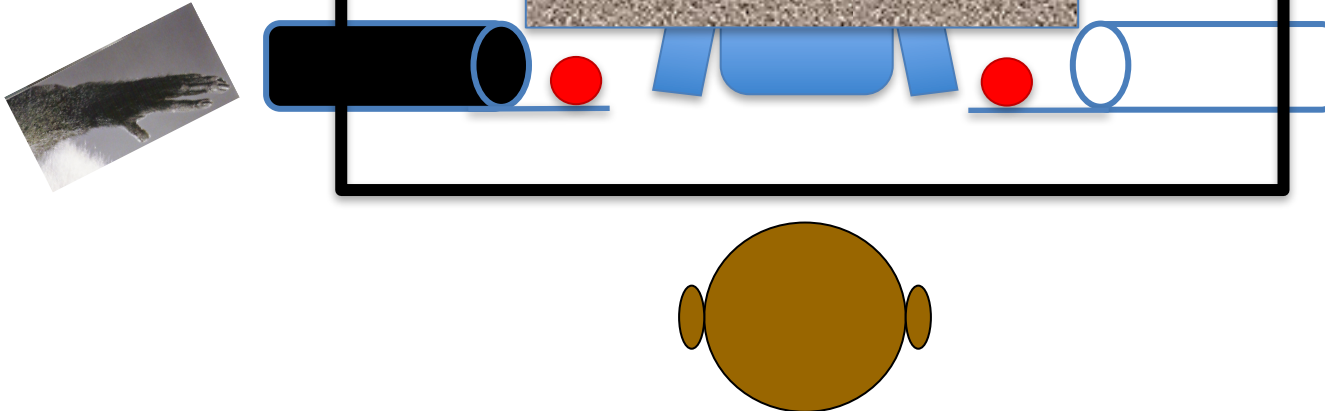
IN THE LAB

- Experimenter in booth w/food on either side
- Chimp can reach through tunnels for food
- If detected, Experimenter will snatch food away
 - So, this is a competitive paradigm

Experimenter view of
subject blocked

EXP 1:
One tunnel
opaque

Other
transparent



- Chimp will reach in opaque not transparent tunnel

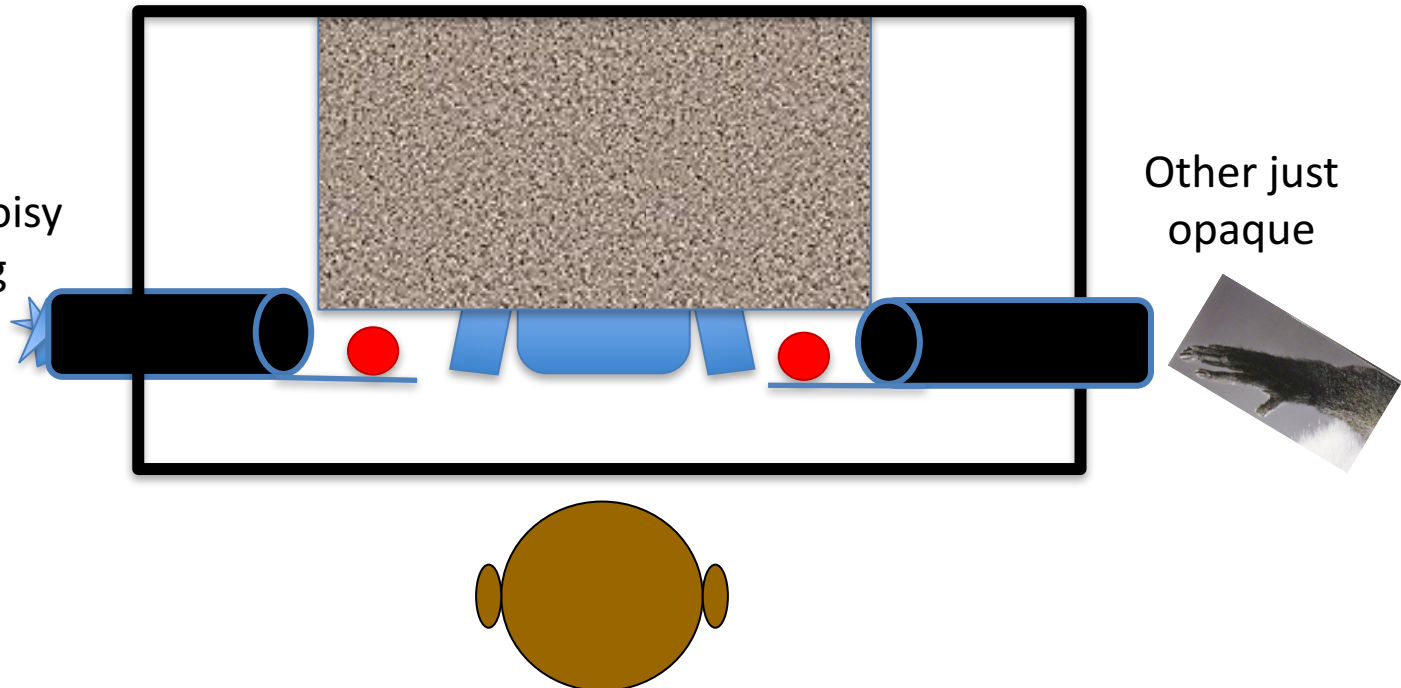
Tactical Deception

IN THE LAB

- Experimenter in booth w/food on either side
- Chimp can reach through tunnels for food
- If detected, Experimenter will snatch food away
 - So, this is a competitive paradigm

Experimenter view of
subject blocked

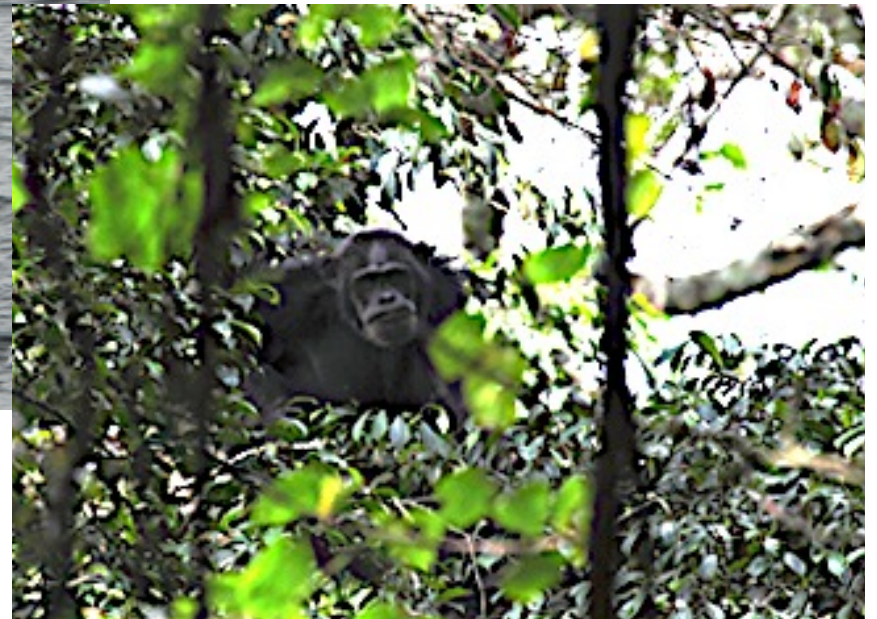
EXP 2:
1 tunnel has noisy
plastic lining



- If both tunnels opaque, will reach in quiet not noisy

Self Control

- Above interactions (and others) probably selected for increased Self-Control
 - e.g. Stealth
 - Orca silently hunting other cetaceans
 - Collaborative chimp hunters that silently get into position



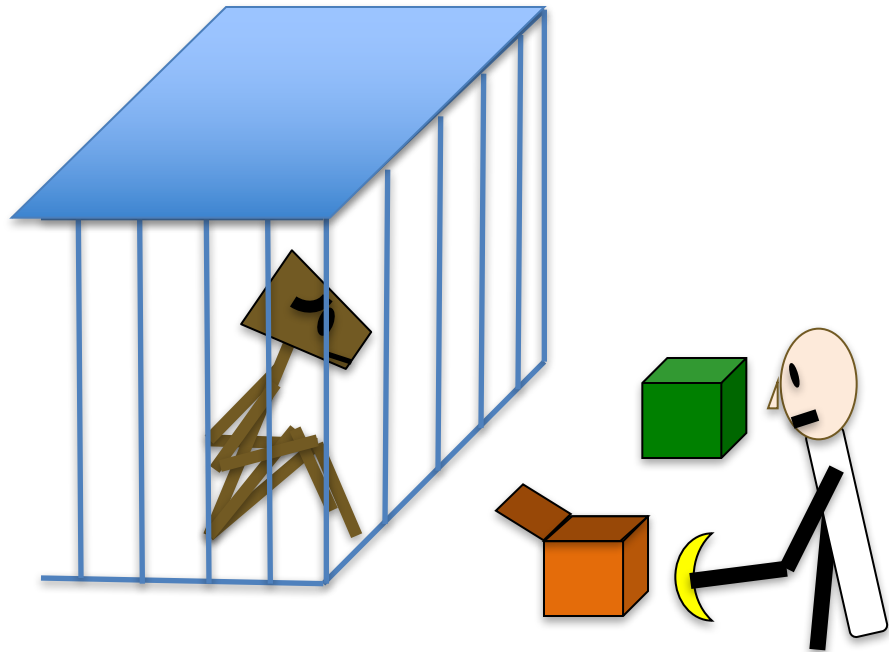
Self Control

In the Lab

Self Control

In the Lab

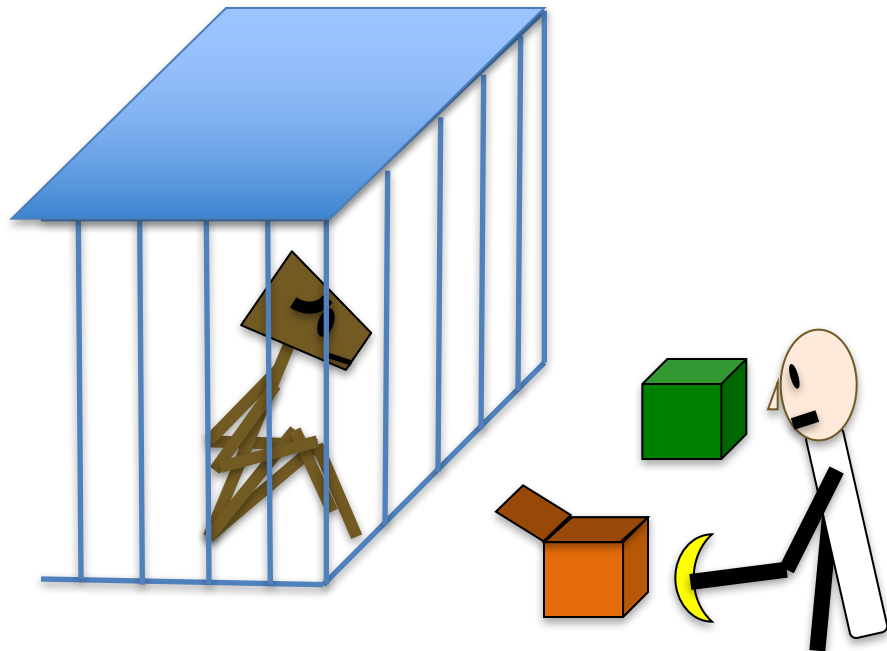
Subject watches as experimenter
hides a treat



