
Biology and Philosophy **19:** 721–737, 2004.

Hominid cultural transmission and the evolution of language

LAUREANO CASTRO[1], ALFONSO MEDINA[2] and MIGUEL A. TORO[3]
[1]*Departamento de Mejora Genética Animal, SGIT-INIA, Carretera de La Coruña km. 7, 28040 Madrid, Spain;* [2]*Facultad de Psicología, UNED, C.A. de Madrid, Faculty of Social Sciences, Saint Louis University, Madrid, Spain;* [3]*Departamento de Mejora Genética Animal, SGIT-INIA, Carretera de La Coruña km. 7, 28040 Madrid, Spain (e-mail: toro@inia.es)*

Key words: cultural transmission, evolution of language, human evolution

Abstract. This paper presents the hypothesis that linguistic capacity evolved through the action of natural selection as an instrument which increased the efficiency of the cultural transmission system of early hominids. We suggest that during the early stages of hominization, hominid social learning, based on indirect social learning mechanisms and true imitation, came to constitute cumulative cultural transmission based on true imitation and the approval or disapproval of the learned behaviour of offspring. A key factor for this transformation was the development of a conceptual capacity for categorizing learned behaviour in value terms – positive or negative, good or bad. We believe that some hominids developed this capacity for categorizing behaviour, and such an ability allowed them to approve or disapprove of their offsprings' learned behaviour. With such an ability, hominids were favoured, as they could transmit to their offspring all their behavioural experience about what can and cannot be done. This capacity triggered a cultural transmission system similar to the human one, though pre-linguistic. We suggest that the adaptive advantage provided by this new system of social learning generated a selection pressure in favour of the development of a linguistic capacity allowing children to better understand the new kind of evaluative information received from parents.

1. Introduction

> "I suggest that advanced mental qualities might possibly be produced as an incidental effect of selection for the ability to understand and remember simple verbal instructions early in life"
>
> G.C. Williams (*Adaptation and Natural Selection*)

The origin and evolution of language is a controversial topic within developmental biology. According to Darwin, linguistic capacity went through an evolutionary process driven by natural selection which led from those

primates who were able to produce unarticulated screams, to humans with articulated language and a number of syntactic rules. Max Muller, a notable linguist at the time of Darwin, defended the opposite position, inspired in the Cartesian tradition which considered that language lacks any animal antecedent and constitutes the true Rubicon separating our kind from the other species. During the 20th century, the development of psychology as a science did not help to bring language and evolution closer to one another. Behaviourism, the dominant paradigm for a long period, made some progress towards shortening the gap between psychology and biology, but its notion of an ontogenetic acquisition of language as just one more learned skill resulted in no special treatment or study for language, apart from the unfruitful attempt to justify verbal overt behaviour. Confronted with the conceptions of the behaviourists, Noam Chomsky (e.g., 1972, 1988) suggested the existence of an innate mental ability for language and a specific mechanism for acquiring it (L.A.D., Language Acquisition Device), which might explain the ease with which an average child can learn any language. Each unit of the natural languages is generated by applying a finite set of rules that constitute the so-called Generative Grammar. Chomsky defended the presence of a deep logical structure common to all languages, and which reflects our innate capacity for language.

Support for an innate linguistic capacity could have helped to narrow the gap between linguistics and Neodarwinian theory of evolution. However, there was no such *rapprochement*. Chomsky's refutation of behaviourism was taken by many biologists as the Cartesian reaffirmation of a qualitative lag between the rational and linguistic capacities of our kind and the absence of them in the rest of the species. This posture was indeed encouraged by Chomsky himself, who repeatedly held that the origin and presence of the innate and universal linguistic capacity in our kind could not be explained by natural selection (Chomsky 1972, 1988). Moreover, some evolutionists, most prominently Stephen Jay Gould, suggested language to be the by-product of other evolutionary processes (a spandrel), rather than a special adaptation arising through ordinary natural selection acting on mutations. In the early 1990s, Pinker and Bloom (1990) and Pinker (1994) wittily criticized these rationales, and defended the hypothesis that natural selection has a central role in the origin of linguistic capacities. The kernel of their argument focuses on the fact that language is far too complex a structure for us to accept that it could have emerged without a specific functional purpose. These authors believe that language shows some signs of the presence of a complex design aimed at fulfilling some function – signs that cannot be explained in a convincing manner by any other theory. Even more plainly, language serves many everyday functions. We devote a great deal of time and

energy to mastering it and using it. Hence, it becomes necessary to accept that natural selection is involved in language evolution.

