HEB 1330: Primate Social Behavior

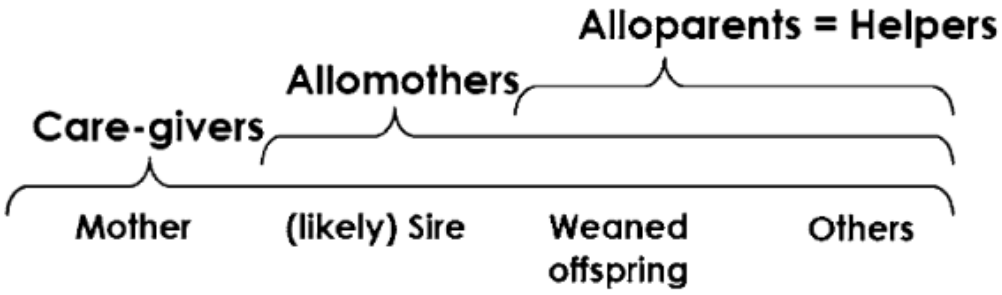
Cooperative breeding

Overview

1. What is “cooperative breeding”?
2. Are humans cooperative breeder?
3. Cooperative breeding hypothesis
4. Grandmother hypothesis

Cooperative Breeding

Social systems in which non-parents (helpers or alloparents) provide care for infants



Cooperative Breeding

Social systems in which non-parents (helpers or alloparents) provide care for infants

Helpers/Alloparents:

- other reproducing adults

communal breeder

Cooperative Breeding

Social systems in which non-parents (helpers or alloparents) provide care for infants

Helpers/Alloparents:

- other reproducing adults — *communal breeder*
- sub-adults prior to dispersal — *cooperative breeders*
- reproductively mature (but non-breeding) adults

Cooperative Breeding

Social systems in which non-parents (helpers or alloparents) provide care for infants

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- sub-adults prior to dispersal — *cooperative breeders*
- reproductively mature (but non-breeding) adults

→ Often involves reproductive suppression (i.e. the alloparents or 'helpers' do not have their own offspring)

→ Obligate vs. facultative cooperative breeders

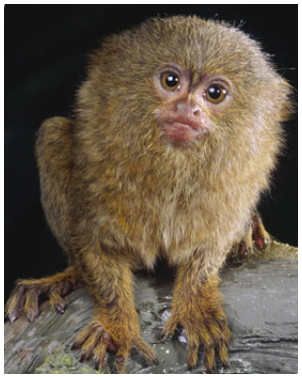
Cooperative Breeding

Social systems in which non-parents (helpers or alloparents) provide care for infants

Helpers/Alloparents:

- other reproducing adults — *communal breeder*
- sub-adults prior to dispersal — *cooperative breeders*
- reproductively mature (but non-breeding) adults
- Post-reproductive adults
- Infertile adults — *eusocial species*

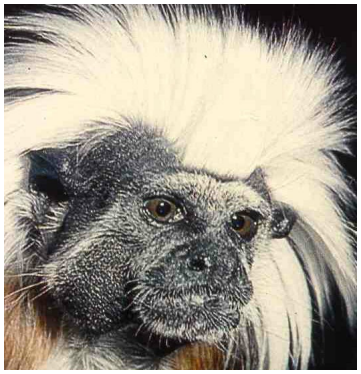
Callitrichidae



Callithrix pygmaea
Pygmy marmoset

Callithrix jacchus
Common marmoset

Leontopithecus rosalia
Golden lion tamarin



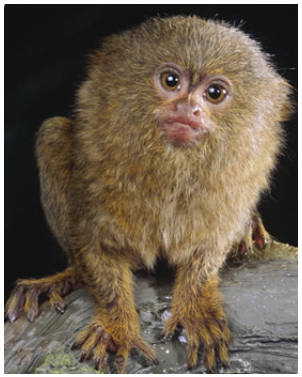
Saguinus oedipus
Cottontop tamarin

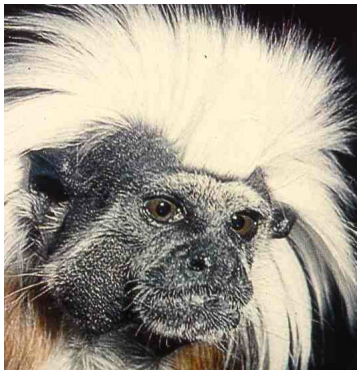
- Marmosets and Tamarins (39 species)
- Central and South America
- Weight: 100-1000 grams
- Diet: fruits, insects, gum

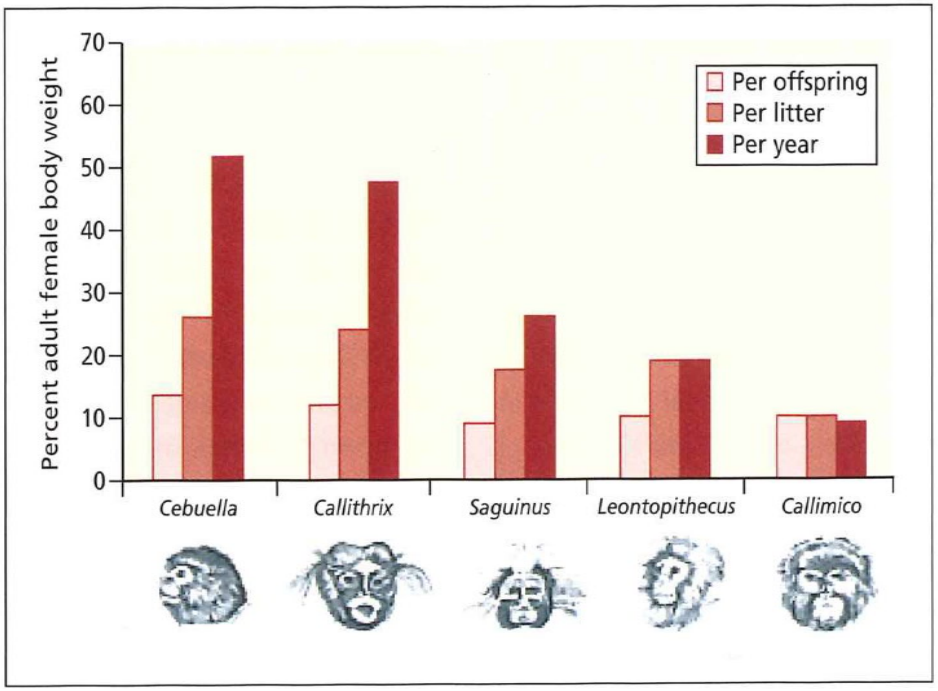
Callitrichidae (https://www.smithsonianchannel.com/videos/the-amazing-adaptation-that-keeps-tamarin-numbers-up/56461?an=science-and-nature)

Callitrichidae

Callitrichidae







→ often twins/triplets

→ all-time primate record:
64 offspring, 25 births, 13 years

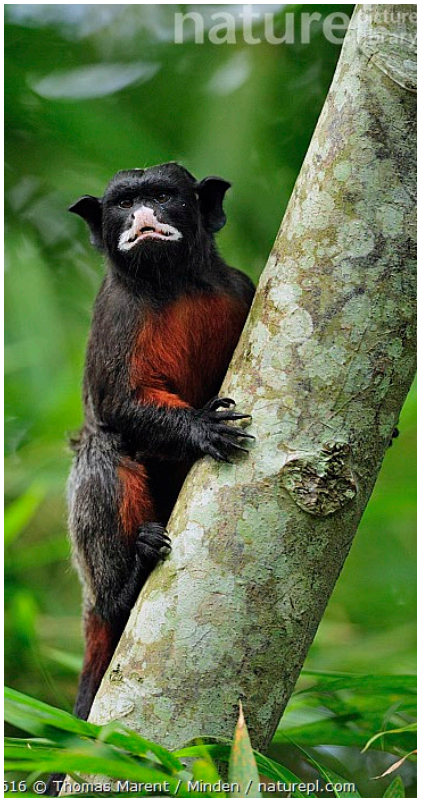
Callitrichidae

Breeding pair needs help

	MONOGAMY	POLYANDRY
% OF TIME SPENT CARRYING BY		
Mother (Female-1)	20-25	20-25
Male-A	40	40
Male-B	-	40
Female-2	25	-
Female-3	12	-
Sub-adults	5-10	-

→ One female and one male can afford only ~ 60% of total time carrying.

→ If pair is alone, a second male is “recruited”



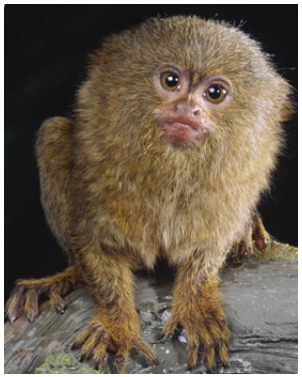
White lipped tamarin (Saguinus labiatus)

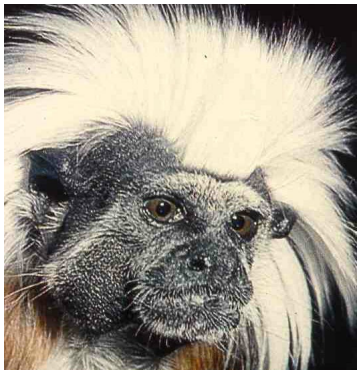
→ 12% of infants abandoned when older offspring present
57% of infants abandoned when other offspring too young to help

If allo-parental support likely insufficient, mothers will abandon newborn

Goldizen 1988

Callitrichidae



- Breeders get help by non-breeders in:

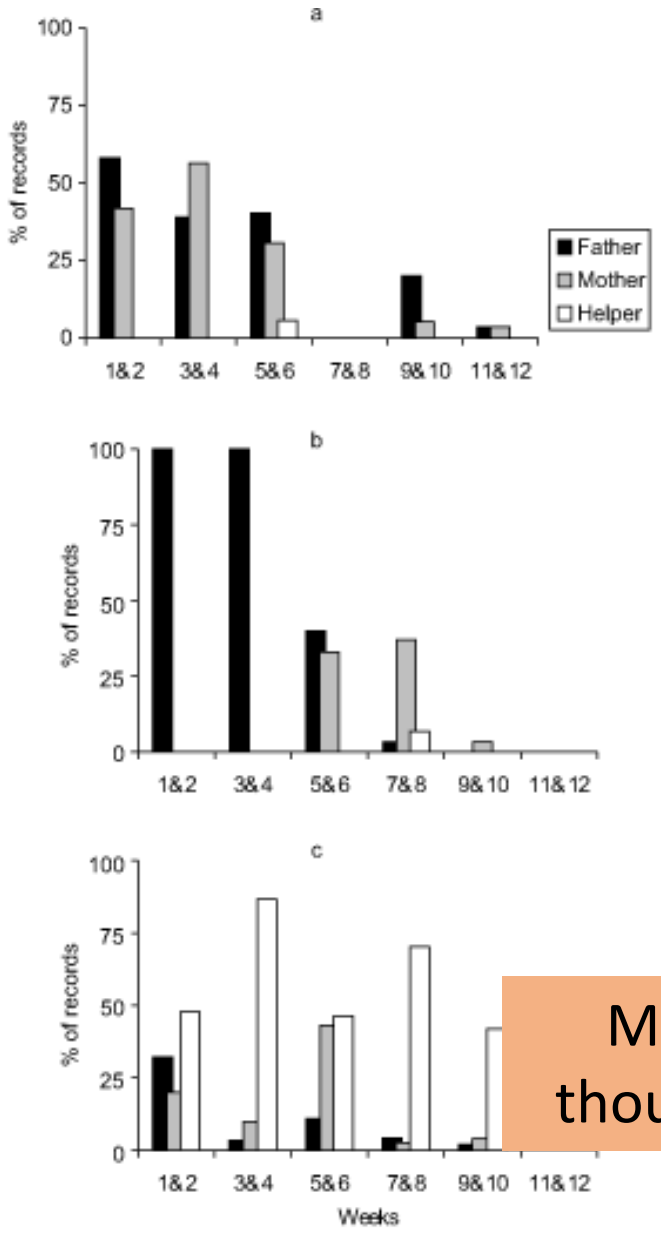
  vigilance against predators territorial defense allo-parenting

- allo-parenting performed by:

  juveniles / non-breeding adults / polyandrous males

  → offspring often stay as adults (delayed dispersal)

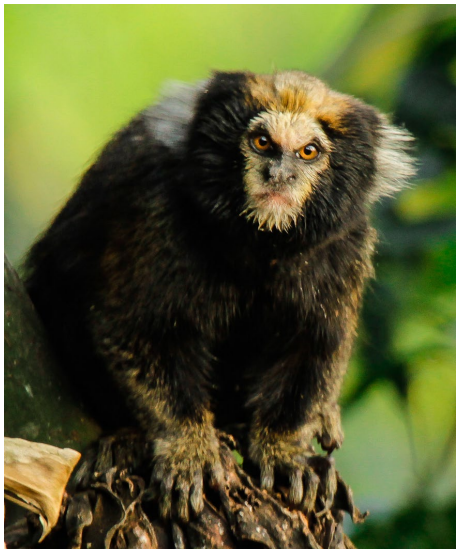
Callitrichidae



father = mother

father >> mother

helper >> mother/father



Buffy-tufted-ear marmoset

Mother always gets help from someone - though there is variation in who the helper is

Santos & Martins 2000

Callitrichidae

Why do subordinates stay and not leave for own reproduction?

Why do subordinates not reproduce in group ?

Callitrichidae

Why do subordinates stay and not leave for own reproduction?

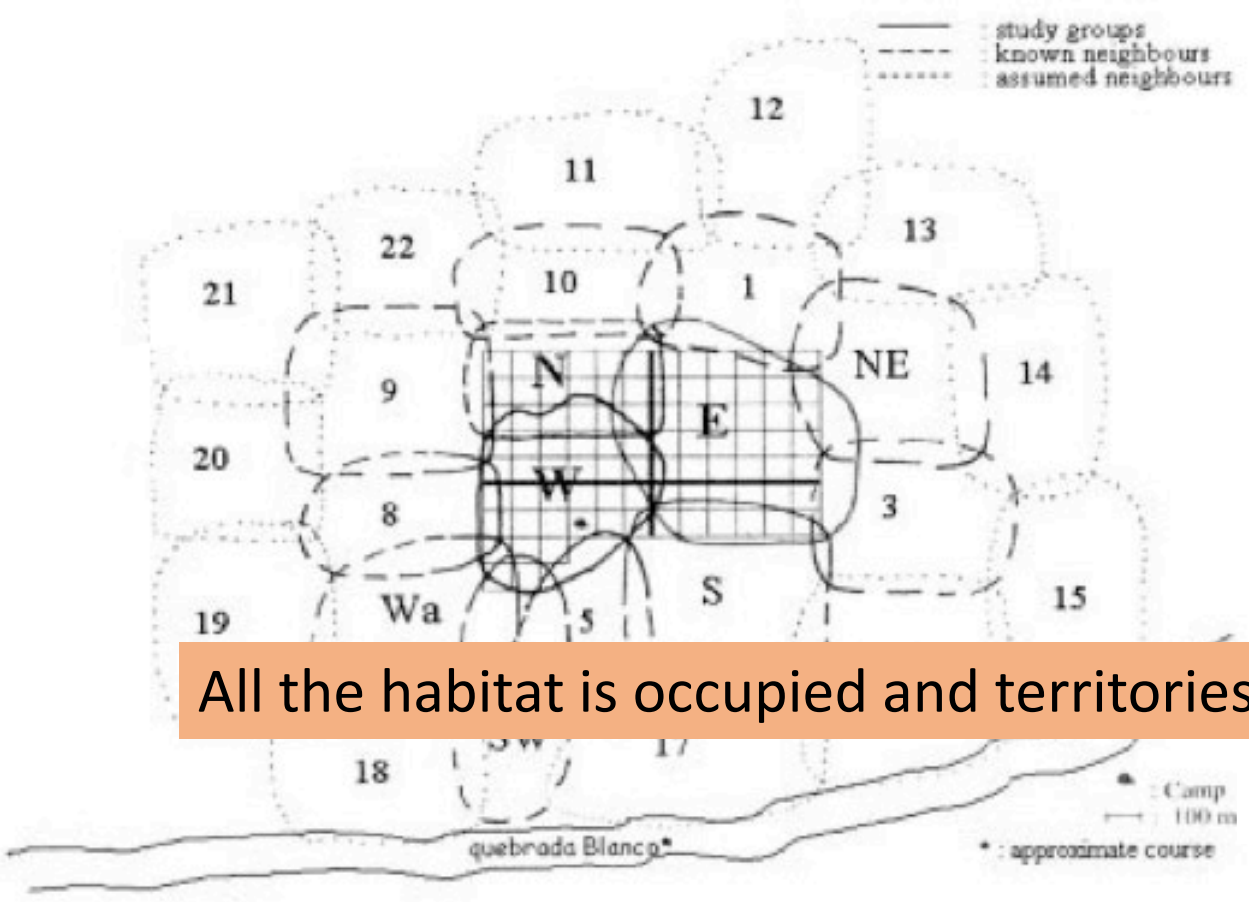
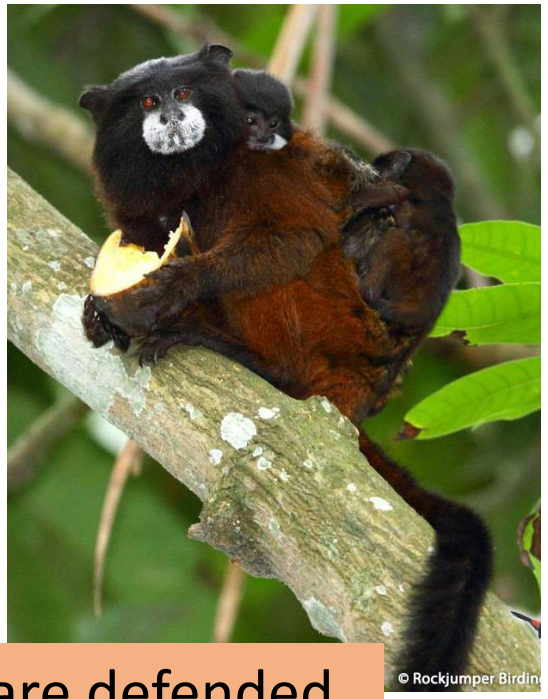


Fig. 1. Home ranges of study and neighboring groups. Grid depicts paths of site.

All the habitat is occupied and territories are defended



Moustached tamarins

Sanguinus mystax

Huck et al. 2005 *AJPA*

Callitrichidae

Why do subordinates not reproduce in group ?

a. Interference and disruption of sexual activity by dominant

-sharing sleeping holes
-very few subordinate mating attempts and almost no disruptions

Golden-white tassel-ear marmoset (*Mico chrysoleucus*)

Saltzman et al 2009

Callitrichidae

Why do subordinates not reproduce in group ?

b. Avoidance of mating with close relatives

Behaviour	Control daughters†	UM daughters†
Sexual solicit to male	0/9 (0/7)	8/13 (7/11)
Tongue in–out to male	0/9 (0/7)	4/13 (4/11)
Tongue in–out from male	0/9 (0/7)	7/13 (7/11)
Attempted mount from male	0/9 (0/7)	4/13 (4/11)
Mount from male	0/9 (0/7)	6/13 (5/11)

Callithrix jacchus
Common marmoset

UM = unrelated male

Callitrichidae

Why do subordinates not reproduce in group ?

c. Olfactory and Visual cues from the dominant female

Evidence:

- Removal of olfactory ability in subordinates resulted in ovulation
- Removal from group but continued scent of dominant female, delayed ovulation
- Visual exposure to the dominant female delayed ovulation
- Effects are only present with familiar dominant individual

Callithrix jacchus
Common marmoset

Ongoing interactions with a dominant female necessary for ovulation suppression

Saltzman et al. 2009

Callitrichidae

Why do subordinates not reproduce in group ?

d. Infanticide by breeding female has selected for a ("self-imposed") reproductive suppression (**Restraint Hypothesis)**

Evidence:

- Infanticide is likely when two females are pregnant at the same time
- Often the pregnant mothers kill their daughter's infants
- But sometimes, the subordinates kill the dominant's infants and then become dominant (tug-of-war)

Saltzman et al. 2009

Callitrichidae

Why do subordinates stay and not leave for own reproduction?