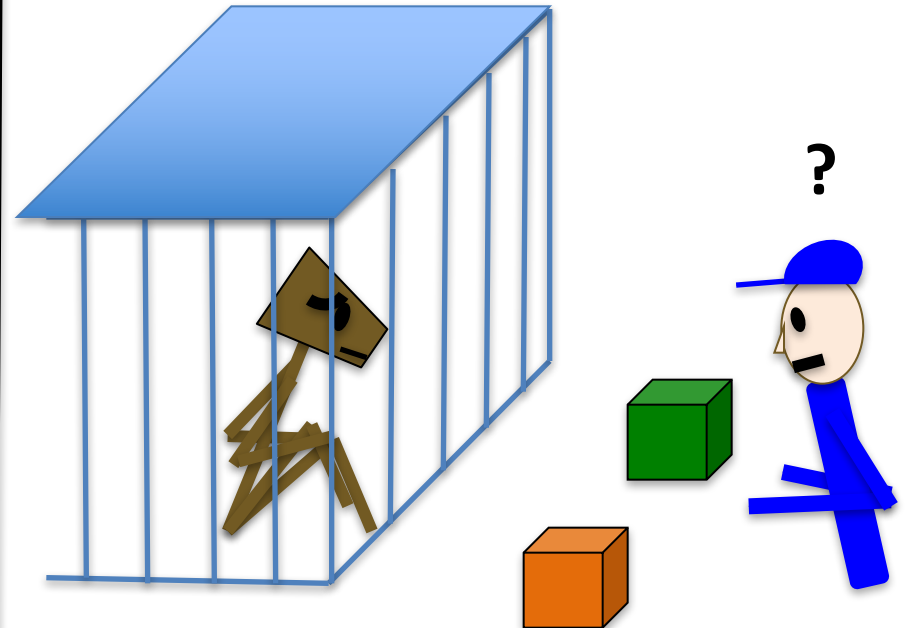
Self Control

In the Lab

Subject watches as experimenter
hides a treat



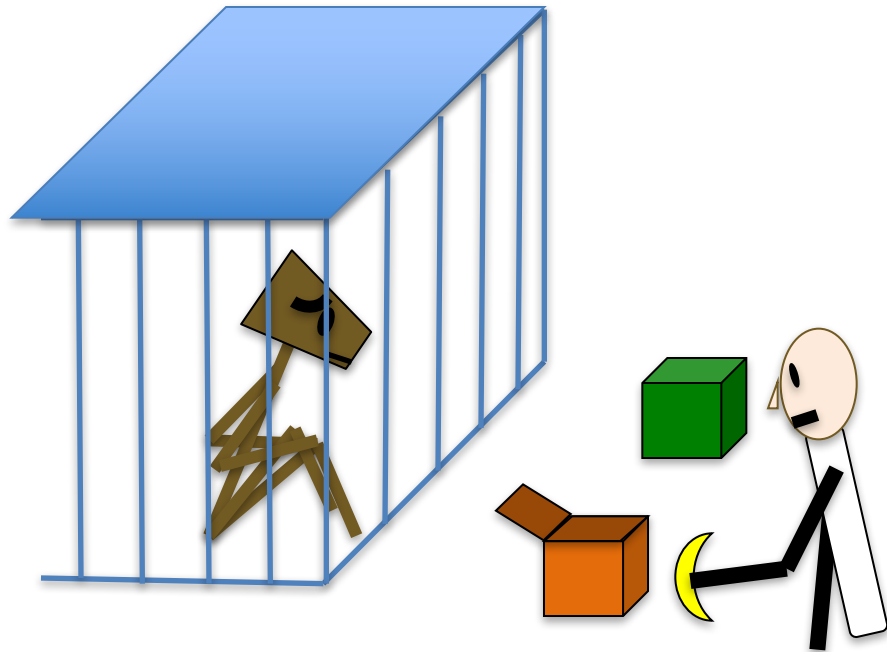
Different trainer, ignorant of location,
asks chimp for treat



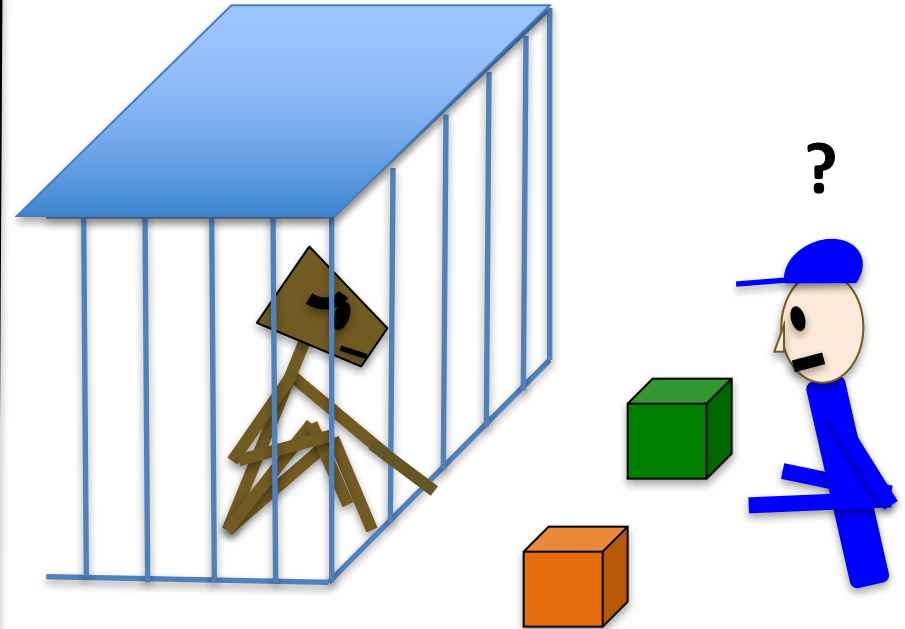
Self Control

In the Lab

Subject watches as experimenter
hides a treat



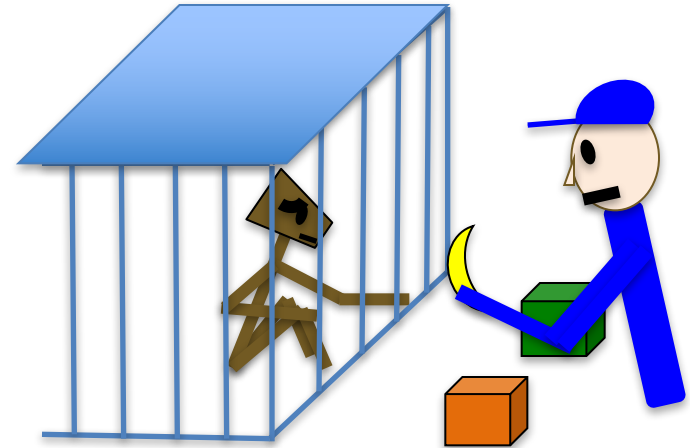
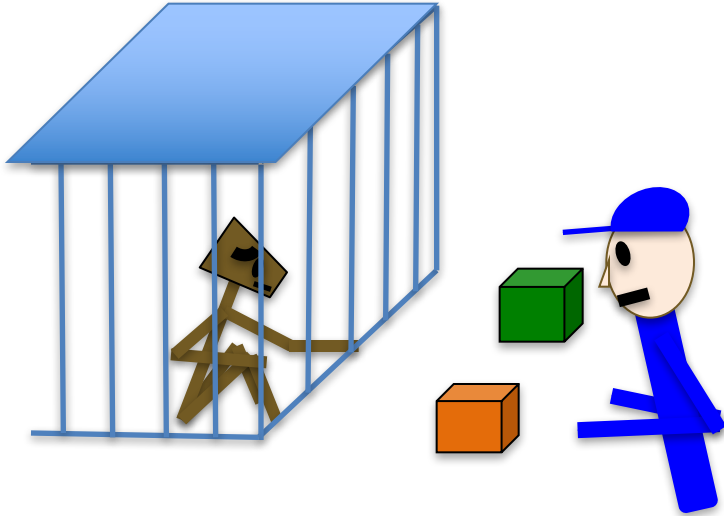
Different trainer, ignorant of location,
asks chimp for treat