In the last few years, considerable evidence supporting the idea of a gradual evolution of linguistic capacity during the hominization process has been provided by palaeontology, and most of all from genetics (see, for example, Lai et al. 2001; Enard et al. 2002; Zhang et al. 2002). The acceptance of the Darwinian thesis led to a number of hypotheses attempting to discern the possible adaptive advantage that allowed the evolution of language through natural selection (Dunbar 1997; Deacon 1997; Calvin and Bickerton 2000). For example, Deacon (1997) holds that humans are "the symbolic species". Language is not merely a mode of communication, it is also the outward expression of an unusual mode of thought – symbolic representation. Symbolic communication was a response to a reproductive problem that only symbols could resolve: the regulation of reproductive relationships between early hominids. For Deacon, our ancestors could only take advantage of a hunting-foraging subsistence strategy if they could regulate marriage, and symbolic communication was subsequently improved, gradually, because of the myriad advantages it provided for other forms of communication: mother-infant communication, passing on both foraging tricks and tool-making skills, manipulating competitors, collective warfare and defence, and sharing of past experiences.

Other theories link the development of language and the human mind to social life. Dunbar (1997) suggests that social interactions are complex in primates, and demand big brains because so much has to be remembered. Individuals need to remember who did what to whom, and how strong every alliance is at a particular moment. These complex relationships are maintained by grooming for many primates. In other words, the real function of grooming is to keep social groups together. For Dunbar our hominid ancestors faced increasing predation when they moved into the grassland, so that increasing the size of the group would have been a valuable strategy for survival. But as groups get larger the time requirements for grooming become impossibly high. This is where language sprung up, to allow the cementing and maintenance of our human relationships. The function of language is gossip, and gossip is an ultra-efficient form of grooming because we can talk to more than one person at a time.

The theory proposed by Bickerton (1990) and Calvin and Bickerton (2000) is especially relevant for us. These authors support the hypothesis that the evolution of language occurred in two stages: in the beginning, a kind of "proto-language" would have emerged, in which words had no syntactic organization and worked as labels for signalling concepts in an organism's mind; later, a true language with defined syntactic rules would

have evolved. Proto-language would have emerged under the selection pressure of the need to transmit information about the location of food resources and to alert offspring to potential risks they faced. Accordingly, the developmental ancestor of human language would be not the set of previous animal communication systems, but the previous conceptual representation systems such as those which some primates appear to have. The development of syntax would have occurred at a later stage, as a consequence of the establishment of reciprocal altruism in those hominid groups that already had a proto-language. Reciprocal altruism requires the development of a kind of social intelligence allowing clarification of "who did what to whom?", in order to identify and reject those individuals who cheat, and in order to maintain alliances. For Bickerton, episodic memory required to recall these actions is useful for giving labels to those elements involved in a particular action that play the roles of agent, topic and goal, which are precisely the core of the basic syntactic categories.

All of these hypotheses about the evolution of language face the same problem: identifying the triggering factor in the hominization process. The lifestyle of our hominid ancestors was, as far as we know, quite similar to that of the direct ancestors of the chimpanzees, and the problem is to determine why there were selection pressures that caused the development of the brain and of linguistic abilities in the hominid line, and why these did not act in the same way in other primates. In the present study, we adopt Bickerton and Calvin's position on the fact that the ancestors of human language are the primates' conceptual representation systems, and we defend the hypothesis that language was selected as an instrument that increased the efficiency of the cultural transmission system possessed by the first hominids.