All the habitat is occupied, and territories are defended

Why do subordinates not reproduce in group ?

a. Interference and disruption of sexual activity by dominant
b. Avoidance of mating with close relatives
c. Olfactory and Visual cues from the dominant female
d. Infanticide by breeding female has selected for a ("self-imposed") reproductive suppression (**Restraint Hypothesis)**

Cooperative breeding in Callitrichidae

Ecological constraints
(limited habitat; dispersal difficult)

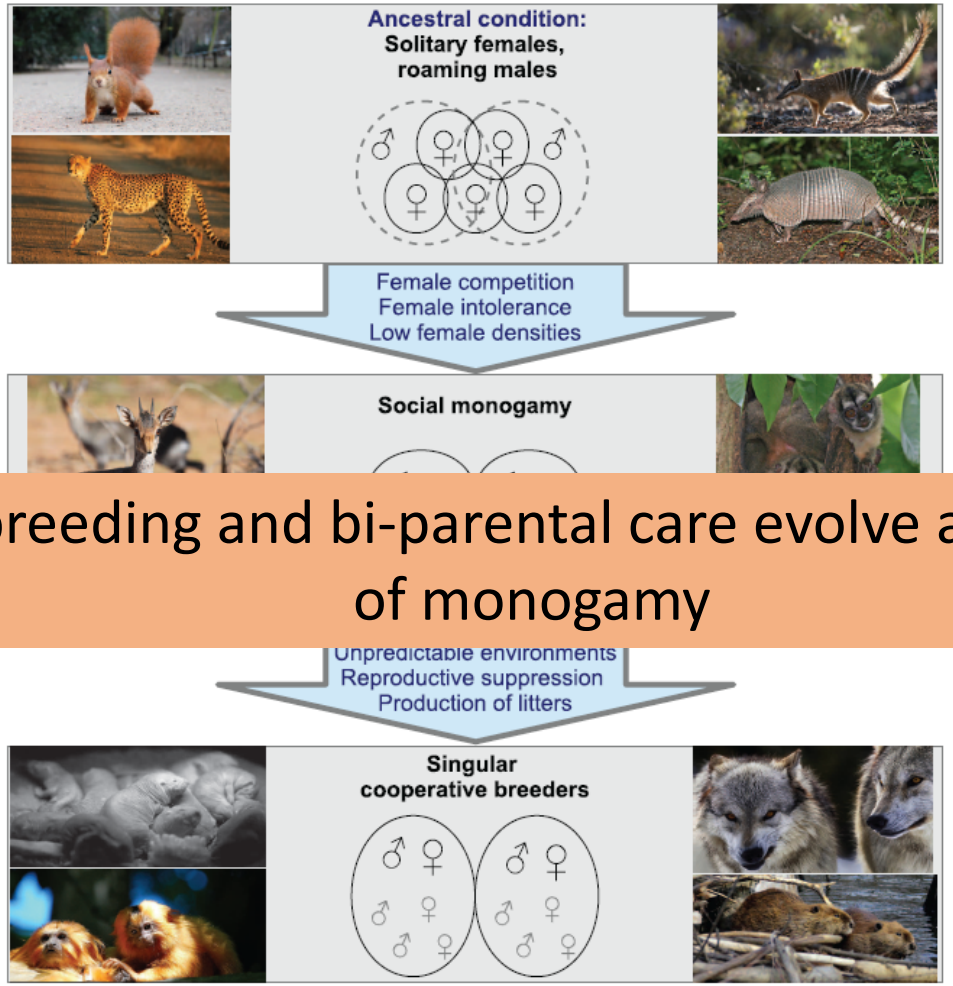
Low probability of subordinates breeding

Social constraint
(incl infanticide by dominant female)

Subordinates "making best of a bad job"

Subordinates maximize fitness by investing in kin, learning to parent & waiting for breeding opportunities

The Evolution of Cooperative breeding

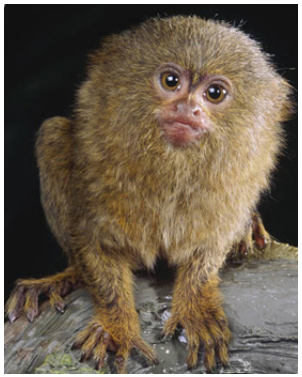


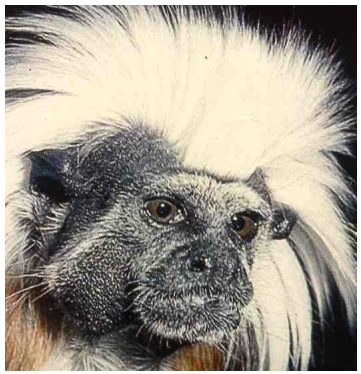
Cooperative breeding and bi-parental care evolve after the evolution of monogamy

Fig. 2. Evolutionary pathway to monogamy and singular cooperative breeding in mammals. In mammals, social monogamy derives from ancestral social systems in which females are solitary and male ranges overlap those of several females. Social monogamy appears to have evolved in species where females rely on high-quality, low-density diets; breeding females are intolerant of each other; and female density is low, preventing breeding males from guarding more than one breeding female. In some monogamous lineages where females are polytocous and habitats are unpredictable, systems where one female monopolizes breeding and her young are raised by other group members who are typically close relatives that have not yet left their natal group have evolved (*29*). [Photo credits: red squirrel (*33*), numbat (*34*), cheetah (*35*), armadillo (*36*), dik-diks (*37*), night monkeys (*38*), small-clawed otters (*39*), elephant shrew (*40*), naked mole rats (*41*), wolves (*42*), golden lion tamarins (*43*), beavers (*44*). All photos made available under Creative Commons attribution licenses.]

Lukas and Clutton-Brock 2013

Callitrichidae



- **Breeding female:** tends to control breeding
  death results in instability
- **Mates:** mutually tolerant, dominance undetectable
  M approach F > F approach M
- **Males:** need not be kin
  mutually tolerant → No fights / groom
  equally close to female (% time) / no fighting over copulations

Benefit of shared helping promotes high male tolerance in Callitrichidae

Overview

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2. Are humans cooperative breeder?
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4. Grandmother hypothesis

Humans as cooperative breeders

What is evidence presented in pre-lecture movie?

Humans as cooperative breeders

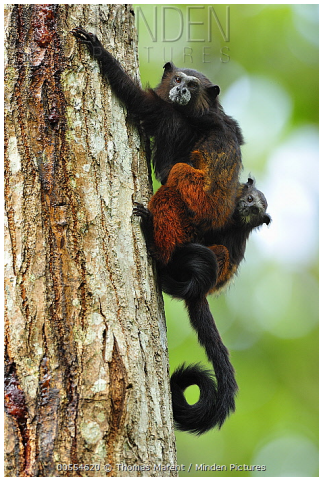
Humans

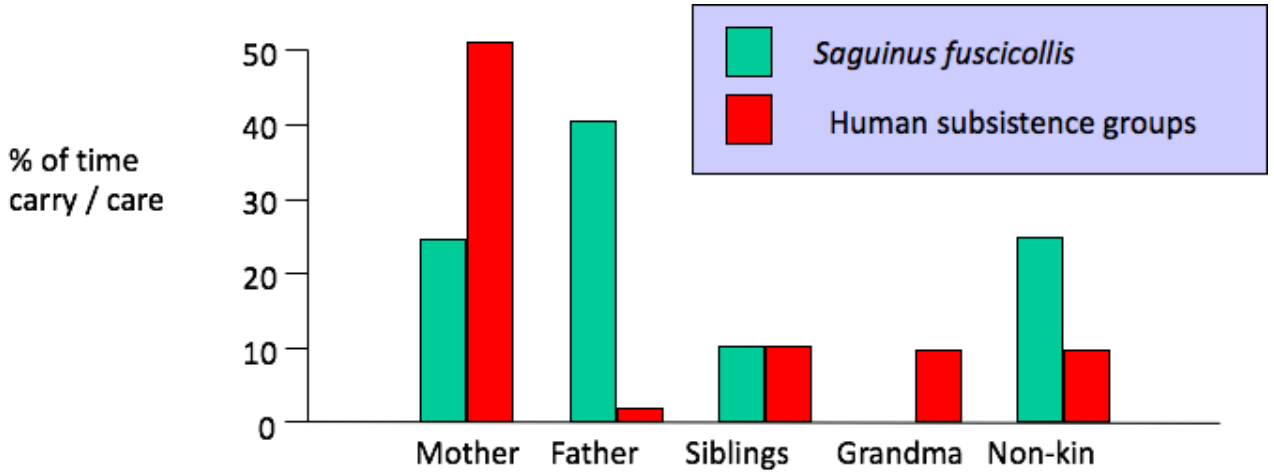
- Babies are held by non-mothers between 25% (Kung!) and 80% (Efe) of the time
- Allo-nursing exists in 87% of small-scale societies
- Mothers nervous about infant well-being, but happy to let others hold infant

Other great apes

- Babies hardly ever carried by non-mothers
- No allo-nursing among great apes
- Non-mothers interested/affiliative towards infants, but mothers often won't give up infant

