From Experiential-Based to Relational-Based Forms of Social Organization
A Major Transition in the Evolution of Homo sapiens

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Introduction

• Part 1: A cognitive constraint in the evolution of primate social systems
  – Compare starting point (monkey societies) and ending point (human societies).
  – Contrast in social organization
    • Monkey societies: emergent social structure
    • Human societies: constructed social structure
  – Chimpanzees: Cognitive barrier due to individualization
Introduction (cont’d)

• Part 2: Overcoming the constraint
  – Four types of behavior: asocial, action/reaction, interaction, social interaction, relationship to forms of social organization
  – Theory of Mind and the concept of a relation leads to …
  – … a reciprocal relation system that provides the basis for symmetric social interaction, but has a …
  – … coordination problem: symmetric social interaction dependent upon mutual sharing of reciprocal relation concepts
  – Coordination problem was solved by culturally constructed kinship systems expressed through kinship terminology systems

• Conclusions
Part 1: A cognitive constraint in the evolution of primate social systems
Old World Monkeys/Hunter-gatherer Reference Points

Time

OW monkeys

Hunter-gatherers
Female Dominance Hierarchy

“Social groups of Old World monkeys such as baboons, macaques, and vervets are composed of … matrilines arranged in a stable, linear dominance hierarchy in which all female members of one matriline outrank or are outranked by all female members of another” (Bergman et al. 2003:1234)

“during the 10 years … there were no changes in the adult female dominance hierarchy other than those caused by recruitment and mortality” (Bergman et al. 2003:1233)
Rule for Hierarchy

Rule: Offspring enters between mother and next lower female.
Hierarchy and Grooming

Rhesus Monkeys: Grooming in mother/daughter and sister/sister dyads occurs 16 times more often than in other dyads (from Lindburg 1973: Table 1).

Blue Monkeys: “juvenile females groomed related adult females 10 times more than males did” (Ekernas and Cordes 2007:1014)
"Uniform nature … of cercopithecoid social organization…” (Di Fiori and Rendall 1994:9944)

**Genetic Information/Kin selection**

**Social Unit: troop**

**Social Structure**
- *Within troop*
  - Face-to-face interaction
  - Female/offspring (parenting, grooming)
- *Between troops*
  - Boundary maintenance through aggression

**Emergent Organization**
- Stable dominance hierarchy
H-G Social Social Organization

Residence Group

Family

Hunting/Gathering Society

Residence Group
“People in every society have something like our concept of a "family" or "extended family, meaning a set of actual individuals they consider to be relations. They also have a set of shared ideas and symbols (kin terms) that define such relations and enable them to trace out, recognize, and signify their mutual connections reciprocally. ” (Leaf and Read forthcoming, emphasis added)
Hunter-gatherer Residence Group Structures

cousin marriage
(most women marry out)

Netsilik Inuit residence group:
father/son links

!Kung san residence group:
Sibling/spouse links

Lee 1972
!Kung san Terminology

Structure 1

- 'in-law' terms
  - #tum
  - otsu
  - !kwa ('husband')
  - tsiu ('wife')

Family terms

- Name giver/Name receiver
- tsu
- ba ('father')
- tai ('mother')
- !ha ('son')
- #hai ('daughter')
- otsu

Structure 2

- Male terms
  - tun!ga (ws) → !ku!na (ms)
  - Male self, Female Self
  - tsin ('younger sibling')
  - [reciprocal terms: !ko ('older brother'), !kwi ('older sister')]

- Female terms
  - !ku!na (ms) → tun (ms)
  - ms = man speaking
  - ws = woman speaking

Legend:

- 'parent'
- 'child'
- 'sibling'
- 'spouse'

ws = woman speaking
Kariera Terminology

Male speaker

Female speaker

Kariéra (hunter-gatherer group)
Terminology Structure to Residence
Group Structure

Structure 2

Male terms

Female terms

<table>
<thead>
<tr>
<th>Term</th>
<th>Meaning</th>
</tr>
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<tbody>
<tr>
<td>!ga</td>
<td>husband</td>
</tr>
<tr>
<td>!na</td>
<td>wife</td>
</tr>
<tr>
<td>tsu</td>
<td>sister</td>
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Family terms

<table>
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<tbody>
<tr>
<td>ba</td>
<td>father</td>
</tr>
<tr>
<td>tai</td>
<td>mother</td>
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</table>