Our rationale starts out from a consideration of the adaptive significance and evolution of social learning in animals. First, we discuss in section 2 the evolution of social learning from the perspective of dual-inheritance theory, which suggests that social learning may have evolved as far as human complexity, when it could make individual learning less costly and more accurate. Later, in section 3, we suggest that a key factor enabling such a transformation was the fact that some hominids developed the capacity to conceptually categorize their own learned behaviour in terms of values – positive or negative, good or bad – and that such a capacity allowed them to approve or disapprove of their offspring's learned behaviour (Castro 1992; Castro and Toro 1995). We propose that during the early stages in human evolution, hominid social learning, which was probably rather similar to that of today's chimpanzees, based on social indirect learning mechanisms and perhaps true imitation, turned into a cumulative cultural transmission based on true imitation and the approval or disapproval of offspring's learned behav-

iour. We believe that natural selection favoured those hominids equipped with this capacity to approve or disapprove of their children's behaviour, and thus transmit all their behavioural experience to their offspring. By valuing some of their experiences positively and others negatively, and by communicating these valences to their offspring, parents could become active teachers, rather than relying simply on the imitative abilities of their children. Similarly, if naive offspring acquired, by individual or social learning, negatively-valued traits, parents' disapproval could be used to extinguish them. This means that communication in hominids embedded a new type of information referring to the adaptive value of a given learned behaviour, a kind of information that, as far as we understand, is not transmitted among non-human primates (Seyfarth and Cheney 1992; Tomasello and Call 1997; Premack 2004). With the help of a mathematical model, we have shown that the capacity to approve or disapprove of offspring's behaviour may have become adaptive and evolved in hominids by making individual learning more precise and less expensive (Castro and Toro 2002). Finally, in section 4, we suggest that the adaptive advantage provided by this new system of cultural transmission generated a selection pressure in favour of the development of a more efficient communication system, allowing children to better understand this new kind of information received from parents about the value of a given learned behaviour. In other words, it generated a selection pressure in favour of a linguistic capacity.

2. The evolution of social learning

Although non-learned behaviour is a sufficient tool for the life of a large number of animal species, many others have also developed the capacity to learn. Individual learning evolves with the aim of allowing organisms to acquire a degree of phenotypic plasticity that may yield a better adjustment to the unpredictable elements in the environment. There are many different kinds of individual learning: from habituation and perceptual learning to classical conditioning and trial-and-error learning. The last of these is of special importance in the quest for phenotypic plasticity, since it allows the animal to learn to associate a voluntary activity with the consequences that follow.

In species with some trial-and-error learning capacity, the development of a system of cultural transmission can turn out to be adaptive, since it allows a reduction in the time and cost involved in such learning (Boyd and Richerson 1985), and takes advantage of the range of behaviour developed by the previous generation (Lumsden and Wilson 1981). However, although culture defined as variation acquired and maintained by social learning is common in nature, it is nowhere as important in any other species as it is in humans,

where it led to a cumulative cultural evolution process with great adaptive value (Tomasello 1999). Moreover, it is not clear how cultural transmission has improved human adaptability while other primates with social learning abilities show comparably restricted ranges. Boyd and Richerson (1995) have shown that social learning can be adaptive if it makes individual learning less costly or more accurate. The first condition is satisfied if individuals use individual learning when it is cheap and reliable, and switch to social learning when individual learning is expensive. The second allows the accumulation of behaviours that no individual learner could acquire by him/herself from one generation to the next. That is, it allows cumulative cultural evolution.

The evolution of the first condition poses an interesting problem, because although individual and social learning should not be regarded as mutually exclusive, their co-evolution implies some kind of evolutionary trade-off. Most of the theoretical models used to analyse the evolution of social learning consider that the two processes work in a mutually exclusive way (Boyd and Richerson 1995; Feldman et al. 1996; Laland et al. 1996; Henrich and Boyd 1998; Aoki 2001, for a review). It is assumed in these models that when individuals use trial-and-error learning, they learn the appropriate behaviour but they face learning costs. When they use imitation, individuals adopt the behaviour of the one that they use as a model and, therefore, avoid the costs of individual learning, but they incur a cost if they imitate an inappropriate model. Steady equilibrium might be achieved through a mixed strategy involving either polymorphism between pure imitators and pure individual learners, or more realistically, individuals displaying both modes of behaviour in a fixed proportion (Boyd and Richerson 1995; Feldman et al. 1996; Henrich and Boyd 1998). Social learning would work as an inheritance system alternative to the genetic one, and would be adaptive if individuals used social learning when evaluation of the behaviour to be adopted was costly and unreliable – that is, when individual learning was costly.