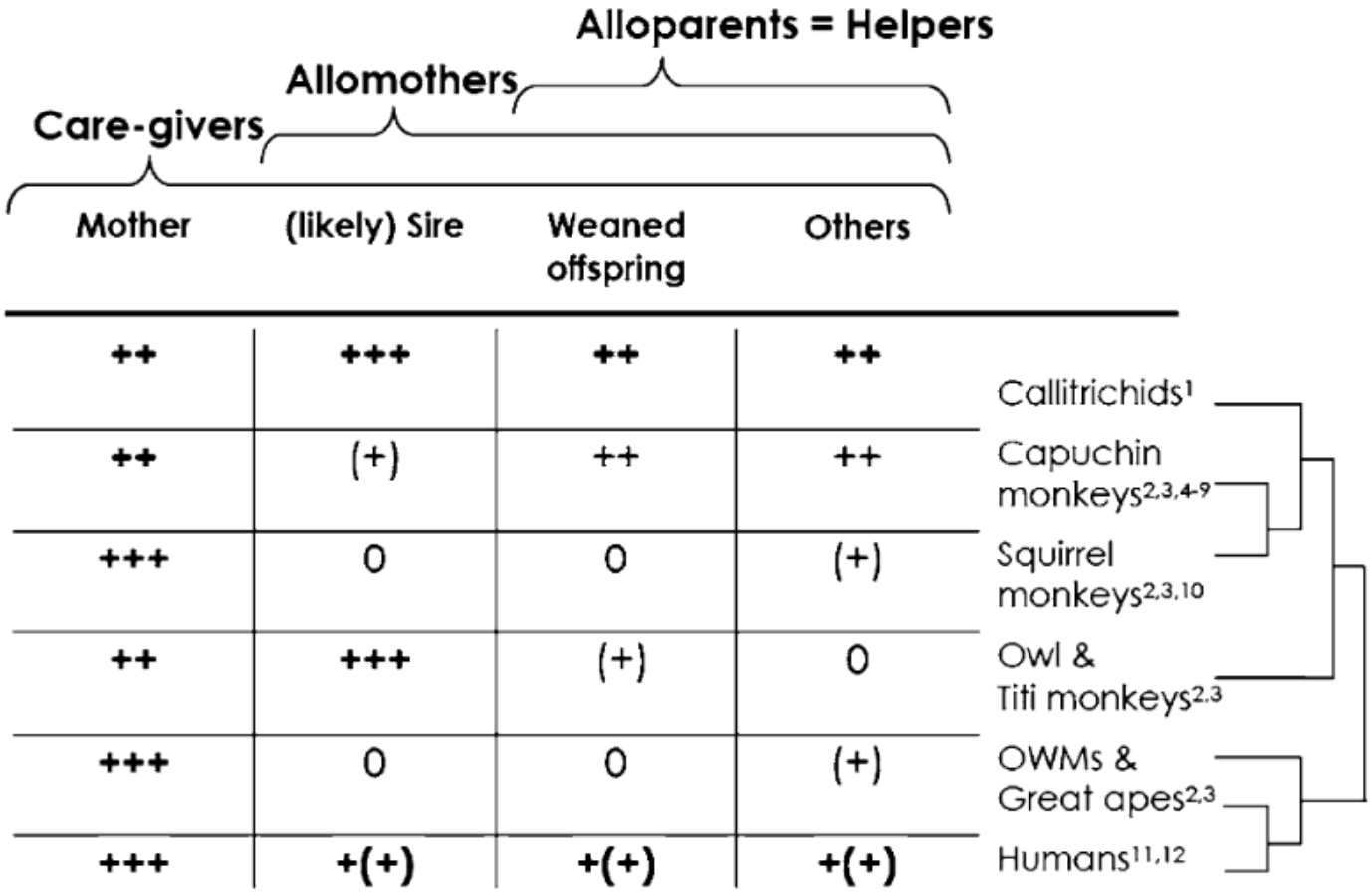
Humans as cooperative breeders





Data from Goldizen, Kramer

Humans as cooperative breeders



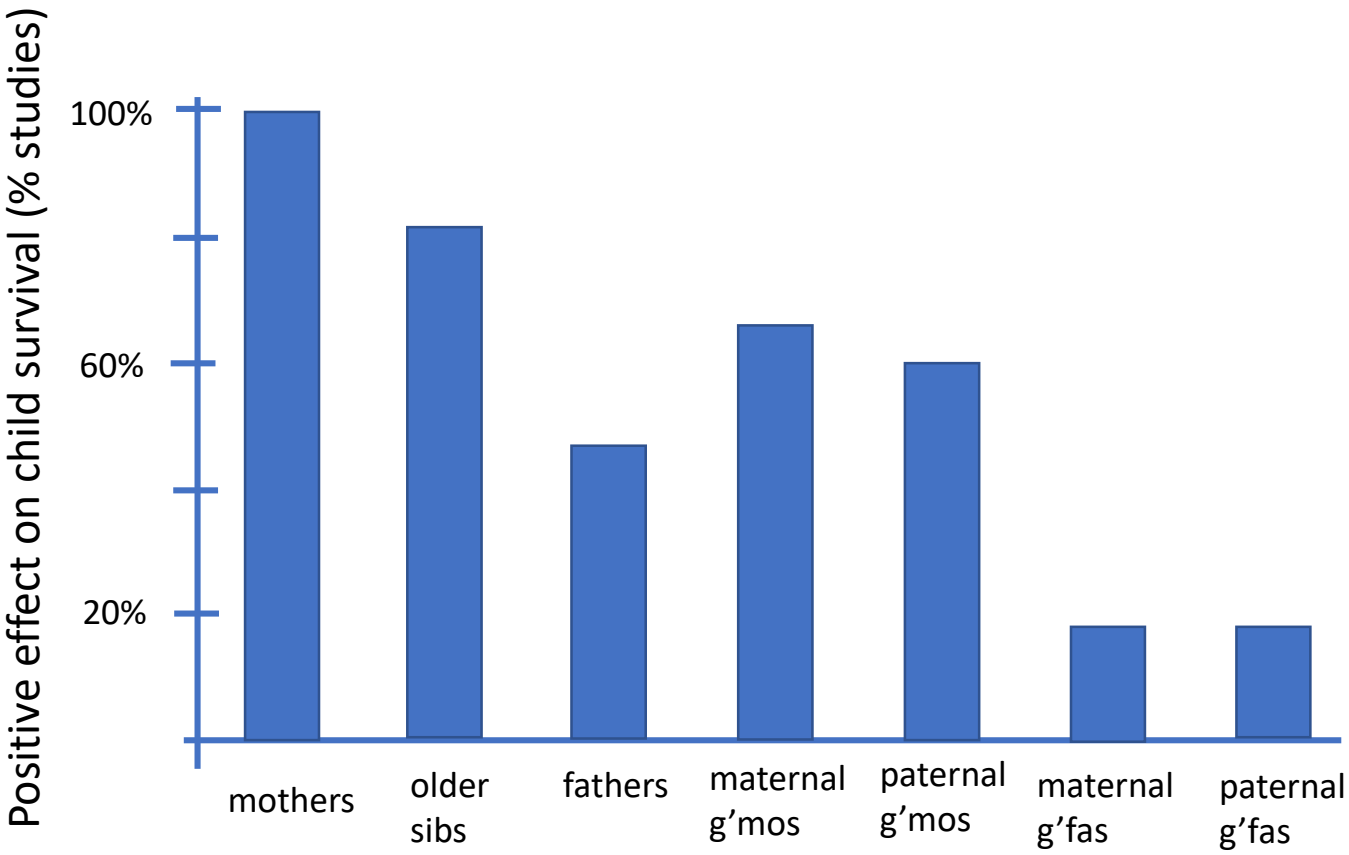
Humans as cooperative breeders

What is evidence presented in pre-lecture movie?

Is there evidence that humans are cooperative breeders in life history parameter?

Humans as cooperative breeders

Is there evidence for beneficial allo-parental care?



Sear and Mace 2008

Humans as cooperative breeders

Is there evidence for beneficial allo-parental care?

Great Ape Species	Maximum Lifespan (Years)	Age at First Birth (Years)	Adult Female Weight (kg)	Gestation Length (Days)	Neonate Weight (kg)	Neonate as a % of Maternal Weight	Age at Weaning (Years)	Interbirth Interval (Years)	Age at Last Birth (Years)
Orangutan (*Pongo pygmaeus* and *P. abelii*)	58.7[a]	15.6[d]	36.0[i]	260[m]	1.56 (1.31–1.81)[o]	4.3%	7.0[e]	8.05[d]	>41[d]
Gorilla (*Gorilla gorilla*)	54.0[a]	10.0[e]	84.5 (71–98)[j]	255[m]	1.95 (1.6–2.3)[o]	2.3%	2.8[e]	4.40[e]	–
Bonobo (*Pan paniscus*)	50.0+[b]	14.2[f]	33.0 (27–39)[j]	244[n]	1.38 (1.30–1.45)[o]	4.2%	–	6.25[r]	–
Chimpanzee (*Pan troglodytes*)	53.4[a]	13.3[g]	35.0 (25–45)[j]	225[m]	1.90 (1.4–2.4)[o]	5.4%	4.5[e]	5.46[s]	42[u]
Human (*Homo sapiens*)	85.0[c]	19.5[h]	47.0 (38–56)[k]	270[m]	3.00 (2.4–3.6)[p]	5.9% [q]	2.8[e]	3.69[t]	45[v]

a) How do humans differ from the other great apes
b) Could these differences be interpreted as evidence for cooperative breeding

Humans as cooperative breeders

Is there evidence for beneficial allo-parental care?

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A. Long life

B. Slow maturation

C. Short inter birth interval

D. Early weaning

Combination of A+C and B+D suggests mother alone cannot care for infant

Humans as cooperative breeders

Is there evidence for beneficial allo-parental care?