Male self, Female self

<table>
<thead>
<tr>
<th>Term</th>
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<tr>
<td>!ko</td>
<td>older brother</td>
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<tr>
<td>!kwi</td>
<td>older sister</td>
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Name giver/Name receiver

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<td>!kwa</td>
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Lee 1972
Terminology Structure to Social Structure

**Parent/Child**

- Maeli = Kabali
- Mama = Nganga
- Kaja = Nuba
- Margara = Kumbali
- Mainga = Kundal

**Marriage**

- Maeli, Kandari, Kaga, Margara, Mari [ego]
- Tami, Kabali, Turdu, Nuba

- Kaga, Nganga, Kuling (ms), Nagaraia (ms), Kundal (fs), Mainga (fs)
- Mama, Toa, Yuro (fs), Mainga (ms), Kundal (ms), Nagaraia (fs)

**Banaka** = Burung

**Palyeri** = Karimera

Kariera 4 Section system

"Sibling" of ____ = "Spouse" of ____
"Son" of ____  = "Daughter" of ____
"Father" of ____  = "Mother" of ____
Change in Social Organization

Asocial females with a solitary form of social organization, female dispersal from natal community at puberty (Garneus et al. 1999)

Males form temporary subgroups, have unstable male dominance hierarchies (Garneus et al. 1999, Muller and Mitani 2005)

Extensive grooming by adult males, used to alleviate tensions when a subgroup reforms (Bauer 1979, Goodale 1986)

Highly aggressive and violent community territorial defense by males, including intercommunity killings (Nishida and Hiraiwa-Hasegawa 1987)

Genetic Information/Kin selection
Social Unit: troop
Social Structure
Within troop
   face-to-face interaction
   female parenting, grooming
Between troops
   boundary maintenance
Emergent Organization
dominance hierarchy
“Uniform nature … of cercopithecoid social organization…” (Di Fiori and Rendall 1994:9944)

Cultural Information
Social Unit: Residence Group
Social Structure
   Within residence group
      Family (marriage)
      Rules for membership
   Between residence groups
      Integrated by kin relations
Constructed Organization
   Kinship terminology system
Emergent Organization
   Societal boundary via mutual kin recognition

Great apes

Pongo: Solitary individuals
Gorilla: Single male harem
Pan troglodytes

OW monkeys

???

Cultural Information
Social Unit: Residence Group
Social Structure
   Within residence group
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   Kinship terminology system
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   Societal boundary via mutual kin recognition
Individuality, N, and Social Complexity

**Lemur catta**

“ring-tailed lemurs express only minor behavioral differences between individuals …no extensive differences among individuals as would be seen among anthropoid primates” (Boyd 2000:39, emphasis added)

N = ~1


**OW monkeys**

![Diagram of OW monkeys matriline]

N = ~5

1-2 distinct FI-other pairs

5-6 distinct FI-other pairs


**Great Apes (chimpanzee)**

“The orangutan, gorilla and chimpanzee especially resemble man in this individualization of behavior” (Yerkes 1927:192)

“And perhaps the most intriguing finding is the selection for high individuality, since apes are rather self-contained individuals with few strong tie networks” (Maryanski and Turner 1992:30, emphasis added)

N = ~10 (males)

Males only: 9 distinct FI-other pairs + 36 FI-dyad pairs = 45 pairs

Group Size = 20: N = ~1

troop

1-2 distinct FI-other pairs

5-6 distinct FI-other pairs

Focal Individual (FI)
Cognitive Limit

Number of behaviorally different individuals

Number of different relations = cognitive complexity

Cognitive limit

$N_l$
Socially Coherent Group Size

Number of individual behaviors

Size social group

$N_i$ $N_S$ $Pan$ $Colobus$ $Lemur catta$
## Cercopithecoids (Old World Monkeys)