The evolution of the second condition also appears problematic, and in fact, cumulative cultural evolution resulting in behaviours that no individual could invent on their own is rare – it is limited to humans, song birds, and perhaps chimpanzees (Boyd and Richerson 1996). All primate cultural traditions may be maintained through indirect social learning, while the evidence suggests that cumulative cultural change is only feasible with true imitation, and not with indirect social learning, since with the latter the behaviour is not truly imitated, but rather has to be re-invented (Boyd and Richerson 1995). More precisely, imitation and teaching are direct social learning modalities, whose possible presence in primates (especially in the case of teaching) is questionable. As far as imitation is concerned, there is a consensus among researchers that either it does not exist at all or it is very rare to find true

imitation in primates living in their natural environment (Galef 1992; Visalberghi and Fragaszy 1990; Tomasello 1996); however there is clear evidence that chimpanzees are able to imitate when they are bred in captivity and with a high level of cultural training (Tomasello and Call 1997). With respect to teaching there is practically no evidence in primates (Premack and Premack 2003); Tomasello et al. (1993) hold that chimpanzees do not actively teach their offspring in their natural habitat. The most thoughtful study providing some evidence for the presence of teaching in primates was made by Boesch (1991) with chimpanzees. Boesch observed just two possible instances of active instructions over many years of observation.

For Boyd and Richerson (1996) cumulative cultural evolution is not present in chimpanzee culture because they deploy their imitative learning abilities in a less consistent manner than humans. That is, although a given individual may learn somebody else's innovation by imitation, there will be no other individual that could later imitate it in a precise manner. Consequently, this innovation cannot be propagated, and becomes lost until someone else re-invents it. More recently Tomasello (1999) claims that the key to the transformation of social learning in hominids into a human cultural inheritance system was a qualitative change in imitation ability, which requires as a previous step that individuals develop a capacity for "a theory of mind", enabling them to perceive their peers as intentional beings with a similar mind. For Tomasello, true imitation, rooted in an evolved capacity for "theory of mind", generated human cultural evolution, including language evolution. However, our opinion is that true imitation is not sufficient to explain the transformation that occurred in primates' social learning during hominization.

3. The evolution of social learning: a different perspective

Cultural transmission in our own species works most of the time as a true cumulative inheritance system. Hence, the question is to identify the types of changes that occurred during the hominization process and transformed the typical social learning in primates into a cumulative cultural inheritance system similar to the human one.

Our thesis is that a key factor enabling such transformation was the fact that hominids developed both a capacity for "theory of mind" and a capacity to conceptually categorize learned behaviour. A capacity for "theory of mind" enables individuals to make a connection between the acts of other animals and their own acts and goal states, and such ability was useful for increasing qualitatively (and quantitatively) the effectiveness of imitation. The conceptual capacity to categorize is defined as the ability to categorize one's own

and others' behaviour in terms of values – positive or negative, good or bad –, which in turn allow the transmission of information about the value of learned behaviour between parents and offspring, hence facilitating and orienting learning in the latter. We believe that such a capacity to approve or disapprove of the behaviour of offspring helped to make individual learning both less costly and more accurate, making possible the transformation from primate social learning to human cultural transmission.

We suggest that the simultaneous presence of the two capacities – imitation and approval/disapproval of the offspring's learned behaviour – in our hominid ancestors represented a radical change in the rudimentary cultural transmission of the first hominids. Individuals with both abilities, which we call *assessors*, generated a more efficient cultural inheritance system, since they could transmit information about the behaviour their children were learning by conditioning the final acceptance or rejection of it.

Approval or disapproval of behaviour works as a new behaviour evaluation criterion for the learning individual that is particularly useful when evaluation is difficult and has low reliability. This means children can take advantage of parental expertise, and transforms social learning into an inheritance system in a rigorous sense, since young individuals reproduce the phenotypic structure in their parent's generation, thereby avoiding learning costs. Approval or disapproval of behaviour permits the transmission of information about those behaviours the individual learned to avoid. A great part of what we learn is what we must not do. This type of information cannot be transmitted through imitation, except on very rare occasions and in an indirect way. Individuals discover through individual learning this type of "negative" environmental information, but often at a high cost. Approval and disapproval of behaviour may greatly contribute to avoiding the cost of learning wrong behaviour, and to saving time when having to choose among different behavioural alternatives that are difficult to evaluate.