Infant abandonment

- Humans more sensitive to infant defects and level of support; occasionally abandon/kill own infants
- 1/100 Hadza babies abandoned
- Humans, Tamarins, Marmosets are only primates that abandon infants!

Humans as cooperative breeders

Is there evidence for beneficial allo-parental care?

Gambia

- Study carried out from 1950s-1980s
- 883/2294 children died before age 5
- Presence of an older sister or menopausal grandma reduced pre-5 mortality from 40% to 20%

Ifaluk Atoll

- Couples whose first-born child is daughter produce more surviving offspring than couples with first-born sons

Humans as cooperative breeders

Allo-parental care is beneficial in humans

…..we are “evolved to rear children as part of an extended family enterprise.”

Sear and Mace 2008

There is one large armada of non-breeding group of alloparents …

Humans as cooperative breeders

Allo-parental care is benefitial in humans

There is an armada of non-breeding group of alloparents …

Overview

1. What is “cooperative breeding”?
2. Are humans cooperative breeder?
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4. Grandmother hypothesis

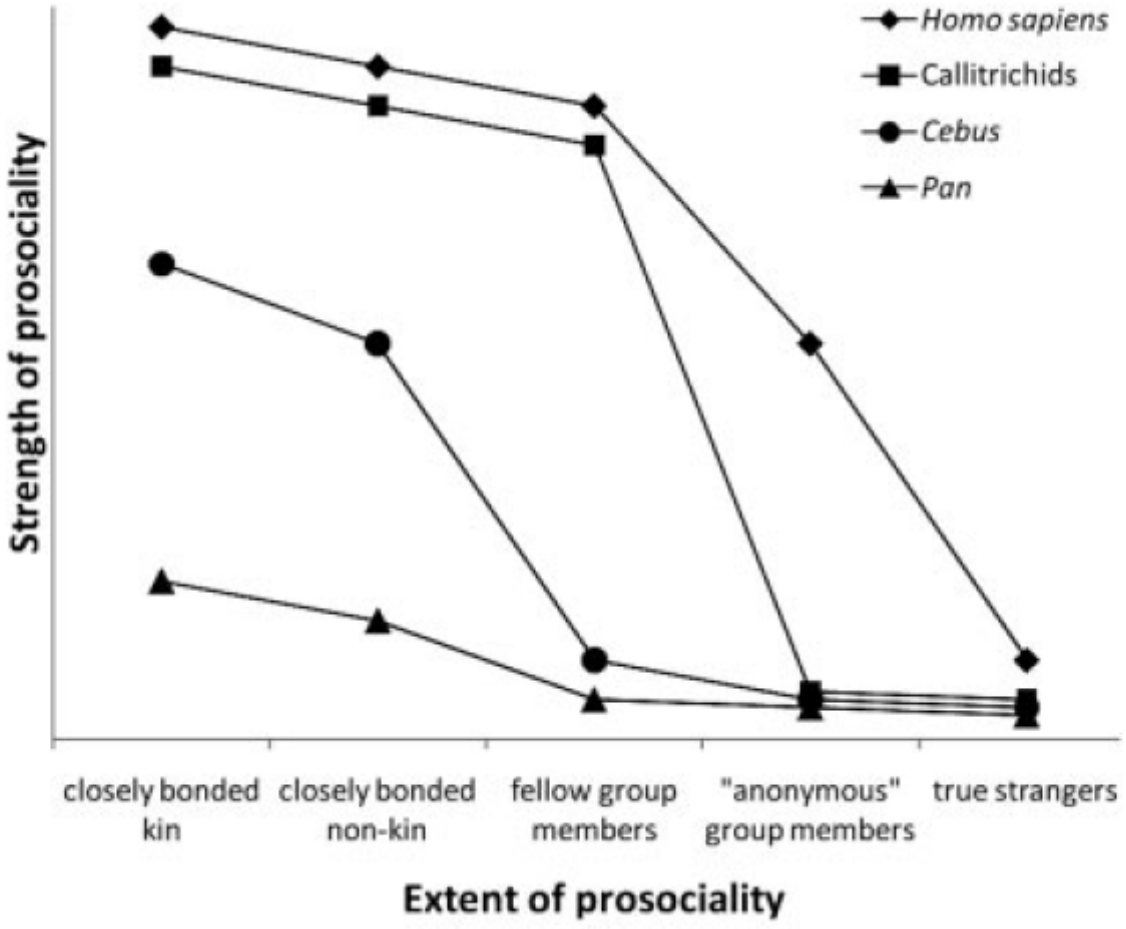
Cooperative breeding hypothesis

Proposes a link between cooperative breeding and other human traits that set us apart from the apes

Cooperative breeding hypothesis

Proposes a link between cooperative breeding and other human traits that set us apart from the apes

Cooperative breeding hypothesis



Burkhard et al 2010

Cooperative breeding hypothesis

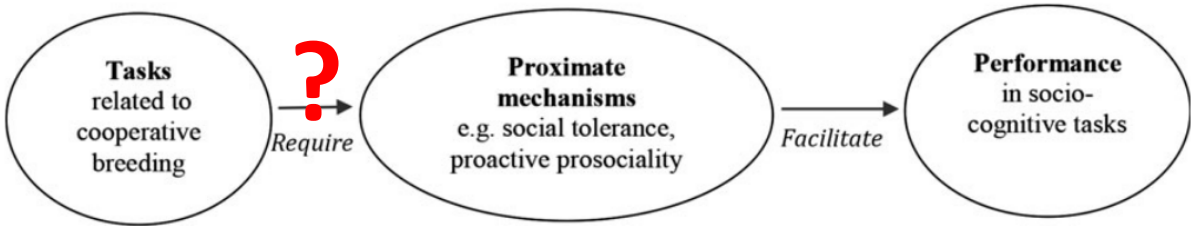
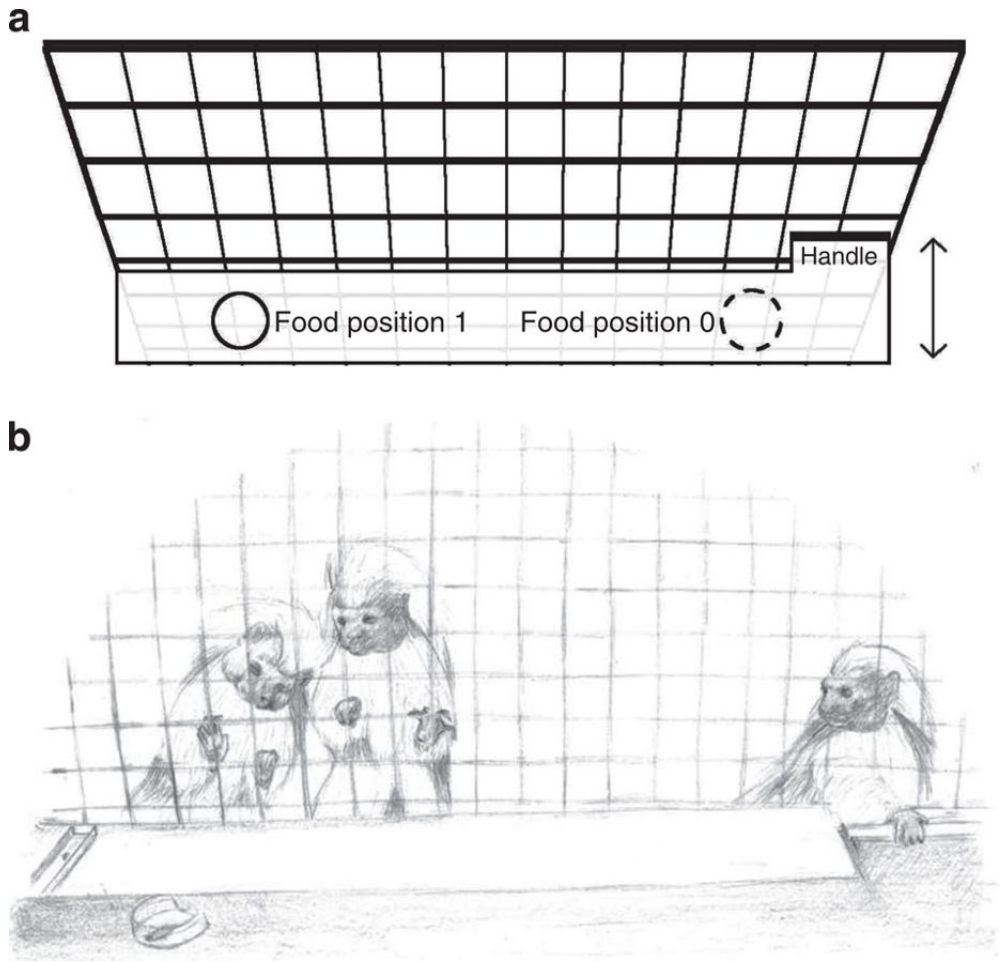


Figure 1 The hypothesized pathway for a link between cooperative breeding and socio-cognitive performance. The cooperative breeding hypothesis predicts that cooperative breeding – or extensive allomaternal care – is associated with a set of proximate mechanisms necessary to support and enable allomaternal behaviours. At the same time, these proximate mechanisms facilitate performance (but not necessarily ability) in a variety of socio-cognitive tasks. For instance cooperatively breeding primates show increased levels of social tolerance, which is necessary to ensure smooth infant transfers in the canopy At the same time, however, social tolerance also facilitates performance in social learning tasks (see text).