<table>
<thead>
<tr>
<th>Grooming</th>
<th>Occurs primarily between biologically related individuals, especially mothers and offspring (Gouzoules and Gouzoules 1987)</th>
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<tbody>
<tr>
<td>Social Structure</td>
<td>Stable groups around 30 – 50 individuals</td>
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<td></td>
<td>aggregates of up to 200 (Kummer 1968; Crook 1966; Dunbar and Dunbar 1975; Sharman 1981)</td>
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<tr>
<td></td>
<td>most males transfer from natal group to neighboring groups (Pusey and Packer 1987)</td>
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<td></td>
<td>stable female dominance hierarchy</td>
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</table>
### Pan Troglodytes (Chimpanzee)

| **Grooming** | **Mainly male-male grooming:** 59% male-male versus 13% female-female adult grooming (Table 7, Nishida 1979)  
Grooming occurs in reunions of male groups, with grooming directed towards newcomers to the group (Bauer 1979) |
| **Social Structure** | **Community** – shares single home range, consists of 20 – 100 individuals but made up of small, unstable male groups (< 6 for *Pan*)  
Community fissioning occurs when there are around 19-20 males  
Females transfer from natal group  
Unstable male dominance hierarchies (Nishida and Hiraiwa-Hasegawa 1987) |
Grooming versus Group Size

Chimpanzee grooming rate twice *Piliocolobus* grooming rate

Female dispersal or fission-fusion $\Rightarrow$ probability of interacting with non-familiar individuals increases with group size

Figures from Lehmann et al. 2007
# Trend, Neocortex Ratio

<table>
<thead>
<tr>
<th>Neocortex ratio</th>
<th><em>Lemur catta</em></th>
<th>Female philopatric, arboreal</th>
<th>Female philopatric, terrestrial</th>
<th><em>Pan</em></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1.18</td>
<td>$\bar{x} = 2.27$, $n = 3$ species</td>
<td>$\bar{x} = 2.63$, $n = 6$ species</td>
<td><em>troglodytes</em>: 3.22, <em>paniscus</em>: 3.22</td>
</tr>
</tbody>
</table>
Cognitive Constraint: Implications

Anthropoids  
(Monkeys and Great Apes)  

Genotype Transmission  
(inclusive fitness, biological kin selection, sexual selection)  

Trend  
Increasing individualization  

Phenotype Transmission  
(imitation, learning)  

Consequence  
Smaller social units, less integrated groups  

Social Integration  
Face-to-face interaction  
Emergent Social Organization  

Homo  
(ancestral, modern)  

Cultural kin relation system  
Social roles and behavior  

Culture Transmission  
(enculturation)  

Trend  
Larger, integrated groups  

Social Integration  
Relation system  
Constructed Social Organization  

“less cohesive, less stable grouping patterns … resulting in group fission”  
(Lehmann et al. 2007)
Part 2: Overcoming the Constraint
Prior and Post Behavior

Prior Behavior

Individual $i$
Behavior $b_i$

Post Behavior

Individual $j$
Behavior $b_j$

Time
Asocial Behavior

Prior behavior: Probability, $Pr(b_i)$, for behavior $b_i$ by individual $I_i$ depends only on the behavior, $b_i$.

Post behavior: Conditional probability for behavior $b_j$ by individual $I_j$ given prior behavior $b_j$ by individual $I_j$ is independent of the prior behavior $b_i$: $Pr(b_j \mid b_i) = Pr(b_j)$.

The behaviors of individuals $I_i$ and $I_j$ are statistically independent, which leads to solitary social organization.
Action/Reaction Behavior

Prior behavior: Probability, $Pr(b_i)$, for behavior $b_i$ by individual $I_i$ depends only on the behavior, $b_i$.

Post behavior: $Pr(b_j \mid b_i) \neq Pr(b_j)$.

Spatial structure is pushed towards herding or flocking behavior when each individual spatially acts positively to a behavior by another individual.
Interaction Behavior

Prior behavior: Let $\theta_j = Pr(b_j)$ be a parameter whose value may be specific to $I_j$. Probability for behavior $b_i$ by individual $I_i$ is a function of $\theta_j$: $Pr(b_i) = f(\theta_j)$. We will use the notation $Pr(b_i \mid \theta_j = Pr(b_j))$ to denote the probability that $I_i$ does the behavior $b_i$ knowing that $I_j$ does behavior $b_j$ with probability $Pr(b_j)$.

Troop form of social organization among the Old World monkeys involves (learned) interaction. Troop structure is widespread and consists of cohesive social integration within a group and behavioral isolation of one group from another.

Post behavior: $Pr(b_j \mid b_i) \neq Pr(b_j)$. 