The capacity for approving or disapproving of individually or socially learned behaviour may be considered as an elementary form of teaching, since individuals with such capacity (*assessors*) can transmit to their children the emotional value they gave to those behaviours they have previously learned and categorized. Note the implication here that individuals, when adults and far from parental influence, can re-evaluate their behaviour if its result is unsatisfactory. Transmission of values turns imitation into a parent-child inheritance system, without eliminating children's capacity to innovate. Hence, the possibility to learn from other individuals does not constrain their evaluation system either; it simply feeds it through approval and disapproval while individuals are young. Moreover, this cultural inheritance system is flexible, in spite of its reliability, since it does not impede dissemination

of behavioural innovations when these were not negatively evaluated by the parental generation.

We showed in a previous study that the capacity to approve or disapprove of behaviour may be adaptive in a wide range of situations (Castro and Toro 2002). We can summarize the adaptive advantage of approving or disapproving of behaviour in the following points:

a) The approval and disapproval of offspring's learned behaviour increases phenotypic resemblance among parents and offspring for those behaviours that parents know and have previously categorized, which is adaptive as long as the environment does not change so fast that it cancels out the biological value of what was learned by the previous generation.

b) The approval and disapproval of offspring's learned behaviour increases reliability in imitation processes which allowed the generation of a cumulative cultural inheritance system. The need for fidelity in the copy for imitation to work as a cumulative inheritance system is a serious handicap that also affects cultural transmission in humans (see, for example, Blackmore 1999). Disapproval of badly-imitated behaviour forces the imitator to repeat the process, and this makes the increase of fidelity in the copy possible.

c) Disapproval allows the offspring to acquire information about behaviours they are self-discovering, so that they can reject risky responses without having to experience all their negative consequences. That is, although negative assessment of a given behaviour may be easy, with no need for parental help, disapproval may help to avoid or diminish the cost of experiencing it.

d) Disapproval impedes or makes difficult for the offspring to imitate tasks for which they are not qualified due to their youth. Disapproval represents an extension of parental care to learned behaviour, and decreases the risk in young people that they will tend to imitate other individuals in the same population.

e) Approval favours the implementation of behaviour that has no immediate positive evaluation for the individual experiencing it, decreasing the costs and time involved in adopting a given behaviour when the outcome of its evaluation is not immediately obtained.

Approval or disapproval of offspring's behaviour involves a cost for the teaching *assessor*, as do many other forms of parental care. The cost derives from the time and energy devoted to influencing the offspring's behaviour. Evolution of approval/disapproval of behaviour will depend on whether the benefit of parental orientation outweighs the cost or not. However, it is important to bear in mind that a given amount of parental investment can be used to control simultaneously several behaviours learned by the offspring.

Thus, the cost will be attenuated because it will be offset by the benefits obtained from the transmission of information on several learned behaviours.

If we try to analyse the situation from the perspective of the offspring, they, in principle, do not have the possibility of choosing whether or not to be orientated by their parents. What appears to be true is that, in environments that change little, whatever is learned by one generation may be used for the next, so that parental orientation must be adaptive. The sensitivity of a learner to disapproval reduces the cost of error, by substituting an objectively harmless parental signal of error for a potentially dangerous signal from the world. In fact, the evolution of cultural transmission across generations would never have occurred without a sufficiently stable environment. Moreover, acceptance of parental orientation could hardly be negative if we consider that the docility of offspring does not cancel out the possibility that children keep their innovative tendencies, imitate new behaviour ignored by the parents or change their behaviour when they are adults. In other words, approval or disapproval of behaviour has an adaptive advantage: decreasing the costs of learning and increasing reliability in the replication of imitated behaviour.

In any case, were it not adaptive for the infant to receive parental guidance, a tendency to rebellion could have evolved. However, it seems that humans have developed psychological mechanisms that enable the cultural transmission of values by making ourselves more receptive to parental directions (approval and disapproval of behaviour). For example, Baum (1994) states that humans are unusually sensitive to expressions of approval and disapproval by parents and others. Simon (1990) suggested that humans possess a tendency to accept social influence that can be called "human docility". Such a tendency has been favourably selected, according to Simon, because it allows the individual to use adaptive advantages stored in the cultural tradition. Waddington (1960) defines human beings as "authority acceptors", because children need to have the ability to be taught and they need to develop authority systems in their minds in order to do so.