Subject indicates
hiding place

Self Control

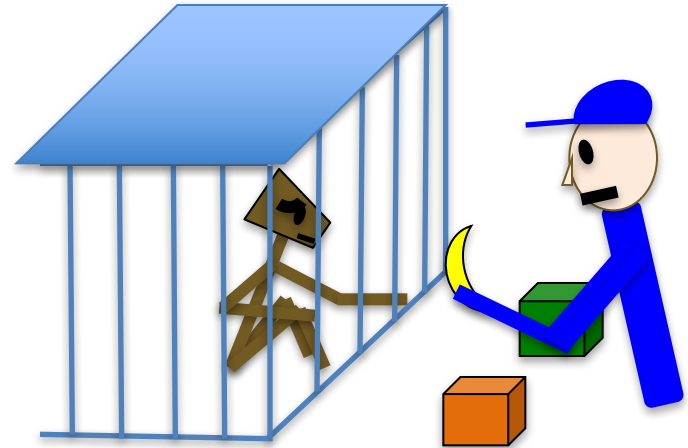
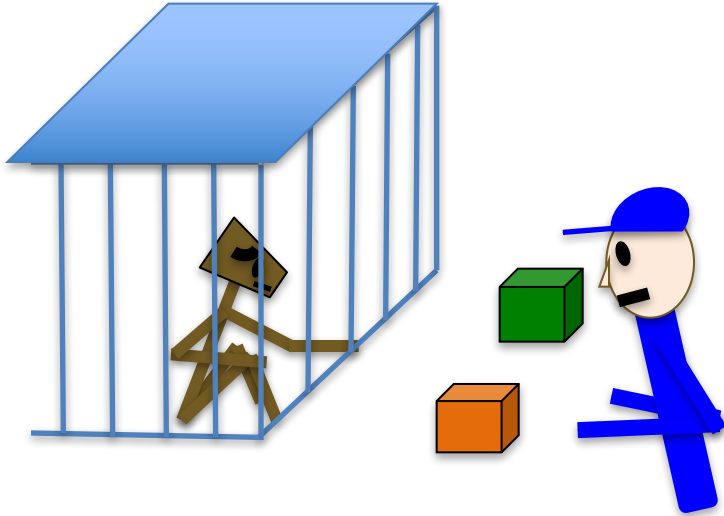
In the Lab



“Nice” trainer shares the banana.

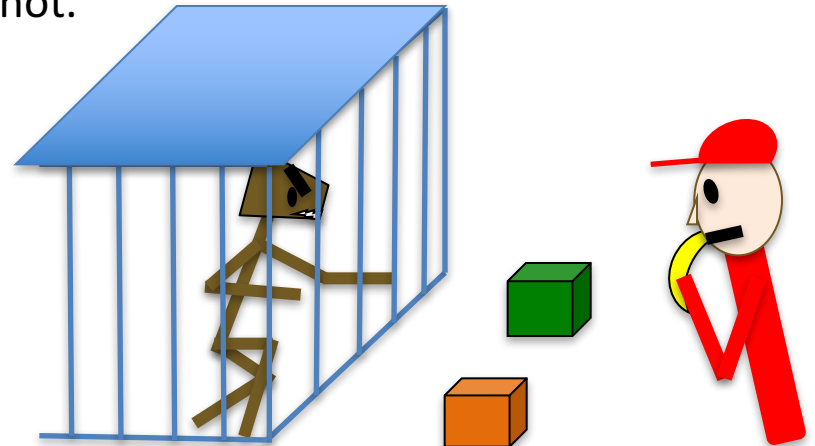
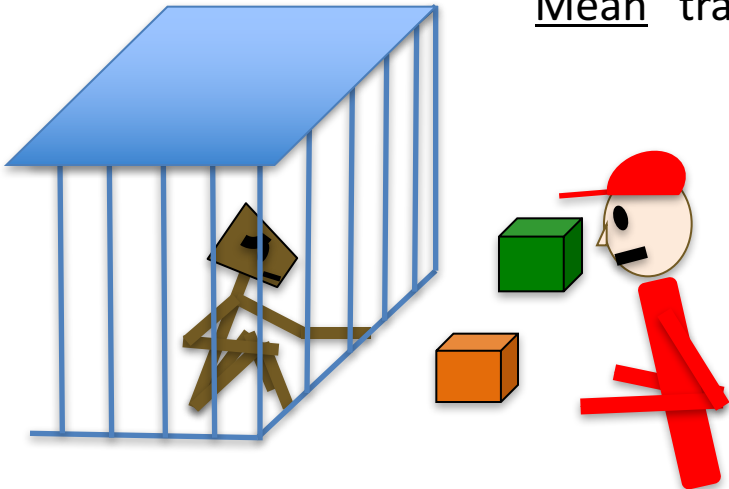
Self Control

In the Lab



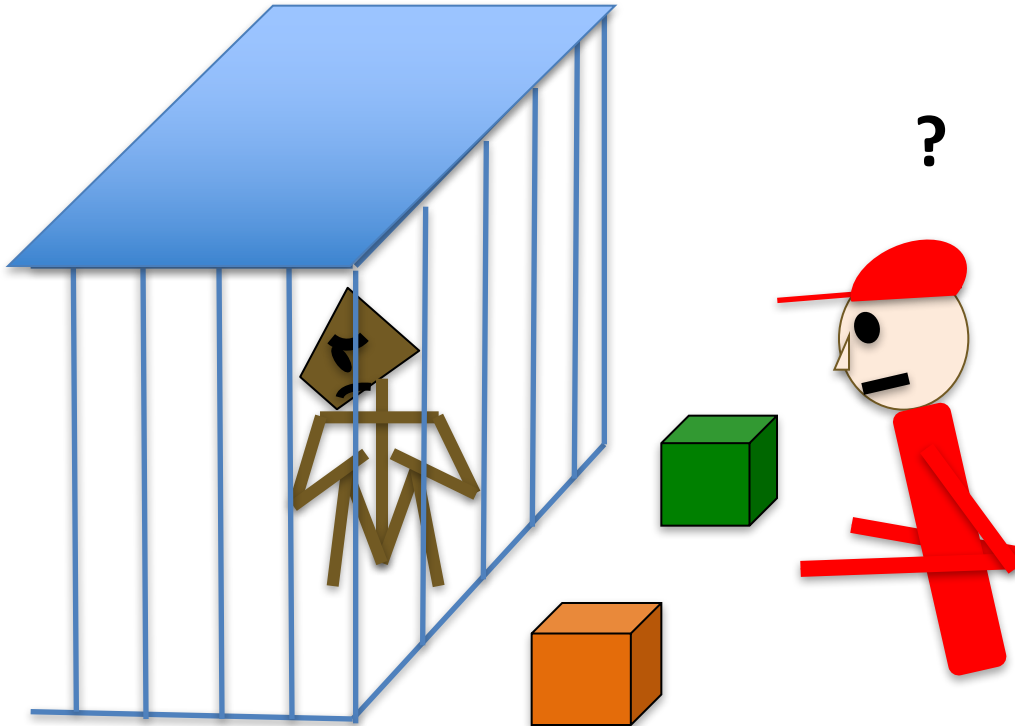
“Nice” trainer shares the banana.

“Mean” trainer does not.



Self Control

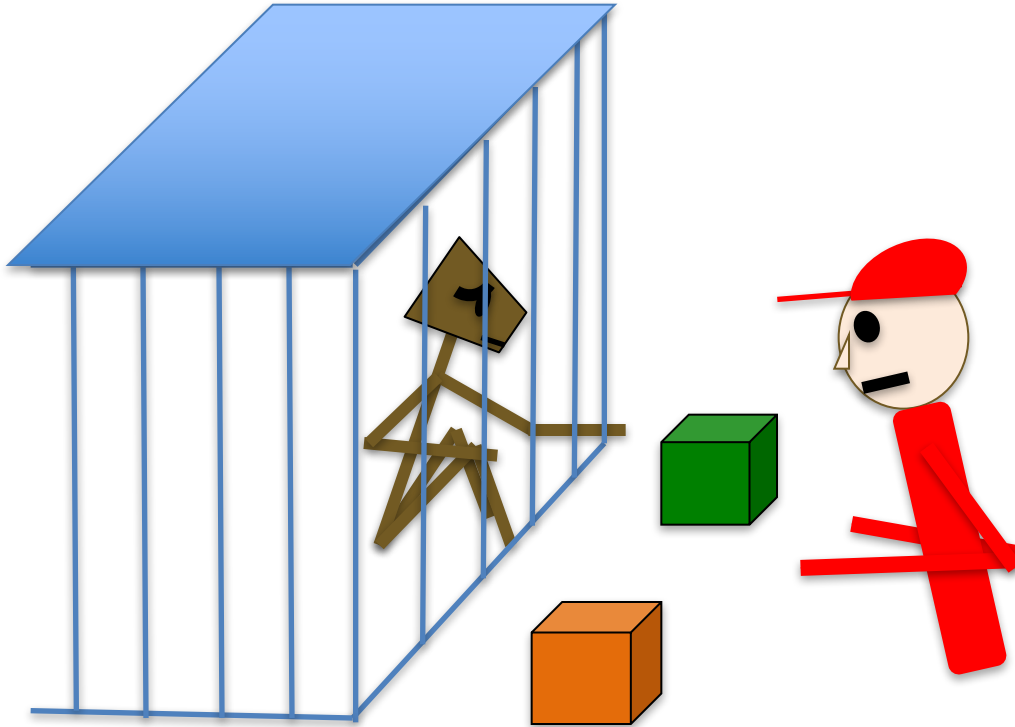
In the Lab



After repeated encounters,
most subjects will
suppress reaching
in presence of "Mean" trainer

Self Control

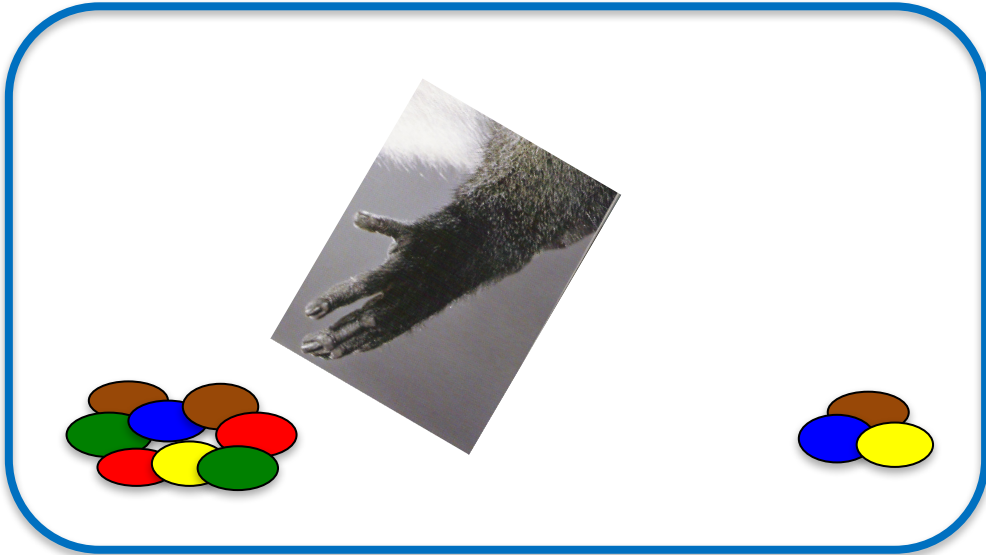
In the Lab



Some will actually
actually MISDIRECT “Mean” trainer!