Troop form of social organization among the Old World monkeys involves (learned) interaction. Troop structure is widespread and consists of cohesive social integration within a group and behavioral isolation of one group from another.
Social Interaction Behavior

Prior behavior: Let $\varphi_{ij} = \Pr(b_j \mid b_i)$ be a parameter whose value may be specific to $I_i$ and $I_j$. The probability for behavior $b_i$ by individual $I_i$ is a function of $\varphi_{ij}$: $\Pr(b_i) = g(\varphi_{ij})$. We will use the notation $\Pr(b_i \mid \varphi_{ij} = \Pr(b_j \mid b_i))$ to denote the probability that $I_i$ does the behavior $b_i$ knowing that $I_j$ does behavior $b_j$ with conditional probability $\Pr(b_j \mid b_i)$.

Post behavior: $\Pr(b_j \mid b_i) \neq \Pr(b_j)$.

“… in the case of interactions with social objects a further dimension is added. Part of ego's expectation … consists in the probable reaction of alter to ego's possible action, a reaction which comes to be anticipated in advance and thus to affect ego's own choices” (Talcott Parsons 1964)
Male chimpanzees form “short-term coalitions in which two individuals join forces to direct aggression toward third parties” but …

… learned social interaction is costly: “Given the importance of coalitions, male chimpanzees work hard to obtain this valuable social service” (Muller and Mitani 2005)
Mother-Child Relation Concept, long-tailed Macaques

Training Exemplars: Mo/Da pair

Trial: Choice between novel Mo/Ch pair and Mo/~Ch pair

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<tbody>
<tr>
<td>Mo/Ch</td>
<td>12</td>
</tr>
<tr>
<td>Mo/~Ch</td>
<td>0</td>
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Stimulus: Novel Mother
Trial: Choice between Ch and ~Ch

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<tbody>
<tr>
<td>Ch</td>
<td>20</td>
</tr>
<tr>
<td>~Ch</td>
<td>2</td>
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</table>

“Mother-offspring pairs were differentiated from any other pair… cues other than the relation between individuals do not plausibly account for the result” (Dasser 1988)
New relations can be constructed from existing relations.
Reciprocal relation leads to self as target of other.
Social interaction behavior arises through individual b directing behavior B towards c in the belief that c will direct behavior B towards b.
Symmetrical social interaction behavior arises when individuals b and c conceptually share the same reciprocal relations.
Coordination and Functionality

• The reciprocal relations $R$ and $S$ become a marker for individuals who will reciprocate behavior $B$ when behavior $B$ is associated with the relation $R$ and its reciprocal relation $S$.
• Consequently, the likelihood of the *potential* functional benefit accruing from behavior $B$ *actually* being realized through reciprocal behavior depends on group members mutually recognizing the relations and their associated behaviors.
• The latter is a precursor to institutionalized social action/role systems (Nadel 1957) as these “are clothed in cultural meaning systems so that institutions cannot be properly represented without … reference to shared meanings” (Fararo 1997)
Coordination and Cultural Kinship Systems

The coordination problem was solved in hominid evolution with the formation of systems of cultural kin relations expressed through kinship terminologies and transmitted via enculturation. The system of cultural kin relations we find in human societies is:

1) a system of reciprocal relations
2) a computational system through which kin relations may be calculated in a simple manner, and
3) a generative computational system (Read 1984, 1997, 2005), thereby enabling faithful transmission through enculturation

In brief, cultural kinship is based on a system of concepts with a generative structure and does not emerge from behavior, but instead provides a model for behavior.
Summary

• The trend towards increased individualization led to exponentially increasing social complexity that became a cognitive barrier with the great apes.
• The cognitive barrier was only overcome with a shift from behavior based on individual phenotype to behavior associated with a conceptual system of self:other relations.
• The evolutionary importance of the shift to behavior associated with self:other relations is two fold:
  1) new relations can be formed from existing relations through the composition of relations and
  2) reciprocal self:other relations led to symmetric social interaction.
• The functionality stemming from behaviors associated with symmetric social interaction will only be realized fully in a community of individuals sharing the same conceptual system of reciprocal relations.
Thus the development of human social organization is driven:

1. by the development of conceptual systems of kinship relations that integrate and bound the social system (Read various);

2. internally by the cohesiveness of conceptual systems and through their culturally instantiated forms that provide the social context for behavior (Read 2002, van der Leeuw et al. In Press);

3. and externally by the functionality provided by a conceptual system for social organization in competition with the functionality of other conceptual systems of social organization through evolution of forms of organization (Read 1985, Lane et al. in Press).