Cooperative breeding and prosociality

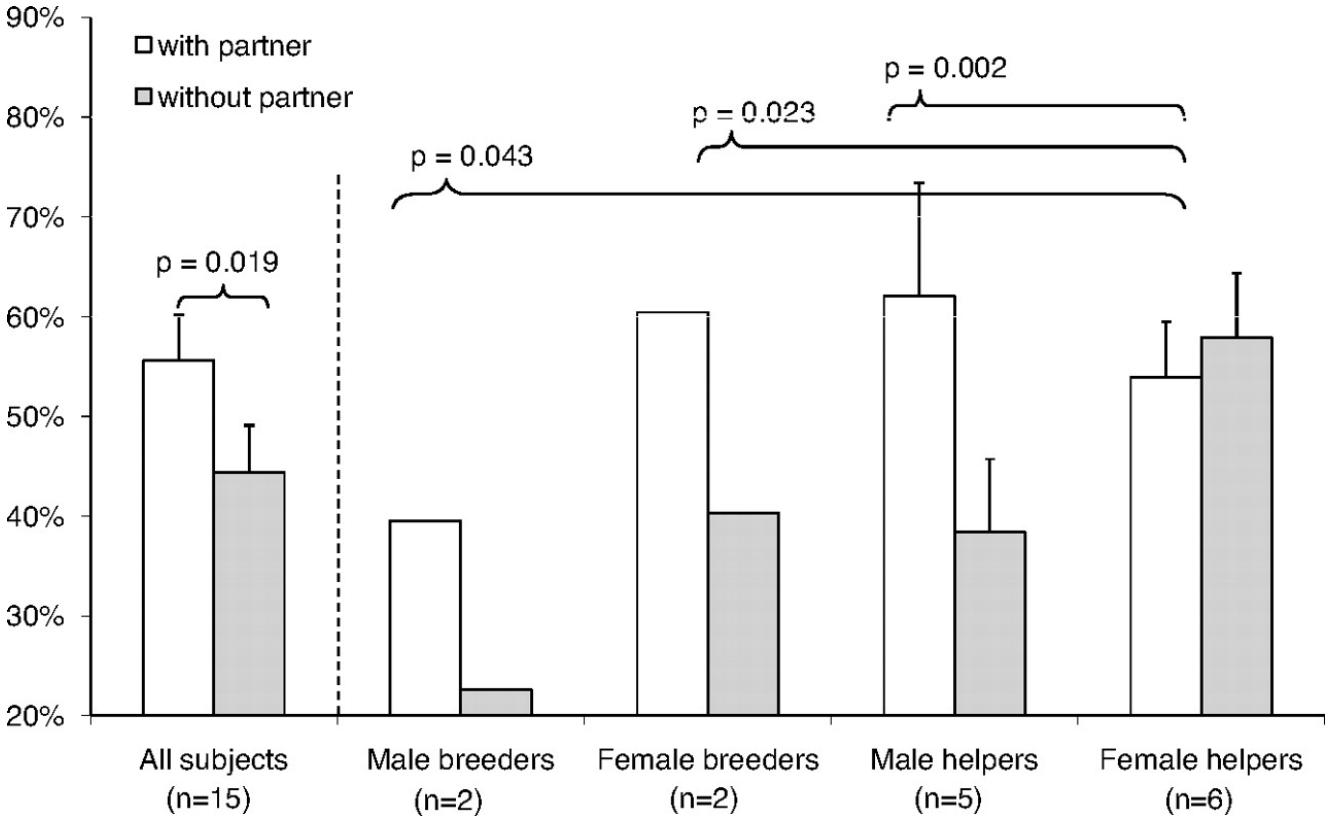
- **Prediction:** Active food sharing across dyads reflects a proximate mechanism of generalized prosociality

Cooperative breeding and prosociality



Cooperative breeding and prosociality

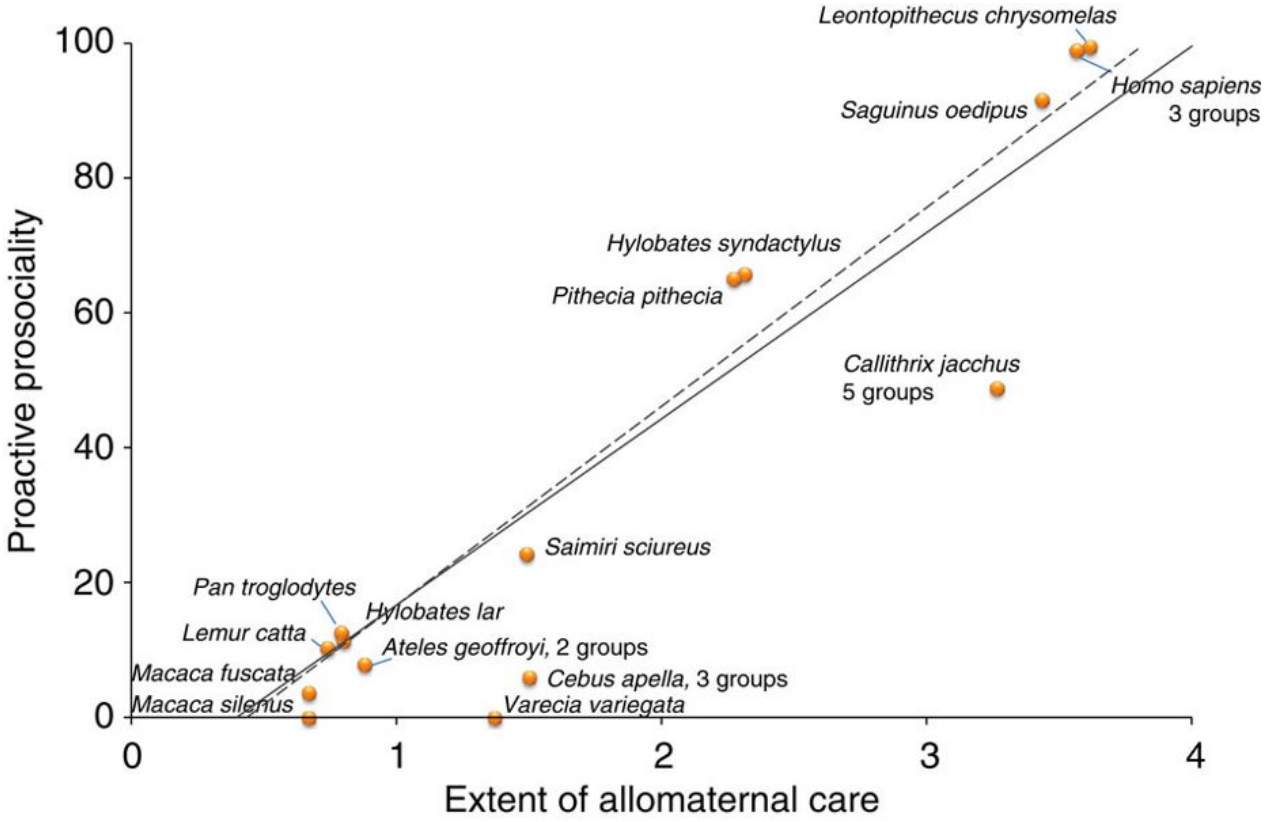
- **Prediction:** Active food sharing across dyads reflects a proximate mechanism of generalized prosociality
- **Result 1:** Marmosets show evidence for prosocial bias in 0/1 vs 0/0 task



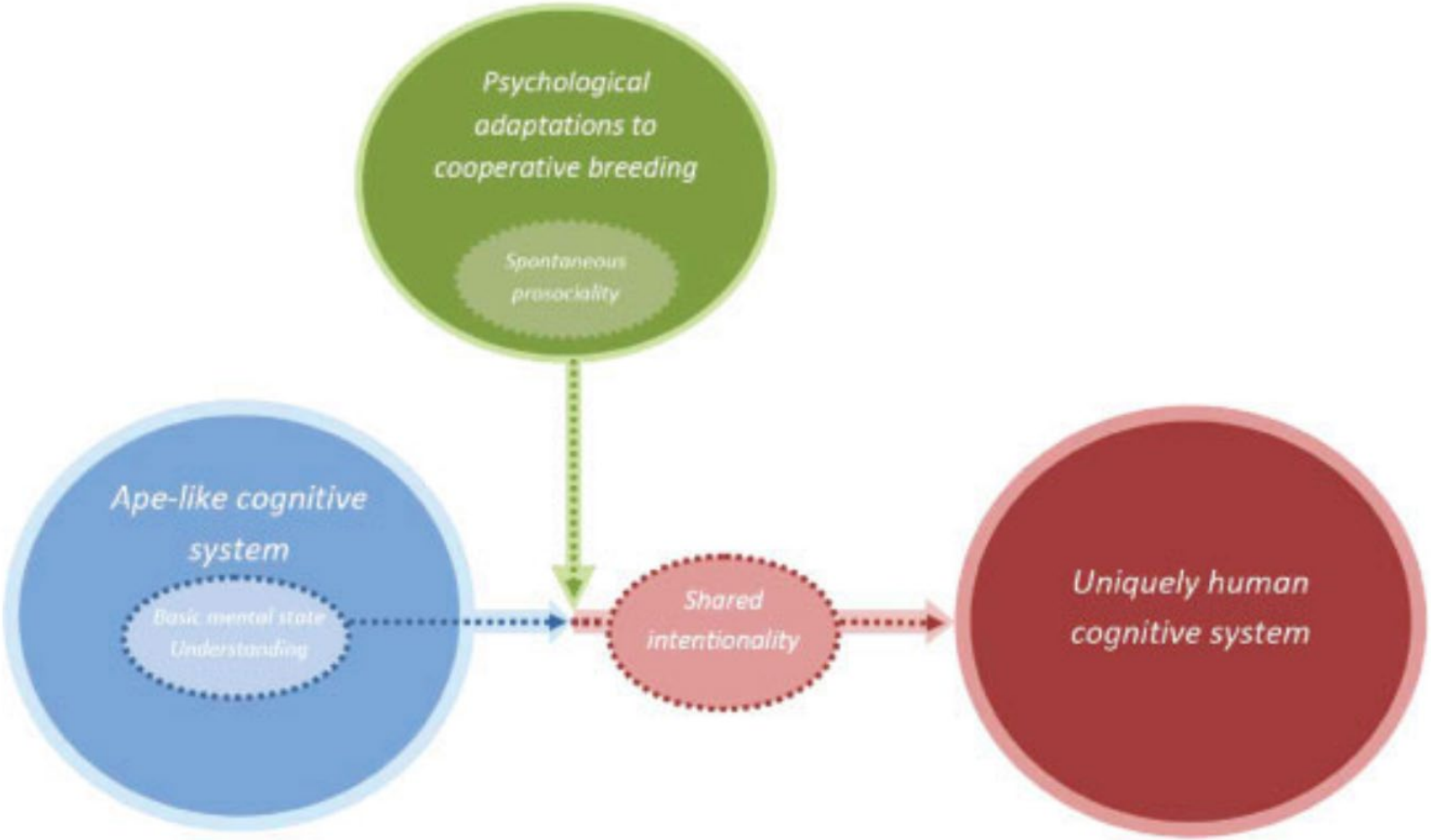
Burkhard et al 2007

Cooperative breeding and prosociality

- **Prediction:** Active food sharing across dyads reflects a proximate mechanism of generalized prosociality
- **Result 2:** Across primates, extent of allomaternal care predicts performance on prosocial task



Cooperative breeding hypothesis



Lack of pro sociality in great apes? (https://www.youtube.com/watch?v=PaO30btWDRo)

Lack of pro sociality in great apes?