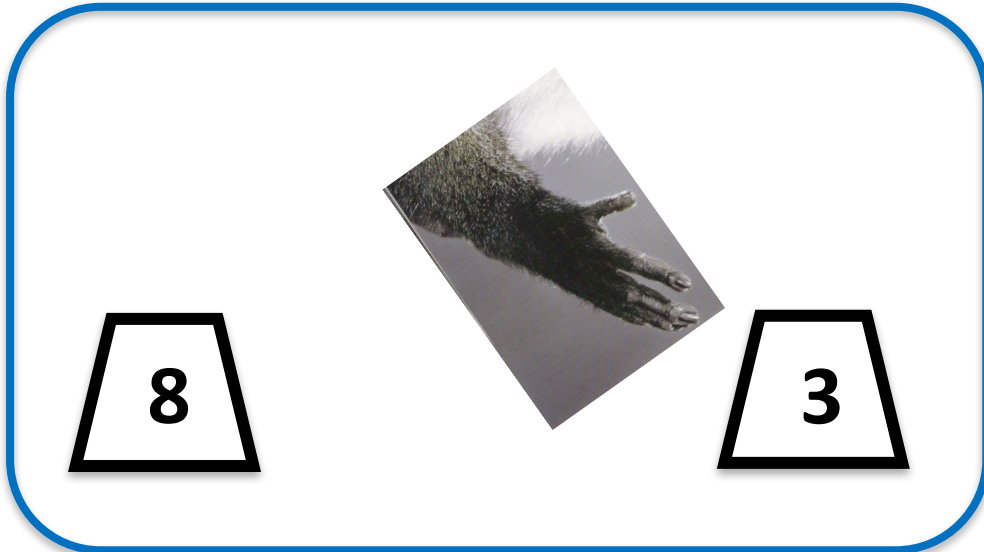
Seen in Chimps
(Woodruff & Premack, 1979)
and Cebus
(Mitchell & Anderson, 1997)

Self Control



Recall:

- Boysen's "Greedy Giveaway" task
- How symbol use can facilitate self-control



Self Control



Orcas in captivity
treat humans
(& other edibles)
as friends
not prey

Cetaceans

- Very little research on social attention
- But other evidence for Self Control

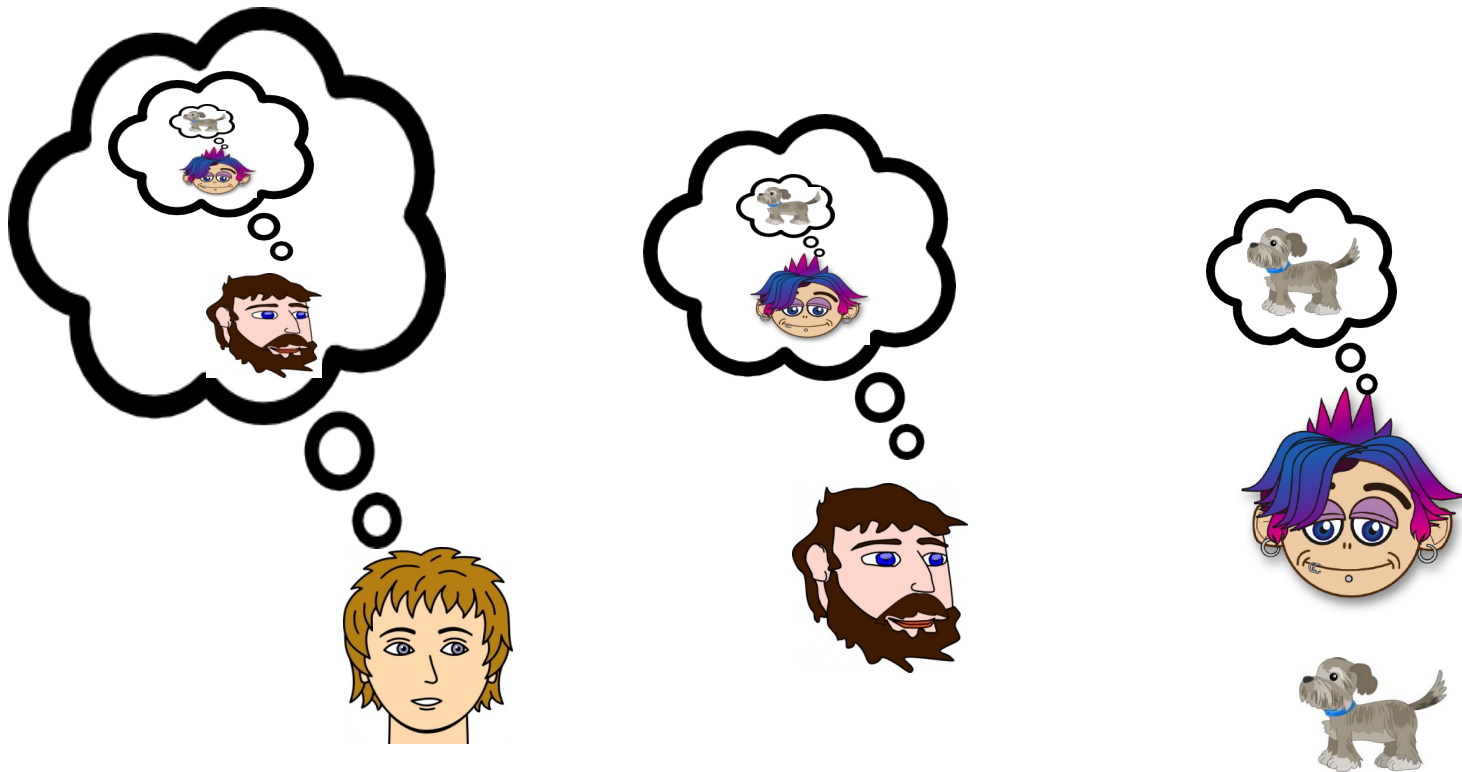


Fission / Fusion

- Within a community, subgroup membership frequently changes
 - Seen, for example, in chimpanzees and bottlenose dolphins
- Adds considerable pressure for social cognition, esp in a complex society
 - i.e. Establishes **differential access to information**
 - i.e. Animal present today has access to current activity; Animal absent does not
 - Sets up situations in which there are payoffs for attending to attention (access)
- This differential access can be exploited
 - e.g. Through competitive interactions, deception
- Or redressed
 - e.g. Through informing ignorant, as with human language

Theory of Mind

- Attributing mental states (e.g. knowledge) to others
 - Often based on attention to other's attention
 - e.g. I SEE you SEE dog . . .
 - I think (believe) that you are thinking (know about) dog



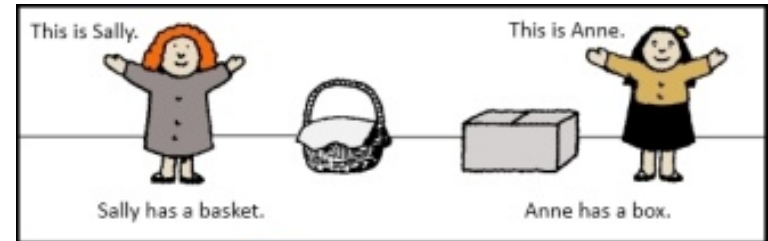
Often presumed to
involve embedded representations

Now considered definitive task for determining Theory of Mind in human children

“Sally/Ann Task”

- Subject sees Sally & Ann

False Belief Task



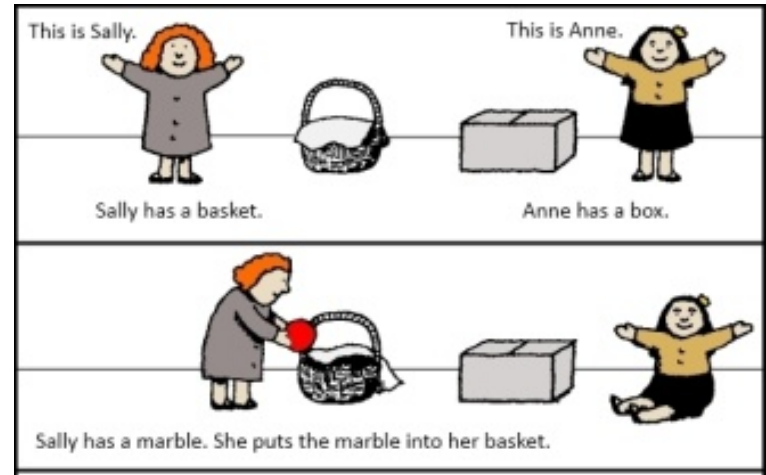
Or Bert & Ernie, etc.