The fact that approval or disapproval of learned behaviour only evolved in the hominid line appears to be related not to the importance of the implied costs, but rather to the need for a previous complex cognitive development, similar at least to that possessed by chimpanzees within primates. According to some authors, true imitation is still present in chimpanzees (Whiten 1998), but not the ability to approve or disapprove of offspring's learned behaviour (Premack 2004). In fact, it seems that there is no animal antecedent of transmission of information about the value of the learned behaviour. In some species, parental care involves innate responses limiting the offspring's movements in order to help them avoid certain risky situations, but these are

not prohibitions of responses that parents learned to avoid and categorized as bad.

Today's primates can emulate other individuals' behaviour, but they do not try to modify that behaviour when they are not directly affected by it. This sort of indifference to other individuals' behaviour when they are not directly affected extends to mother-child relationships. A chimpanzee mother could not teach her infant anything, because, although the infant watches her problem-solving intently, she never returns the infant's observation (Inoue-Nakamura and Matsuzawa 1997). Cheney and Seyfarth (1990) proved experimentally that macaque mothers are unable to transmit to their offspring information about the existence of hidden food or the presence of a predator. The authors attributed this far-from-human behaviour to the fact that monkeys lack of a theory of mind, and so are unable to distinguish between what they know and what others (including their offspring) know. This inability is also found in human infants under 3 years old. Nonetheless, it is difficult to accept that such incapacity could by itself explain such maternal indifference in monkeys, since it would be more logical to expect that mothers show some kind of concern when their offspring move closer to where they shouldn't, regardless of how sure they are about whether the offspring know the risks. It seems more reasonable to assume that mothers are unable to evaluate their offspring's behaviour by approving or disapproving of it and taking their interests into account.

Seyfarth and Cheney (1992) reported that when Vervet monkey offspring start to utter alarm signals or to answer alarms from others they make many mistakes; under such conditions, adults might be expected to try and help offspring learn about aspects related to predators. However, after extensive observation, they have never seen adults selectively stimulating those youngsters who screamed the right alarm signals, or correcting the behaviour of those who respond inappropriately to vocalizations related to danger. Thus, offspring learn by mere observation without explicit tutoring. According to these authors, while human communication greatly helps to condition the knowledge, beliefs, and motives underlying behaviour, monkeys (and perhaps other primates, too) cannot communicate with the intention of influencing another animal's mental states, probably because they do not recognize the existence of these states.

On the other hand, on the basis of reports of people who have tried to raise chimpanzee infants in their homes as children, a companion evolutionary step seems to have been a greater sensitivity to social reinforcement in children than in chimpanzee infants. Good-bad feedback from human parents to chimpanzee *children* results in some socialization, but chimpanzees remain quite wild and troublesome compared to human children (Baum 1994). Thus,

in line with our hypothesis, a chimpanzee may classify another individual's behaviour as favourable or unfavourable with respect to him/herself, and may act accordingly, but he/she is unable to attribute a proto-concept of good or bad to his/her own behaviour, and this impedes the categorization of other individuals' behaviour as good or bad for those individuals.

4. Language evolution and the conceptual capacity to categorize behaviour

It seems reasonable to assume that first ancestors in the hominid line, *Australopithecus*, had some kind of cognitive capacity similar to current chimpanzees, and lacked any linguistic ability. They probably acquired most of their behaviours through trial-and-error learning and social indirect learning, though some of them may have been able to learn by imitation. They may also have had a rudimentary capacity for "theory of mind". Consequently, early hominid culture would not have been much different from that of current chimpanzees. The emergence of *Homo habilis* and, most of all, *Homo ergaster*, meant a considerable increase in relative brain size and level of encephalization, which seems to correlate with a meaningful increase in intellectual capacity. The hypothesis we suggest is that at an early stage of hominid evolution – possibly some ancestor of *Homo ergaster* – the development of a new capacity was arising: the capacity to categorize learned behaviour as good or bad. We defined such a capacity as the ability of an individual to categorize a given behaviour by means of an essentially dichotomous conceptual evaluative code (Castro and Toro 1995; Castro and Toro 1998). This implies the transformation of an automatic mechanism for categorizing behaviour used for individual learning into a conceptual categorization mechanism. Behaviour rewarded during learning will receive, at least initially, a positive conceptual categorization, while behaviour provoking some external rejection will receive a negative evaluation.

