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CHAPTER 7

The human major transition in relation to symbolic behaviour, including language, imagination, and spirituality

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Human evolution can be described in terms of three C's: Cognition, Culture, and Cooperation. Cognition includes the capacity for symbolic thought that lies at the heart of both language and spirituality. Culture includes the capacity to transmit information, both horizontally and vertically, leading to cumulative behavioural change and rapid adaptation to local environments. Cooperation includes the capacity to engage in prosocial behaviours far beyond one's circle of genealogical relatives and narrow reciprocators. The three C's all have precursors in nonhuman species, but they are vastly elaborated in our species.

In what sequence did the 3 C's of human evolution arise and how are they related to each other? A commonly invoked scenario is that the first step was the evolution of advanced cognition, often called "theory of mind (ToM)", which enabled widespread cooperation and culture (e.g. Tomasello 1999). More recently, a consensus is forming around a second scenario. The first step in human evolution was a major evolutionary transition, which enabled within-group cooperation to take place much more strongly than before (e.g. Boehm 1999; Wilson 2002, 2006, 2007; Tomasello et al. 2005). The major transition took place without a prior advance in cognitive ability and was a pre-requisite for the advanced forms of human cognition that we associate with language, symbolic thought, and spirituality. Moreover, much simpler adaptations were required as prerequisites for the advanced forms. The entire package of traits that make humans so distinctive are forms of teamwork that require interactions among trustworthy social partners. The first C to evolve was cooperation and the other two C's are forms of cooperation.

1. What is a major evolutionary transition?

Until the 1970's, natural selection was thought to take place entirely by small mutational change – individuals from individuals. Then, the cell biologist Lynn Margulis (1970) proposed that nucleated (eukaryotic) cells are highly integrated

communities of bacterial (prokaryotic) cells-individuals from groups. Her symbiotic cell theory was regarded as radical at the time but has since become widely accepted. Cell organelles such as mitochondria and chloroplasts are clearly derived from older species of microbes that led a more autonomous existence in the deep past.

In the 1990's, John Maynard Smith and Eors Szathmáry (1995, 1999) generalized Margulis's theory to include other major events during the history of life, such as the first cells, multi-cellular organisms, social insect colonies, and even the origin of life itself as groups of cooperating molecular reactions. In each case, natural selection can take place *within* a given unit, which tends to favour traits that humans associate with cheating, free-riding, and exploitation. Or, natural selection can take place *between* units, favouring traits that humans associate with cooperation and prosociality. The balance between levels of selection is not static but can itself evolve. A major transition occurs when selection between units dominates selection within units, causing the unit to become a functionally adaptive "superorganism."

As an example, consider a proto-cell containing genes that can replicate independently. Some genes are "solid citizens" that participate in the economy of the whole cell, such as gathering resources or defense, all of which would be recognized in human terms as public goods. Other cells "cheat" by using the common resources of the cell to replicate faster than the "solid citizen" genes. It is difficult to describe the scenario without resorting to the human lexicon of social behaviours! The "cheat" genes have the highest relative fitness within the cell. They will increase in frequency and will ultimately replace the "solid citizen" genes unless something more can be added to the story. That "something" is natural selection *among* cells. Cells with a high frequency of solid citizens will survive and divide faster than cells with a high frequency of cheats. What evolves in the total population depends upon the balance between opposing levels of selection, within and among groups.

Against this background, consider the evolution of chromosomes, which binds the genes within a cell into a single structure that must replicate as a unit. The chromosome prevents differential replication within groups, causing between-group selection to become the dominant evolutionary force. Natural selection now takes place primarily on the basis of *teamwork* within the cell, turning the cell into a *superorganism*. Similar scenarios can be described for the origin of life, multicellular organisms, and social insect colonies.

There are three hallmarks associated with a major evolutionary transition:

1. They are rare events in the history of life. Evidently, it is not easy for between-group selection to dominate within-group selection.

2. Once a major transition occurs, the new “superorganisms” become ecologically dominant and diversify into many species. For example, eusociality in insects is estimated to have originated less than 20 times, but these gave rise to many thousands of eusocial insect species that account for over half of the biomass of all insects (Holldobler & Wilson 2008).
3. The transition is never complete. Within group “cheating” is only suppressed, never entirely eliminated. Even single cells and multicellular organisms, the paradigm of internally harmonious organisms, have a disturbing number of elements that benefit at the expense of the organism (Burt & Trivers 2006).

The concept of major evolutionary transitions is one of the most important developments in the history of evolutionary theory. It is so recent that the generalized version didn't appear in book form until the 1990's!

2. Human evolution as a major transition

Although Maynard Smith and Szathmary were bold about expanding the concept of major transitions, they were timid about applying it to human evolution, restricting themselves to the genetic basis of language. Now it appears likely that human evolution was a full-fledged major transition. The reason that we are so unique among primates is because our ancestors became the primate equivalent of a single organism or a social insect colony (Boehm 1999; Wilson 2007; Wilson et al. 2008).

Recall that the key ingredient of a major transition is *the suppression of fitness differences within groups*, causing between-group selection to become the primary evolutionary force. In most primate species, including our closest ancestors, intense within-group competition limits the opportunities for cooperation among members of the group. This is in contrast to extant human hunter-gatherer societies, which are fiercely egalitarian. What accounts for this shift and when did it occur in human evolution?