Now considered definitive task for determining Theory of Mind in human children

“Sally/Ann Task”

- Subject sees Sally & Ann
- Sally hides object at A

False Belief Task

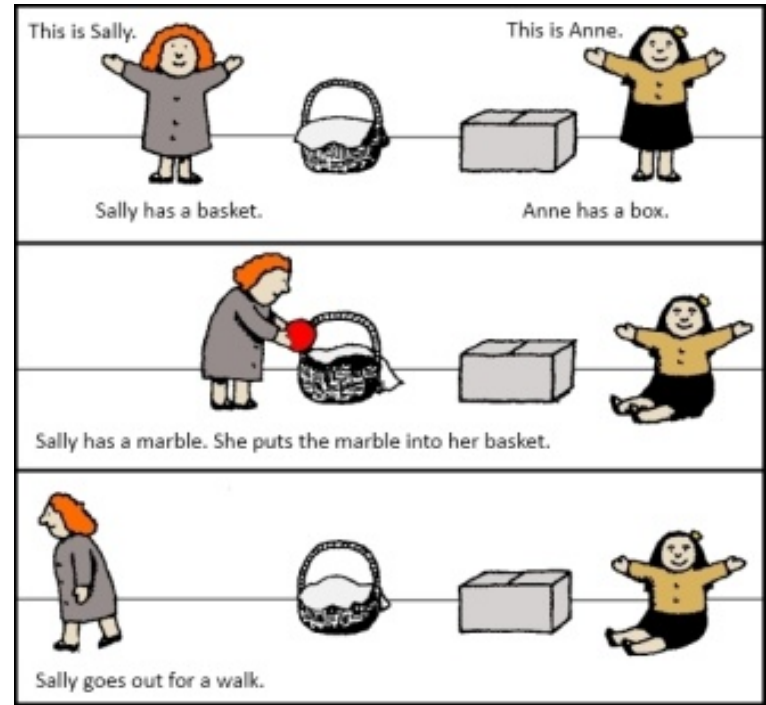


Now considered definitive task for determining Theory of Mind in human children

“Sally/Ann Task”

- Subject sees Sally & Ann
- Sally hides object at A
- Sally leaves, Ann stays

False Belief Task

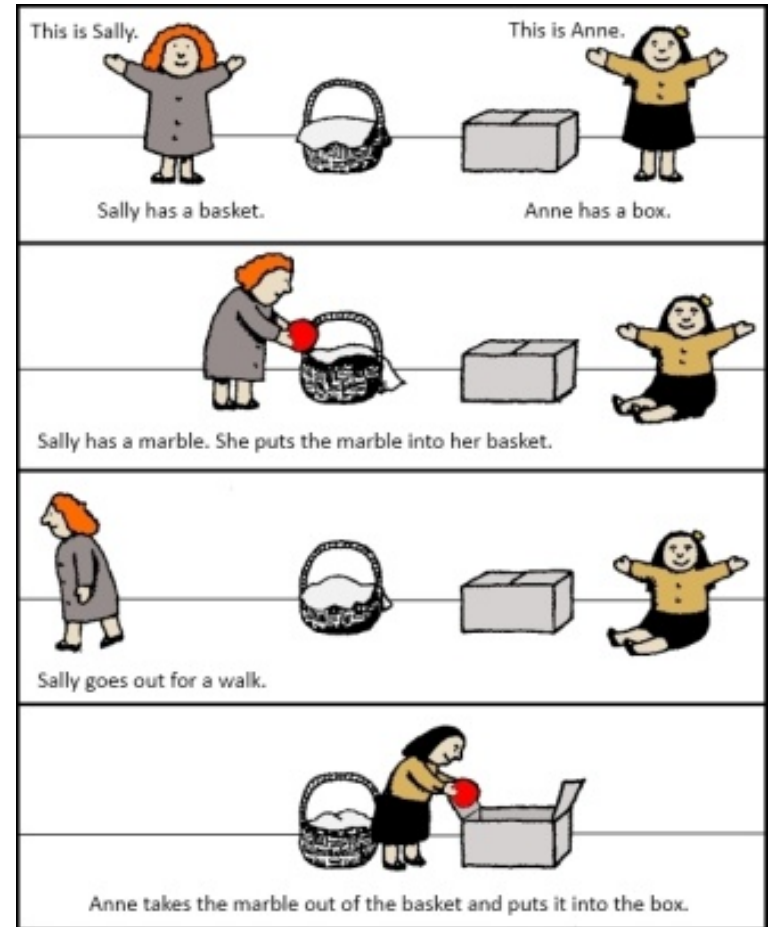


Now considered definitive task for determining Theory of Mind in human children

“Sally/Ann Task”

- Subject sees Sally & Ann
- Sally hides object at A
- Sally leaves, Ann stays
- Ann moves object to B, then leaves

False Belief Task

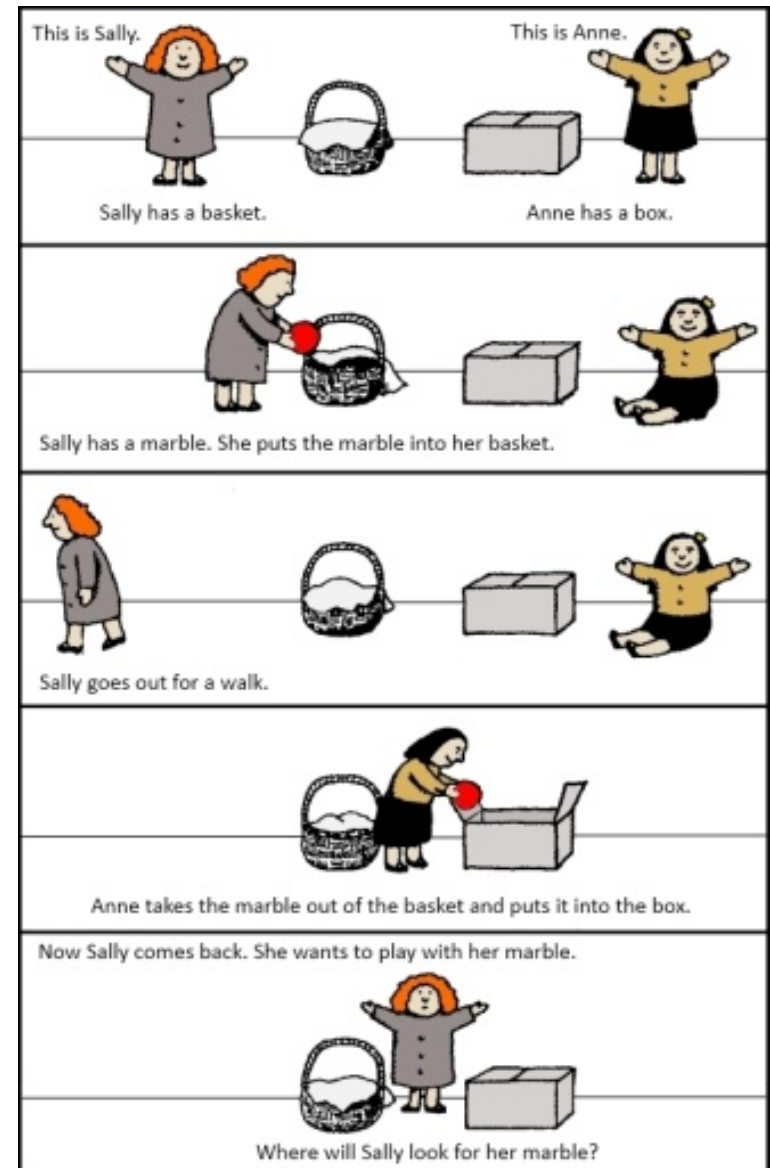


Now considered definitive task for determining Theory of Mind in human children

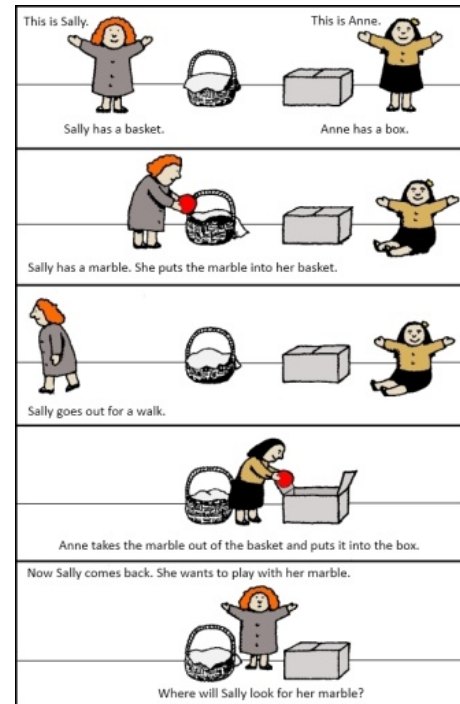
False Belief Task

“Sally/Ann Task”



- Subject sees Sally & Ann
- Sally hides object at A
- Sally leaves, Ann stays
- Ann moves object to B, then leaves
- Experimenter asks subject: “Where will Sally look for object when she returns?”



False Beliefs Task



RESULTS

- 2 yr olds tend to “fail”
 - Pick B  (where object is)
 - Interpreted: “They believe others believe what they believe”
- 4 yr olds tend to “succeed”
 - Pick A  (where object was when Sally was last present)
 - Interpreted: “They believe other has ‘false belief’ different from their own”
- Much controversy over interpretation, role of language, devel trajectory, etc.
 - e.g. Can get success at much younger ages if only use eye-gaze measures

NOTE!

- False Belief Task sets up differential access to information, just as in Fission/Fusion society!

“Guesser vs. Knower” (Povinelli et al. 1990)

A version of “Show-to-Share” with one knowledgeable and one ignorant show-er
i.e. One experimenter saw where treat hidden, other did not

Both face forward, hide eyes vs. mouth



Both face forward, bucket near/covers face



Bodies away, one face to, one from



Both face forward, barrier near/covers face

“Guesser vs. Knower” (Povinelli et al. 1990)

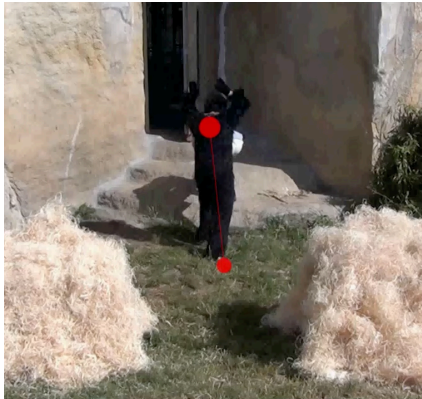
A version of “Show-to-Share” with one knowledgeable and one ignorant show-er
i.e. One experimenter saw where treat hidden, other did not

- Run with Chimps and Macaques
 - Chimps eventually consistently selected “Knower”
 - Macaques did not
- But note, even Chimps took hundreds of trials to learn!
 - In part, we’d now say, because generally poor at “show-to-share”
 - Plus, tho chimps could learn conditions under which it paid to pick X vs Y, not clear if those conditions involved gaze, knowledge, reinforced associations, etc
- In any case, lack of “first trial success” suggests they may not have come to this task prepared to solve it -- ?
- Not very compelling evidence for ToM
 - And, for several years, subsequent efforts also failed, until --

False Belief in Apes

Krupenye et al 2016

Used eye tracking (indicated by red dots) to determine where subject looks while watching a “False Belief” scenario



1) “Ape” attacks Experimenter (establish adversarial relationship)



2) Experimenter sees adversary disappear into right haystack



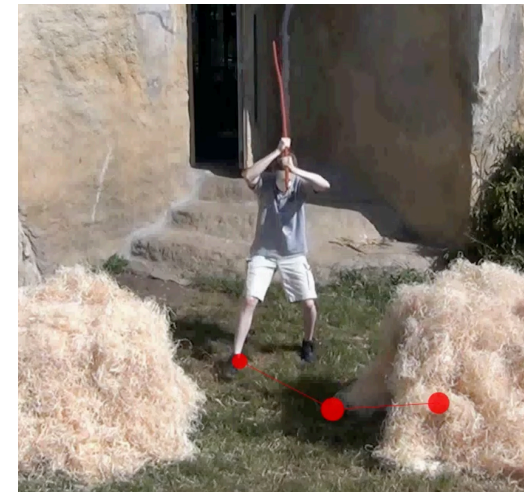
3) Experimenter NOT see adversary move to left haystack

TEST

- Where will subject look when Exp returns w/stick?
 - Look to left, last place Subject saw adversary?
 - Look to right, where adversary last seen by Exp?