The idea we defend is that hominids with the capacity to categorize behaviour (*assessors*) may approve or disapprove of the behaviour learned by their offspring. Hence, hominid *assessors* could transmit to their offspring the emotional value attributed to those responses they have previously learned and categorized. Our hypothesis is that the adaptive advantage providing the possibility to transmit information about learned behaviour exerted a selection pressure in favour of the development of a more efficient communication system between parents and children.

Our thesis suggests that what initially occurred during hominization was modification of the kind of information transmitted, but not of the communication system itself. The set of information that any primate can

acquire is ample, including information about locations, objects, animals, individuals and actions that individuals have to face throughout their life span. The adaptive relevance of some of this knowledge is beyond doubt, and a communication system based on gestures and unarticulated screams is used to deal with it. If evolution of language has been the response to a need to improve such a nonverbal communication system in primates, we should find differences in fitness, which would be directly related to the ability to transmit or receive information, and a given evolution should be perceived in all the different groups of primates. This does not seem to occur: the communication system of current primates is adequate for communicating the kind of information they transmit. We propose that, apart from transmitting information about the same types of issues as other primates, our hominid ancestors were the first primates to be able to transmit information about the value of the learned behaviour, by approving or disapproving of such a behaviour when executed by their offspring. Note that such information transmission may begin working from the very beginning, given that approval or rejection of other individual's behaviour is common in the behaviour of chimpanzees and other primates (for example, a movement of the head or the expression of some emotion through the face may be sufficient for communicating approval and disapproval), even though it always refers to behaviour directly affecting the individual expressing the emotions. However, despite the fact that the system may have initially started working through gestured communication, it is reasonable to think that it soon became inadequate for the efficient transmission of information about what behaviour to follow. It is difficult to forbid children to do something they believe they can do, or something they see others within the same population do: explanation is necessary.

According to Calvin and Bickerton (2000), what first arose was probably a proto-language, in which words had no syntactic organization and worked as labels for designating nonverbal concepts in the organism's mind. From our point of view, the two crucial primary concepts were good and bad, which allowed categorisation of actions performed and objects with which offspring interact. This introduces a qualitative change in intentionality of communication: parents are not indifferent to what their children learn. The important thing now is to evaluate and keep control of what they do, and parents are thus forced to transmit information to them about how to behave at each moment. Information transmitted arises from an evaluative conception of behaviour through which the *assessor* may determine what must or mustn't be done, and the intention of communication is to modify other individuals' behaviour for their own interest.

Our thesis states that the genesis of an arbitrary system of propositionally organized linguistic signs was probably the adaptive response explored

by hominids. The propositional structure allowed the creative flexibility necessary for transmitting a wide range of information items. Its origin, though, may be linked to the transmission of information about the value of behaviours and objects: "This is right, this is wrong", "This is good, this is bad", "Do this, don't do this", where the presence of basic syntactic categories (agent, topic, object) can be identified. Thus, a developmental scenery allowing the gradual evolution of the human language capacity was shaped. Recently, Nowak and co-workers have shown that evolutionary game theory provides a framework in which the evolution of linguistic elements, such as word formation, lexical structures, syntax and universal grammar, can be studied (Nowak and Krakauer 1999; Nowak et al. 2000; Nowak et al. 2001).

Greater efficiency in communication would have made investment in individual learning costs more profitable, and may have favoured intellectual development. The cultural transmission of values increased the fitness of those *assessor* parents with greater cognitive capacity because they were able to transmit all their behavioural experience to offspring – that is, they were able to transmit information that cannot be imitated by others about what must not be done. Moreover, the cultural transmission of values modified the adaptive meaning of intelligence. The pressure of natural selection on intellectual development in a system of value transmission derives from its ability to generate asymmetries of value among different types of behaviour, and consequently to reflect preferences, rather than from the innovative power of intelligence (Castro and Toro 1998). Innovative and creative aspects of intelligence lost adaptive importance compared to the ability to weigh up rationally the advantages and disadvantages of different cultural alternatives. The adaptive value of intelligence would be associated with the capacity to recognise and positively categorize behaviour with adaptive importance that sporadically arises among the population, helping to avoid its disappearance as a result of cultural drift or inadequacies in the hereditary process. All of this, in turn, made the capacity to transmit the learned information more advantageous. Hence, there emerged a self-catalytic process favouring development of the intellect and of a communication system capable of transmitting previously-learned information. Thus any kind of evolutionary trade-off between individual and social learning disappears.