Questions?
Conclusions (cont’d)

• Thus evolution of human social organization is driven:
  – internally by the cohesiveness of a conceptual system and through its culturally instantiated form which provides the social context for behavior (van der Leeuw, D. Lane, D. Read, D. White In Press) and
  – externally by the functionality provided by a system of social organization in competition with the functionality of other systems of social organization (Read 1985).

Questions?
Part 5: Evolution of Social Organization Based on Social Interaction
Evolution of Social Organization

Theory of Mind
Working Memory
Individuation

Cognitive Constraint
Hunter-Gatherer Societies

- Typically self-identify as “the real people” (e.g. the !Kung san of the Kalahari Desert in Botswana refer to themselves as the jun/wasi -- “we, the real people”)
- **Criterion for a “real person”** -- someone with whom one has a kin relation; that is one has a kin term for that person
- Thus the “real persons” are all those individuals who can reciprocally recognize one another as kin
- The modal population size of 500 persons is most likely the limit on the number of persons who can mutually recognize one another as kin
Social Interaction and Culturally Identified Kin

- Persons who co-recognize each other as kin share a *reciprocal* kinship system and have been *enculturated into the same cultural system* that provides the basis for social interaction.

- Non-kin are “strangers” (!Kung san: strangers are *chu dole* = “harmful, dangerous”) and in some H/G groups were killed before they could, as they believed to be the case, cause harm; e.g., the Waorani of S. America (Davis and Yost 2001).

- Briefly, social interaction is not possible with non-kin.
Hunter-Gatherer Band Society Organization

Residence Group:

Internally structured around families

Externally linked by kin relations between families
Tribal Society (groups)

Demographic Size: Several H-G band societies
Tribal Society (lineages)
Tribal Society (Moieties)

Moiety 1
(e.g., Coyote)

Moiety 2
(e.g., Wildcat)

- Ancestor (e.g., Coyote)
- Ancestor (e.g., Wildcat)
- Residence Group
- Political Leader
- Leader-Leader interaction (e.g., Council of Leaders)
- Lineage Structure (Patrilineal or matrilineal)
- Exogamous marriage

Marriage
Tribal Society (ritual)

Moiety 1  
(e.g., Coyote)  

Moiety 2  
(e.g., Wildcat)
State Structure
(top down structure)
OW Monkey Grooming

Cercopithecoids

Data from Lehmann et al. 2007: Table 1
Kinship as a Computational System

By a computational system (kinship terminology) is meant that two individuals $A$ and $B$ can compute the kin relation they have to each other when there is a third individual, $C$, for whom each of $A$ and $B$ knows his or her kin relation to $C$ via the kin terms each of $A$ and $B$ use to refer to $C$:

[Maori kin] terms permit *comparative strangers* to fix kinship rapidly…. With mutual relationship terms all that is required is the discovery of one common relative. Thus, if $A$ is related to $B$ as child to mother, veitanani, whereas $C$ is related to $B$ as veitacini, sibling of the same sex, then it follows that $A$ is related to $C$ as child to mother, although they never before met or knew it. *Kin terms are predictable. If two people are each related to a third, then they are related to each other*. (Sahlins 1962)

A kinship terminology is a system of concepts with a generative structure and does not emerge *from* behavior, but instead provides a model *for* behavior.
Likely Relation Concepts

- Genetic mother
- Genetic sibling
- No (close) genetic relation

Perceives of having a kind of relation to based on differential behavior of expressed towards

3 likely sets of relations:
1. mother, daughter, son (or child), father?
2. brother, sister (or sibling)
3. other
Tribal Society (political office)
Biological Evolution

Assumptions about units, transmission and selection are necessary for Universal Darwinism to apply to biological processes. It is usually assumed that

- units come in one of two forms (male, female)
- characteristics of a new unit are formed from the random selection of an allele from pairs of alleles from one male and one female
- there is competition among units for degree of involvement in unit formation

These assumptions have consequences such as the emergence of higher level units (species) that are not predictable directly from the tenets of Universal Darwinism
QuickTime™ and a decompressor are needed to see this picture.