RESULTS

- Subject gives anticipatory looks to right
- Consistent w/her recognizing that Exp has “**False Belief**” that adversary still there (even tho Subject knows it is not)



ToM - Problems with Interpretation

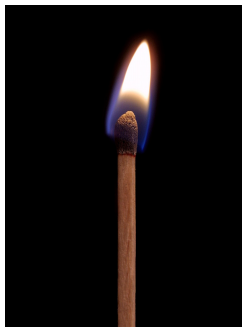


- “Theory of Mind” originally coined by Premack (Premack & Woodruff 1978) working w/ the chimpanzee, Sarah
 - Later, became major focus of human developmental research

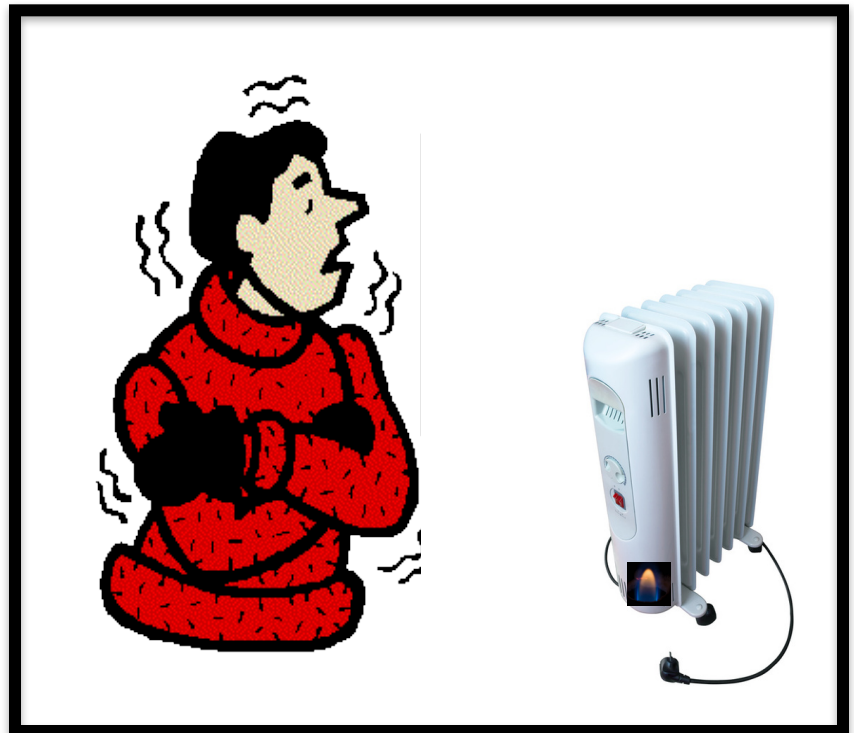


- Sarah presented with videos of Trainer facing various problems (familiar from lab)

She was then asked to choose a photo that “solves” the problem



Note that both options are associated with heater, but only 1 solves current problem



ToM - Problems with Interpretation

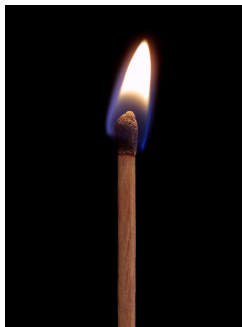
- Sarah often chose “correct” photo

(Premack & Woodruff 1978)

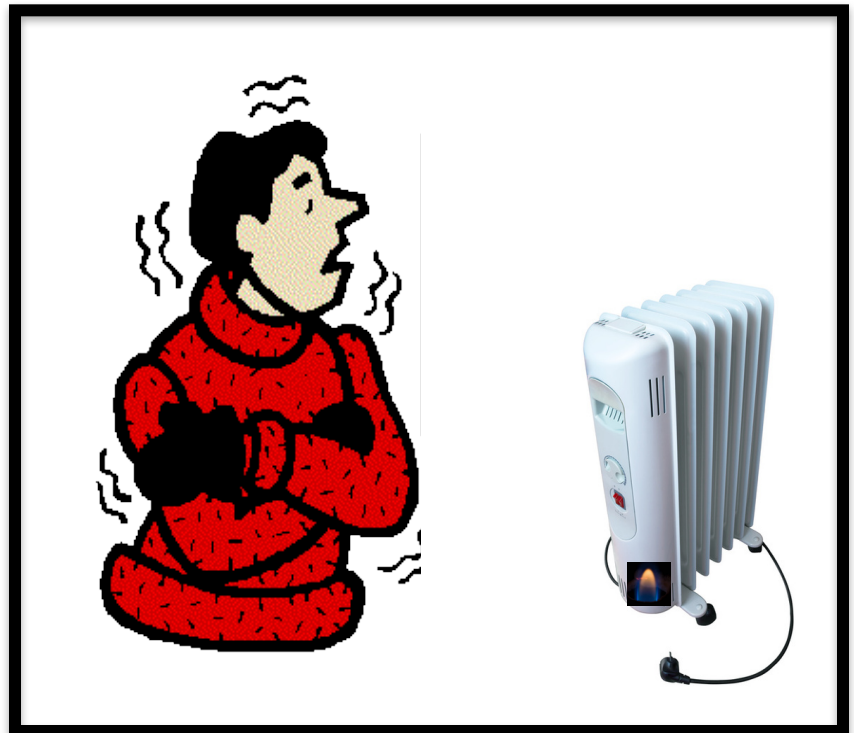
- **BUT, exactly what question was she answering???**

- Sarah presented with videos of Trainer facing various problems (familiar from lab)

She was then asked to choose a photo that “solves” the problem



Note that both options are associated with heater, but only 1 solves current problem



ToM - Problems with Interpretation

- Sarah often chose “correct” photo

(Premack & Woodruff 1978)

- **BUT, exactly what question was she answering???**

- If problem involved a human she did not like...



- She would select what was (to her) the desirable outcome



- So, unclear if she attributes mental states (goals, desires) to human, or just recognizes problem and selects her own solution

ToM - Problems with Interpretation

Falsifiable?? How do you rule out alternative explanations??

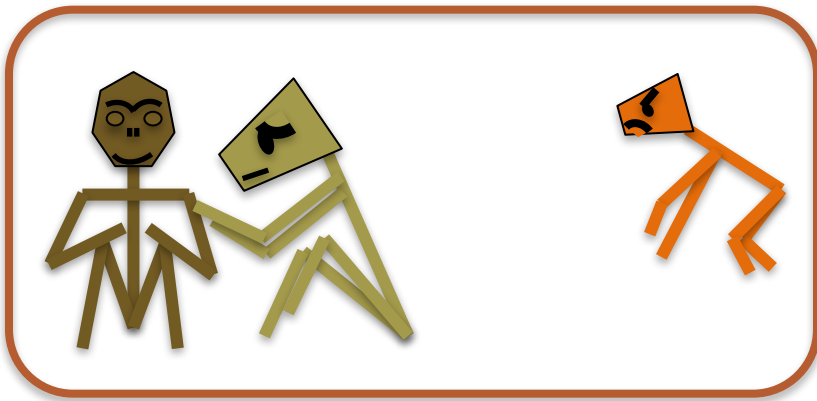
- Prevent Target from knowing, since if he knows, he'll interfere ? (= ToM)
- Prevent Target from seeing, since if he sees, he will interfere ?
- Prevent yourself from seeing his face, since seeing it predicts he'll interfere ?
- Avoid stress of possible eye contact with Target, so can relax for sex ?



Best solution to these issues is to focus on
the cognition we can see - behavioral complexity & flexibility

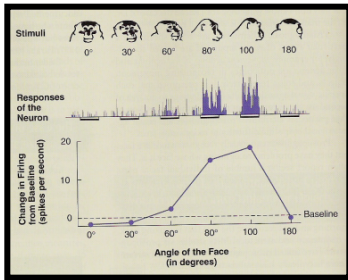
Triadic Attention

Especially in “complex society”, important to assess attention interactions between others



Triadic Attention

- Studied triadic attention in videos of 3 adolescent bonobos (Johnson 2004)
 - What happens when A turns to B in C's presence??