Humans are incomparably better at throwing projectiles than other primates, an ability that required whole-body anatomical changes and evolved early in the hominin lineage. Although the original purpose of throwing was presumably to deter predators and competing scavengers, it could also be used to suppress bullying and other domineering behaviour within-groups (Bingham 1999). This is a specific version of a more general hypothesis of guarded egalitarianism, advanced by Boehm (1993, 1999) on the basis of the egalitarian nature of most extant hunter-gatherer societies. However it was accomplished, guarded egalitarianism provides the key ingredient of an evolutionary transition.

In retrospect, human evolution has all the hallmarks of a major transition. It was a rare event, occurring only once among primates. It had momentous consequences; cooperation enabled our ancestors to spread over the planet, eliminating other hominins and many other species along the way. We also diversified to occupy all climatic zones and hundreds of ecological niches, although by cultural evolution rather than genetic evolution. The advent of agriculture enabled us to increase the scale of society by many orders of magnitude by a process of cultural multilevel selection (e.g. Turchin 2005). Finally, the transition was not complete. Within-group selection still takes place and is merely suppressed compared to between-group selection.

3. Cognitive teamwork and simple forms that preceded more advanced forms

Physical forms of teamwork, such as hunting, gathering, defense, warfare, and childcare, have always been emphasized in scenarios of human evolution. It is somewhat less obvious that our mental capacities for symbolic thought on which language and spirituality are based, along with our capacity for cultural transmission of traits, are forms of cognition cooperation that can only take place among trustworthy social partners. Moreover, the advanced forms of cognition and culture associated with modern humans required the prior evolution of much simpler adaptations. The reason that these adaptations did not evolve in other primates is not because they were too *complex*, but because they were too *helpful* to be advantageous in groups compromised by within-group selection. Examples of such simple adaptations include the following.

1. *Eyes as organs of communication.* We are the only primate species with white sclera and other features that provide information to our social partners about direction of gaze, emotional state, and more. According to the “cooperative eye” hypothesis, this is because this degree of helpfulness was not favoured in any other primate species (reviewed by Tomasello et al. 2005).
2. *Pointing.* Even though pointing appears simple to us and appears early infancy, apes evidently do not point things out to each other or do anything comparable in natural environments. Apes raised in human social environments point to what they want but seldom point to help out their human social partners. What seems to be lacking is a sense of what others might want and/or the motivation to help by pointing. In another telling comparison, dogs comprehend pointing much better than wolves, even when wolves are raised in human social environments. The mental ability of dogs evidently evolved,

by genetic evolution, over 100,000 years of domestication (Tomasello et al. 2005; Hare et al. 2002).

3. *Shared social awareness in human infants.* From an amazingly early age, human infants have an ability to adopt the perspective of others and to help by pointing, joining a task, or otherwise coordinating activities. In short, humans have instincts for *teamwork* that appear extremely early in life and are not manifested in apes at any age (Tomasello et al. 2005).
4. *The evolution of laughter.* Converging lines of evidence strongly suggest that our ancestors were laughing long before they were talking. Moreover, laughter has functions that are clearly related to teamwork, rapidly coordinating mood and facilitating playful activities during short periods of safety and satiety (Gervais & Wilson 2005).

The precursors for these relatively simple adaptations were present in our ape ancestors, and merely needed a more cooperative social environment to be favoured and elaborated by between-group selection.

4. Language, imagination, and spirituality

According to Terrence Deacon (1998) in his book *The Symbolic Species*, humans are unique in their capacity for symbolic thought. Yet, symbolic thought does not require a bigger brain, or even a different brain, than possessed by our closest ape relatives and even other non-human species. The reason that the capacity for symbolic thought is absent in most species is not because it is too complex, but because it isn't *adaptive*. To understand the evolution of symbolic thought in humans, we must search for an environmental context that made it adaptive.

What distinguishes symbolic thought from other forms of cognition, such as associative learning? With associative learning, mental representations are learned when they correspond directly to the environment and are unlearned when the correspondence ceases (e.g. the sound of a bell when paired with food in Pavlovian learning). With symbolic thought, mental representations take on a life of their own, even when they don't directly correspond to anything in the environment (e.g. the word and concept of "ghost"). Symbolic thought can be hugely adaptive because of the behaviours that they *motivate* in the real world, even though they don't necessarily correspond directly to features of the real world.

One implication of Deacon's thesis is that non-human species can be taught to think symbolically, more like us than their own kind. This retrospective "prediction" is confirmed by examples such as Kanzi the bonobo and Alex the African Grey Parrot. The question is then to understand how the social

environment of proto-humans provided something equivalent to the lengthy training procedure that enabled Kanzi and Alex to think (and speak, in the case of Alex!) symbolically. It would need to be a *cooperative* social environment. Thus, Deacon's thesis fits very nicely within the new paradigm of human evolution as a major transition.

Language, imagination, and spirituality had at least three profound effects on human evolution. First, they enabled a higher degree of social control (e.g. through gossip), suppressing cheating and favouring teamwork of all kinds. Second, they provided a new source of *behavioural variation*, upon which natural selection can select. Third, they enabled the most successful behavioural alternatives to be *transmitted*, creating a new mechanism of inheritance. These abilities enabled our ancestors to achieve their ecological dominance and planetary diversity while remaining a single species.

5. Testable predictions

The scenario outlined above leads to numerous predictions that can be tested in the hominin fossil and early archeological record. The ability to throw stones requires many skeletal changes that can be dated during hominin evolution. Suppression of competition within groups includes competition among males for females, perhaps reducing the degree of sexual dimorphism (although between-group conflict can favour large males). Even the evolution of the whites of our eyes can potentially be genetically dated, once we identify the associated genes. Other testable predictions are possible with sufficient ingenuity.

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