Table 3

Paternal-like behavior observed during an adoption by adult males (with the maternal investment as reference).

Name of the pair	Share Night nest	Share Food	Carry Dorsally	Wait for Infant	Support Infant	Search for Infant
Mother/infant	+	+	+	+	+	+
Brutus/Ali	-	+	-	+	+	+
Brutus/Tarzan	-	+	-	+	+	+
Ulysse/Brando	-	+	-	-	+/–	+
Fredy/Yayo	?	?	+	+	+	-
Fredy/Carim	+	?	+	+	+	-
Porthos/Gia	-	+	+	+	+	+
Fredy/Victor	+	+	+	+	+	+

Boesch et al 2010

Overview

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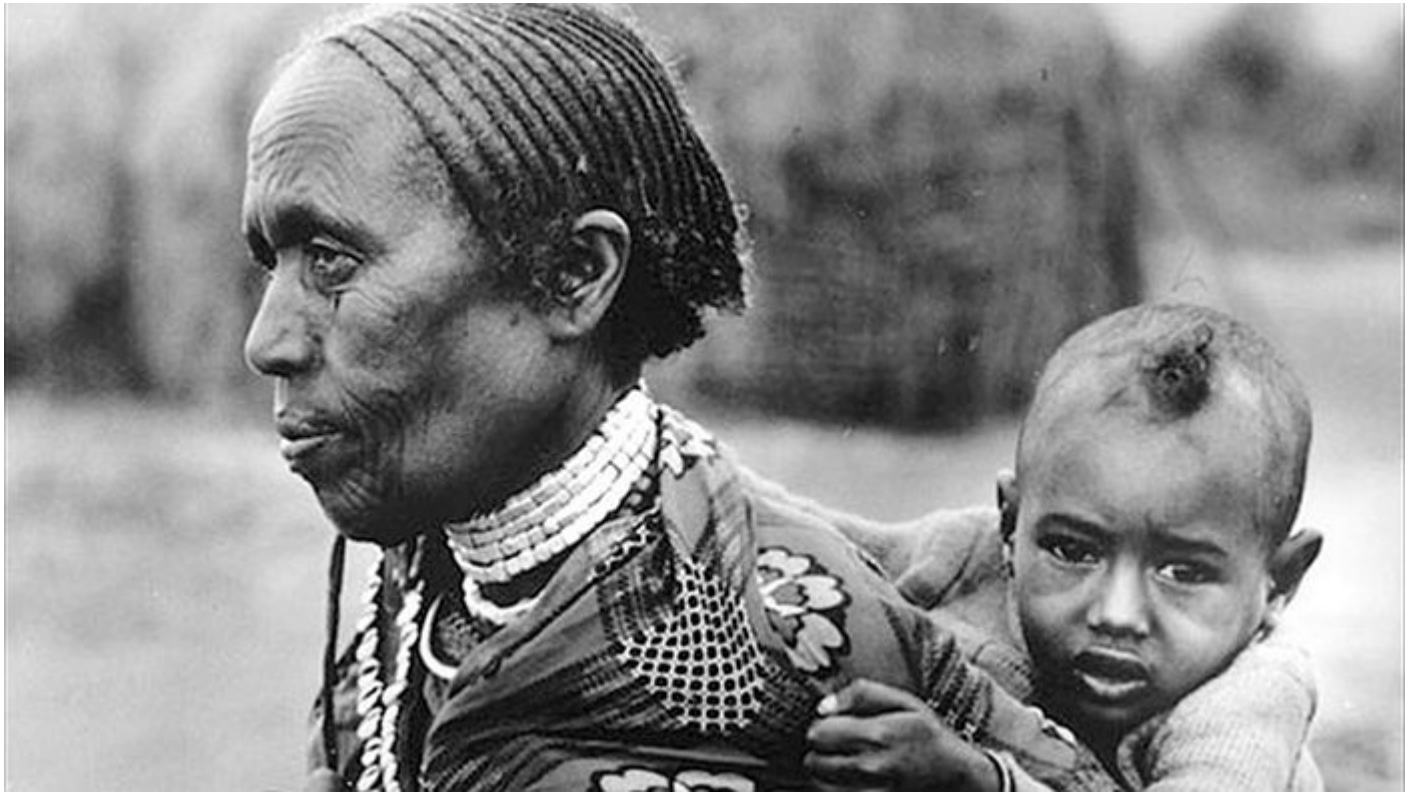
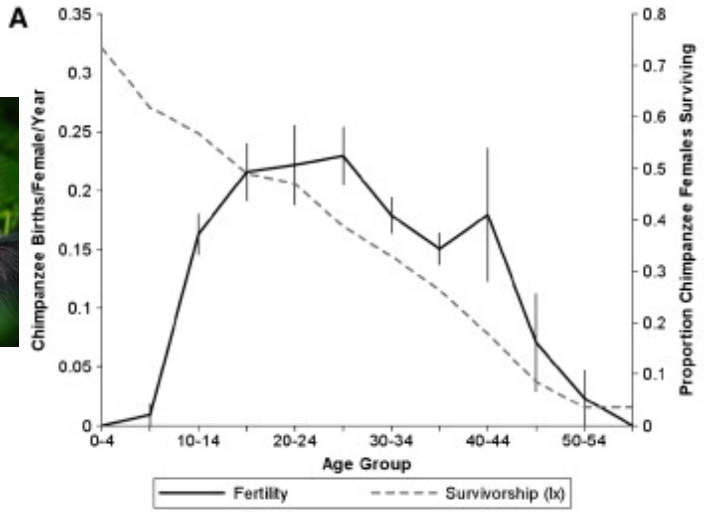
The Grandmother hypotheses

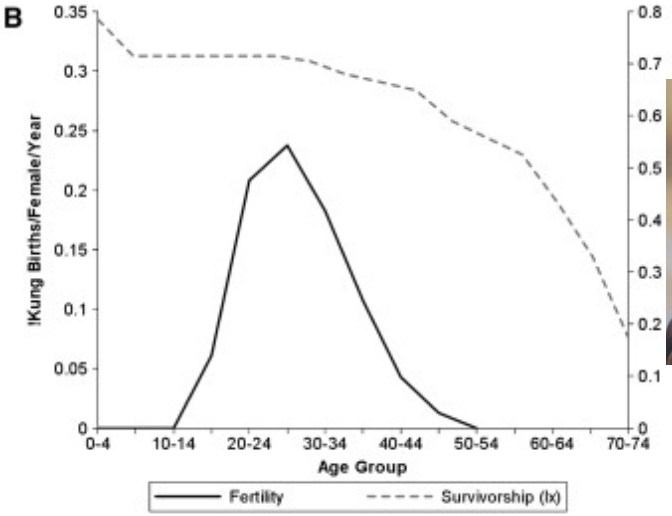
The Grandmother Hypothesis proposes that grandmaternal investment played an important role in the evolution of menopause, lengthened the postmenopausal lifespan, and tightened the interbirth intervals of women compared with other primates.