- Given primates' sensitivity to changes in head direction
- We scored relative head orientation of all 3 animals

- Useful metaphor:

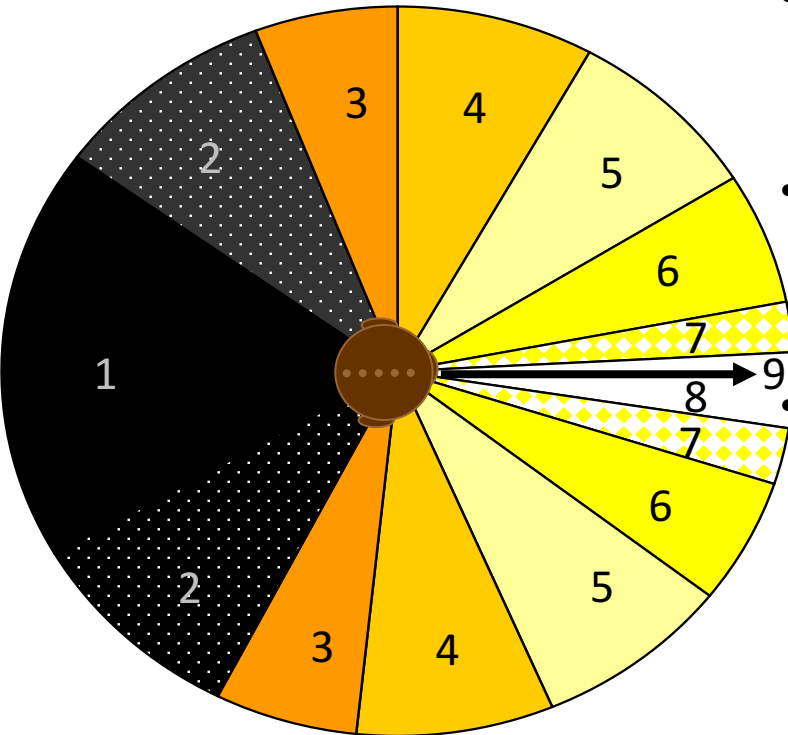
“Brightness”!

- The more direct the look, the “Brighter” that animal is to the other

So, we can assess overall “Triadic Brightness”

For example,
 A = 2 to B, 1 to C
 B = 9 to A, 5 to C
 C = 7 to B, 6 to A

Total Triadic Brightness = 30

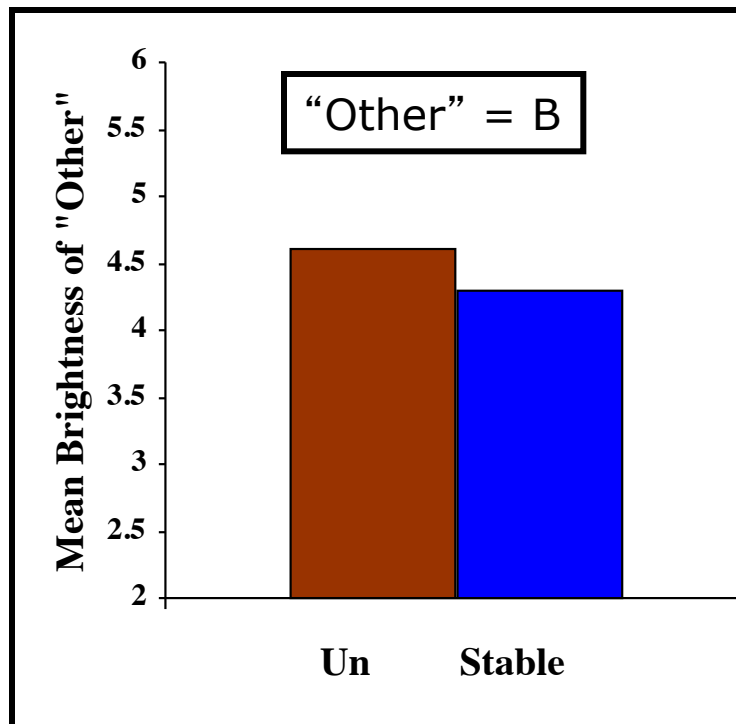


Triadic Attention

- Studied triadic attention in videos of 3 adolescent bonobos (Johnson 2004)
 - What happens when A turns to B in C's presence??

Unstable = A turn to B, A turn away

Stable = A turn to B, stay



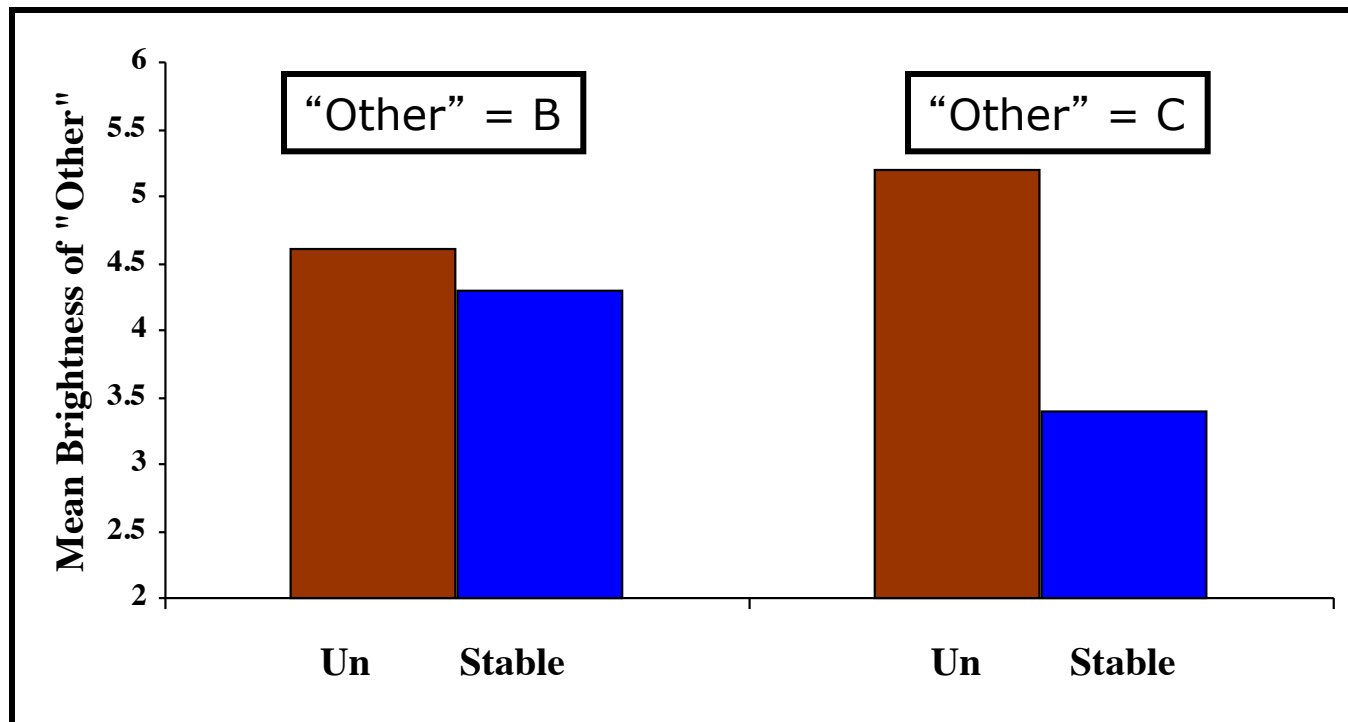
- "Brightness" of B did NOT predict A's in/stability!

Triadic Attention

- Studied triadic attention in videos of 3 adolescent bonobos (Johnson 2004)
 - What happens when A turns to B in C's presence??

Unstable = A turn to B, A turn away

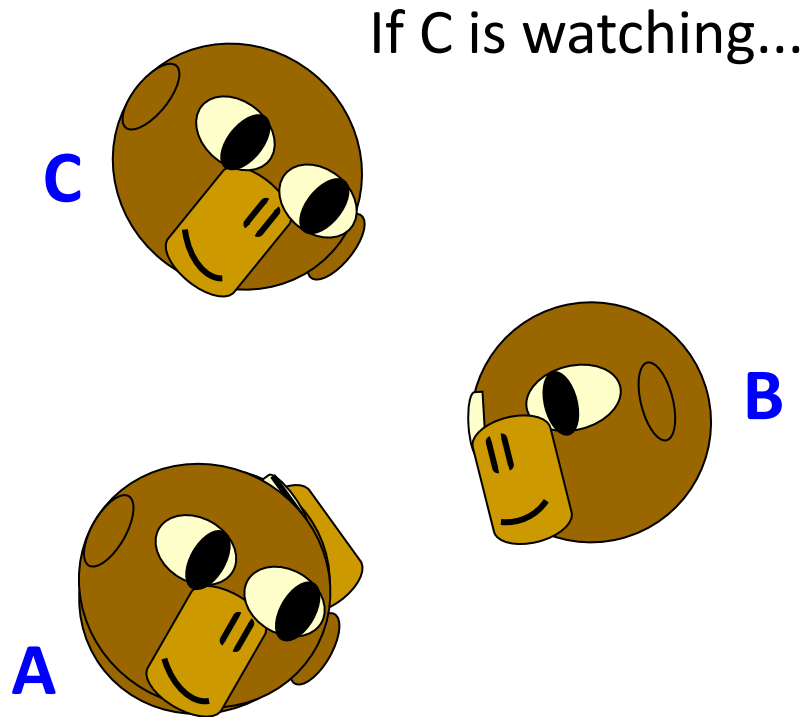
Stable = A turn to B, stay



- "Brightness" of B did NOT predict A's in/stability!
- "Brightness" of C did!
- i.e. A more likely to turn away from B if C was "Bright"

Triadic Attention

So, in this triad of bonobos ---



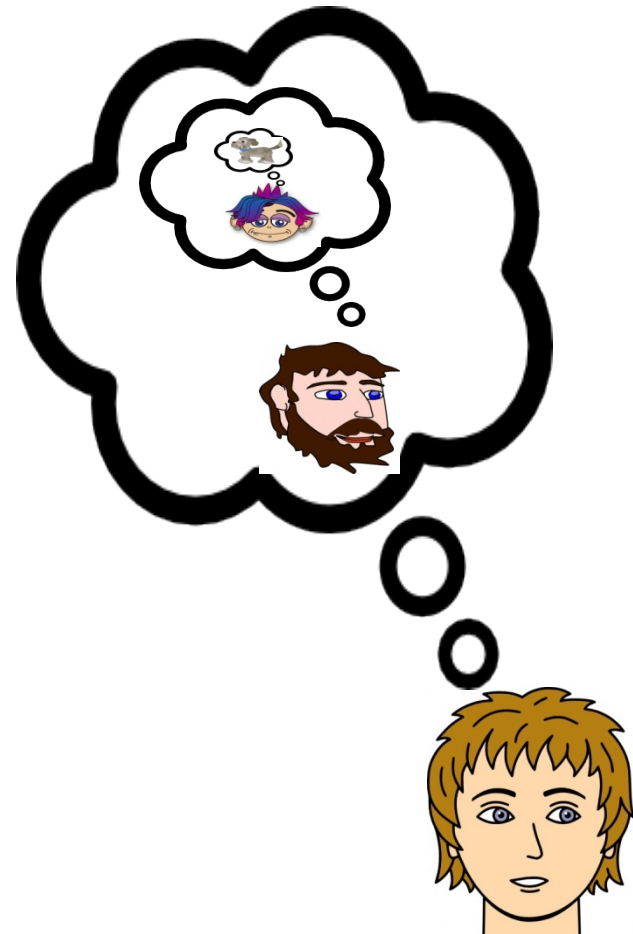
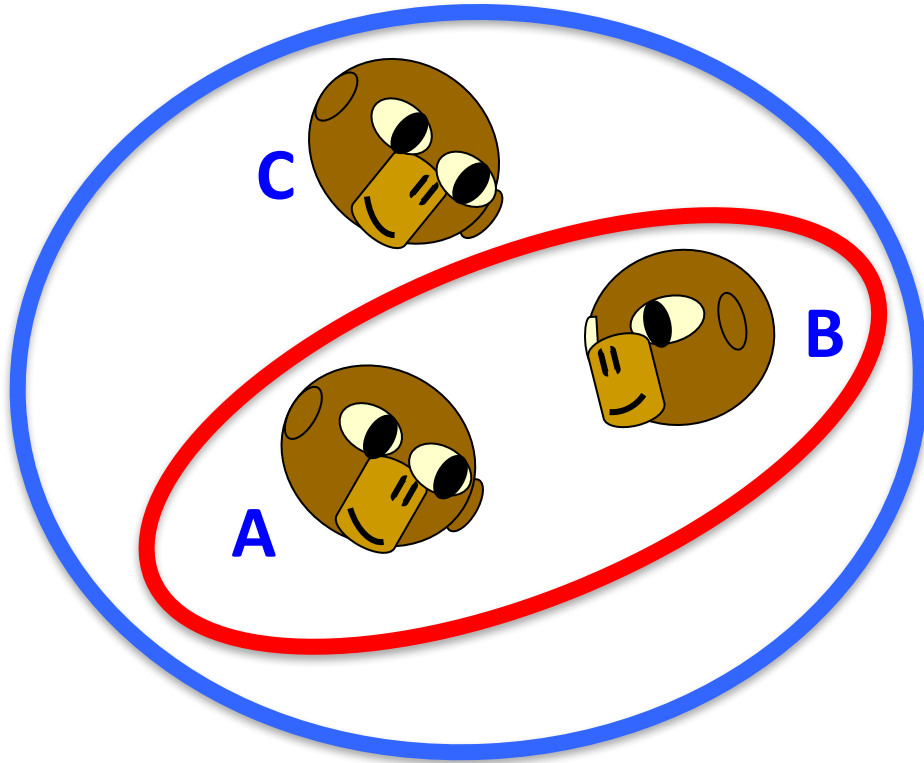
... and A Turns To B ... A will soon turn From B

In fact, if all three attain high levels of access to each other simultaneously,
(i.e. head turn raised total Triadic Brightness > 35)
one will turn away within 260ms (immediately, at limits of reaction time!)

Triadic Attention

Such gaze interactions are **embedded**:

C sees (A sees B)



Suggests parallels with “cognitive embedding”
that is presumed to be required for Theory of Mind . . .

All Triadic Interactions are Embedded

e.g. “Social Tool” interactions

e.g. Buffer



User Connie embeds her interaction with buffer Lori in her interaction with aggressor Akili

User Loretta embeds her interaction with recruited Akili in her interaction with aggressor Erin



e.g. Recruit

All Triadic Interactions are Embedded

e.g. “Social Tool” interactions

“Alibi” = Use show of interest in Tool to deflect unwanted interest from other/s

(Tool)



- Limits on layers of embedding? How deep does it go?!

Self Recognition

Gallup 1970 – Self recognition in mirror via “Mark Test”

- Subject exposed to mirror, then mirror removed.
- Subject anesthetized, forehead marked with paint
- When it awakens, watch to see if detects paint (it does not), then re-exposed to mirror



NOTE: Successfully done in Human children and Elephants

Self Recognition



Monkeys tend to react SOCIALLY to a mirror
i.e. as if seeing another Monkey

Self Recognition



Apes tend to react as if seeing themselves,
i.e. GROOM the mark

Self Recognition

Apes show a variety of “contingency” behaviors when familiar with mirrors



So Apes have a “**self concept**” but Monkeys do not???

Or are monkeys just too put off by EYE CONTACT from monkey in mirror??!

Self Recognition

“Mark Test” has been done with Dolphins

They “seem” to check out mark...



But cannot actually TOUCH mark, so ???

OBJECTION! Not Ecologically Valid test for this species!!

Self Recognition

Like apes, dolphins also show “Contingency Testing” to mirror

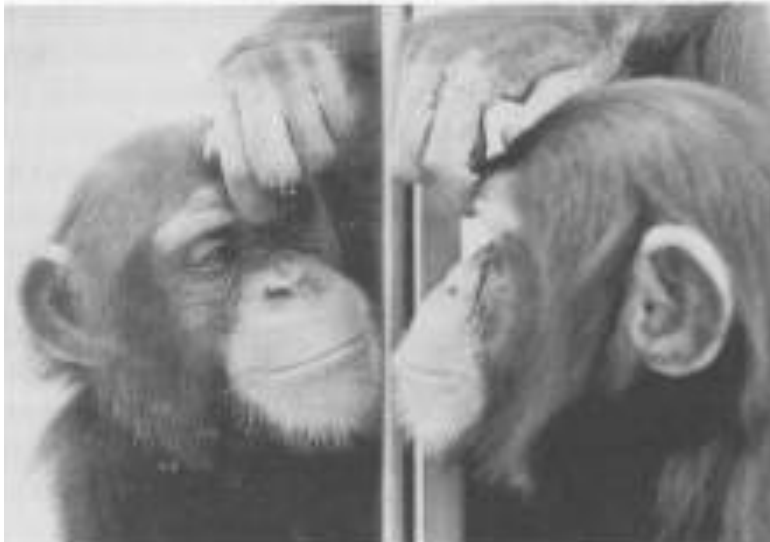
- Open mouth, wag head, turn over, etc...



BUT, also do this when human (or other dolphin?) IMITATES them
- i.e. GAME: “Can you keep up?!”

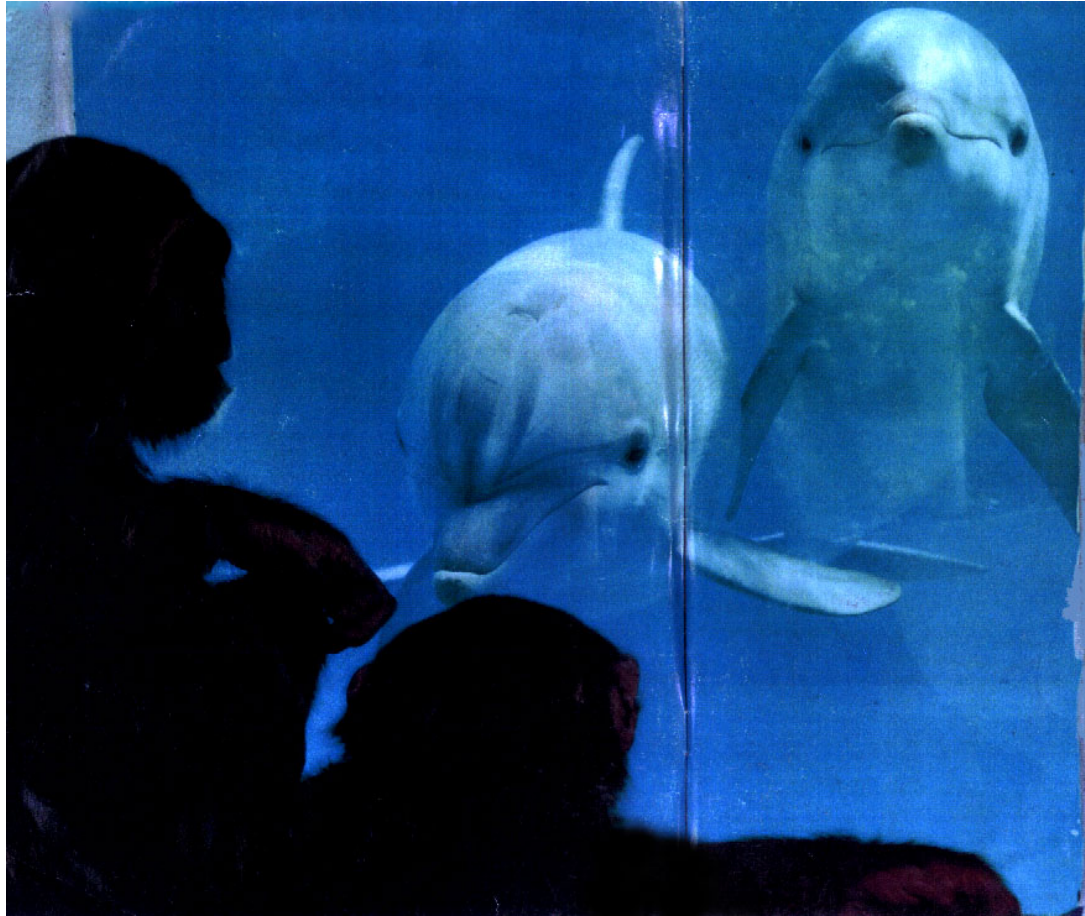
Maybe rather than recognizing ME, they are recognizing WE...?

Self Recognition



- What does “self-concept” even mean???
- Recall see mom’s hands, hear her echoes, before your own, so perhaps wrong to presume ToM maps “self” onto “other”
- In humans, seems to develop out of social interaction...
 - Is this related to “Perspective Taking” ?
 - i.e. Seeing yourself as a thing “seeable” by others...???!

*So many interesting questions
still unanswered...!*



Hopefully, some of YOU will help find them?!