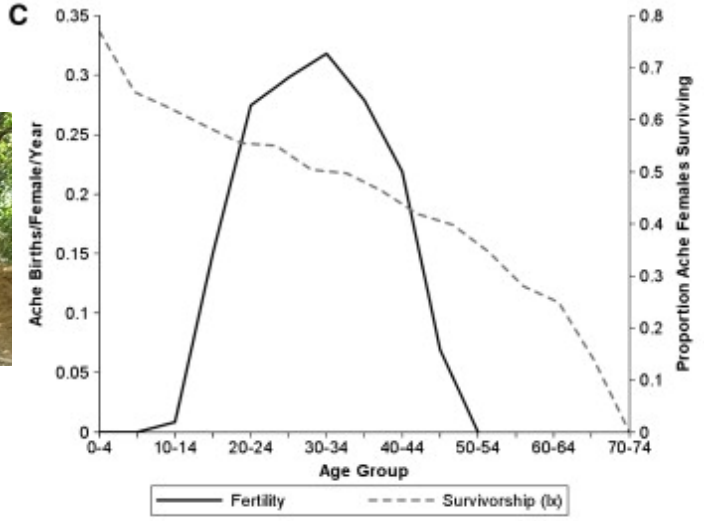


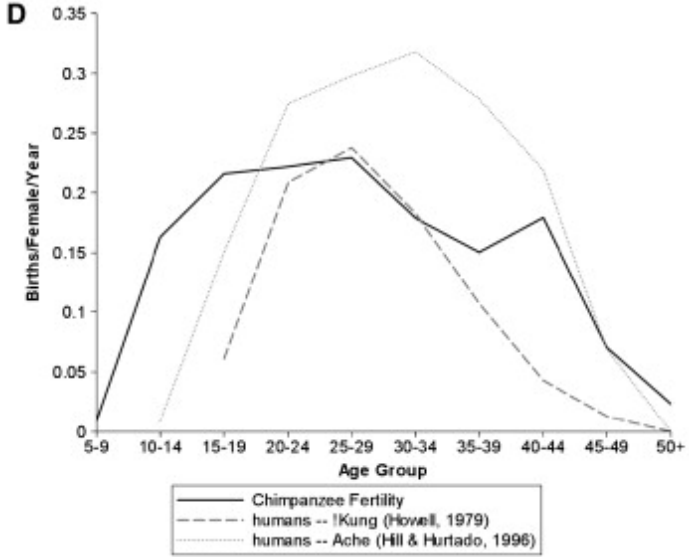
Hawkes et al 1998

The Grandmother hypotheses







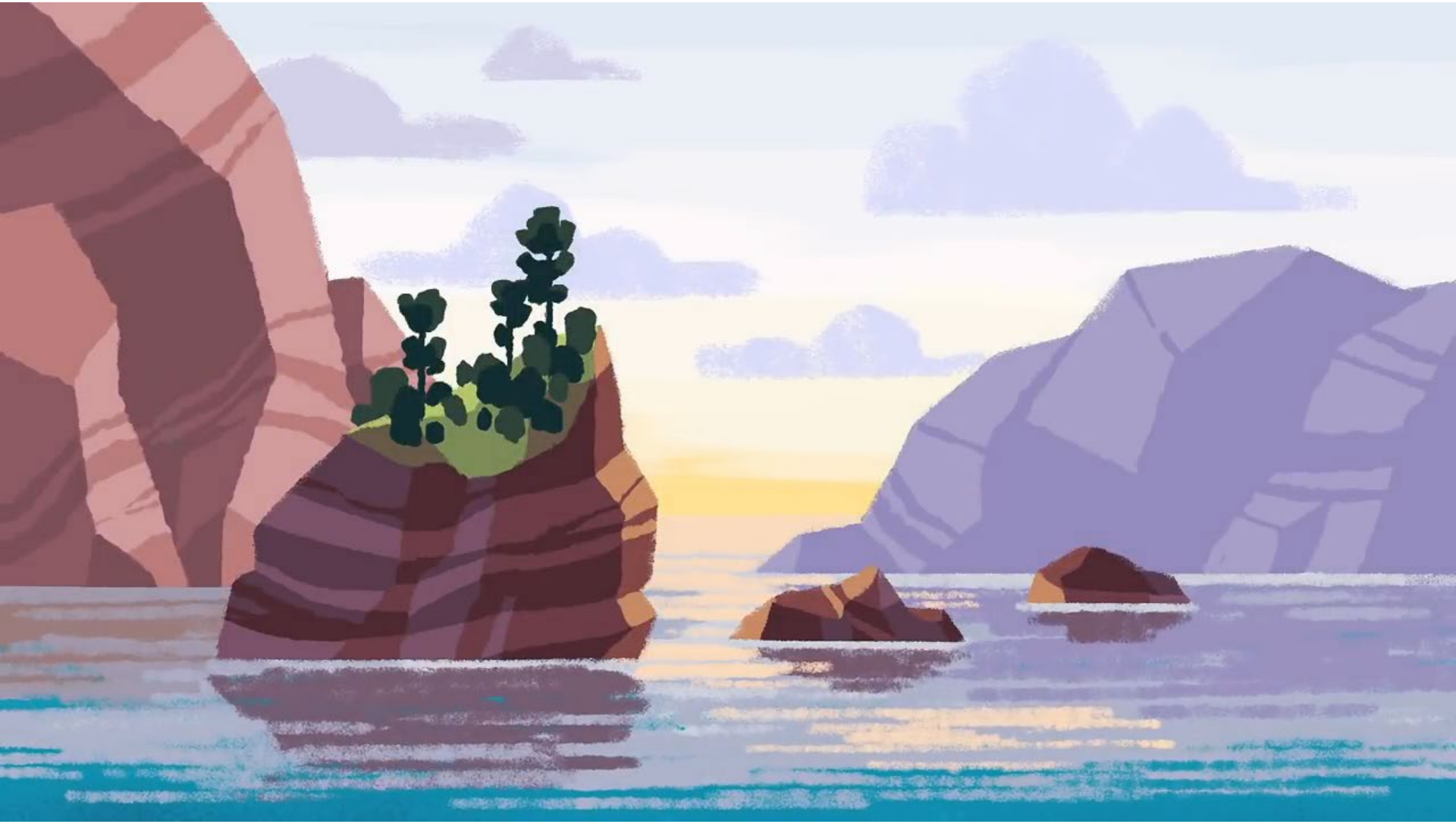


Emery Thompson et al. 2007

- What would be an alternative hypothesis for prolonged lifespan in human females(Orca)?

Alternatives to the Grandmother hypotheses

(https://www.youtube.com/watch?v=sQpGT1BgdX4)



Alternatives to the Grandmother hypotheses

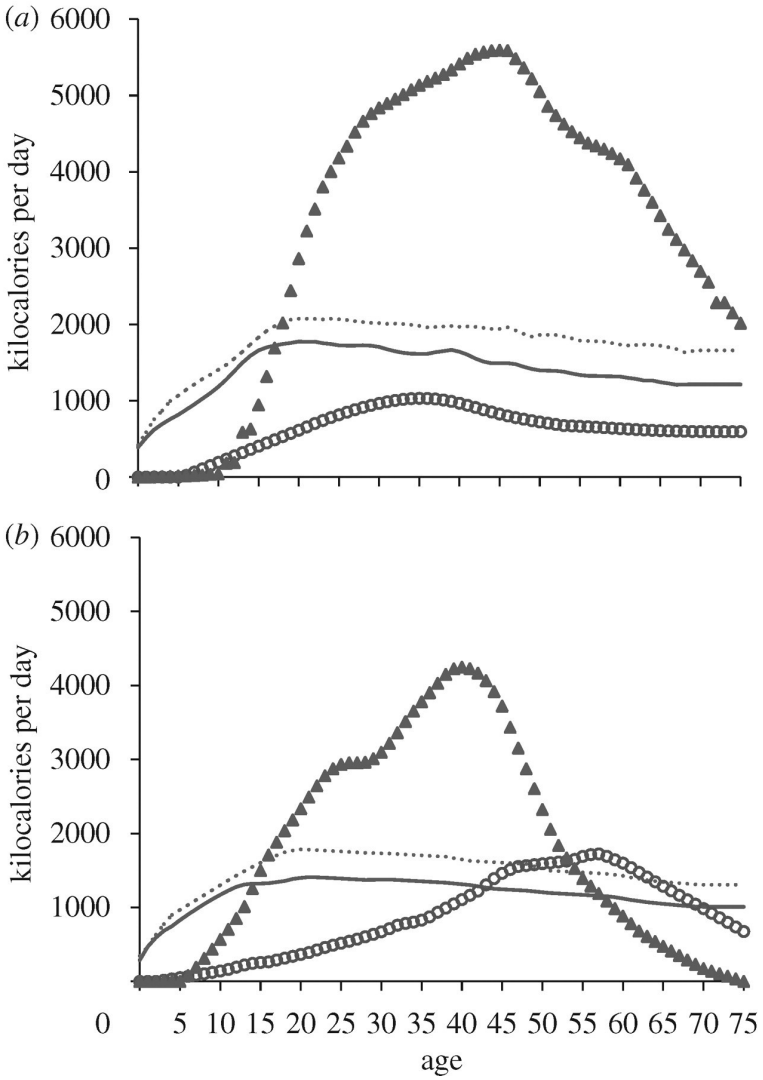
Our analysis thus implies that females of most social mammalian species will experience a decline in local relatedness with age, but that the two unusual and very different social arrangements that characterize menopausal species (respectively, **female-biased dispersal and local mating** in ancestral humans, and **philopatry of both sexes combined with extra-group mating** in pilot and resident killer whales) both give rise to **an increase in local relatedness with female age**.

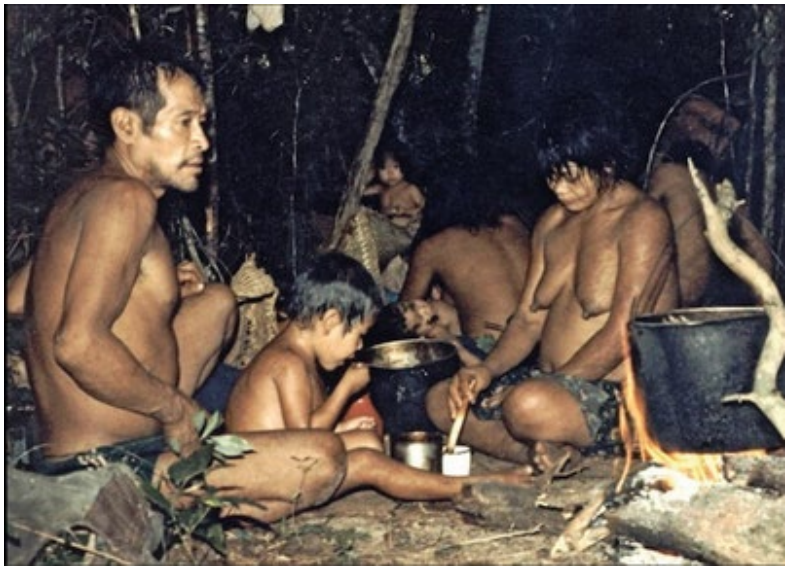
Johnstone & Cant 2010

Overview

1. What is “cooperative breeding”?
2. Are humans cooperative breeder?
3. Cooperative breeding hypothesis
4. Grandmother hypothesis

Alternatives to the Grandmother hypotheses





Hill Hurtado 2009