Some ideas about the ontogenetic development of ethical capacity appear to lend support to our thesis. For example, Kohlberg (1981) identified a sequence of six different stages, grouped in three levels, within the maturation process of moral judgement; these categories, as regards their basic features, have been confirmed in many other studies. The first level, predominant in children up to age 10 years, refers to two types of moral reasoning based on

the refusal to do certain actions, either to avoid being punished (stage 1), or to obtain a reward (stage 2). Good and bad is assessed in terms of what can and cannot be done, and is linked to receipt of a punishment or a reward. This may be interpreted from our perspective as unmistakable evidence of the importance of approval and disapproval of behaviour as a guide to child behaviour in our species.

Finally, it is worthy of note that some important aspects of our hypothesis can be verified empirically. For example, the lack of a true capacity to approve or disapprove of offspring behaviour in primates when it does not directly affect them; the importance of approval/disapproval of behaviour in current hunting and gathering cultures; the effect of the value associated with different behaviours on cultural transmission; and perhaps even, in the near future, the neurological foundations of the conceptual capacity to categorize behaviour.

Acknowledgements

This work was developed within the R+D Project: *Estudio interdisciplinar de rasgos funcionales del grado humano* (BSO2000-116-C04). The work was also assisted by the concession to L. Castro of a "licencia por estudios" by the Madrid local government.

References

Aoki, K.: 2001, 'Theoretical and Empirical Aspects of Gene-Culture Coevolution', *Theoretical Population Biology* **59**, 253–261.

Baum, W.B.: 1994, *Understanding Behaviorism: Science, Behavior, and Culture*, Harper Collins, New York.

Blackmore, S.: 1999, *The Meme Machine*, Oxford University Press, Oxford.

Bickerton, D.: 1990, *Language and Species*, The University of Chicago Press, Chicago.

Boesch, C., 1991, 'Teaching Among Wild Chimpanzees', *Animal Behaviour* **41**, 530–532.

Boyd, R. and Richerson, P.J.: 1985, *Culture and the Evolutionary Process*, The University of Chicago Press, Chicago.

Boyd, R. and Richerson, P.J.: 1995, 'Why Does Culture Increase Human Adaptability?', *Ethology and Sociobiology* **16**, 125–143.

Boyd, R. and Richerson, P.J.: 1996, 'Why Culture is Common but Cultural Evolution is Rare?', *Proceedings of the British Academy* **88**, 77–93.

Calvin, W. and Bickerton, D.: 2000, *Lingua ex Machina*, MIT Press, Cambridge, MA.

Castro, L.: 1992, 'Capacidad ética, transmisión cultural y evolución humana', *Arbor* **564**, 81–92.

Castro, L. and Toro, M.A.: 1995, 'Human Evolution and the Capacity to Categorize', *Journal of Social and Evolutionary Systems* **18**, 55–66.

Castro, L. and Toro, M.A: 1998, 'The Long and Winding Road to the Ethical Capacity', *History and Philosophy of the Life Sciences* **20**, 77–92.

Castro, L. and Toro, M.A.: 2002, 'Cultural Transmission and the Capacity to Approve or Disapprove of Offspring's Behaviour', *Journal of Memetics-Evolutionary Models of Information Transmission* **6** (http://jom-emit.cfpm.org/2002/vol6/castro_l&toro_ma.html).

Cheney, D.L. and Seyfarth, R.M.: 1990, *How Monkeys See the World*, University of Chicago Press, Chicago.

Chomsky, N.: 1972, *Language and Mind*, Harcourt, Brace and World, New York.

Chomsky, N.: 1988, *Language and Problems of Knowledge*, MIT Press, Cambridge, MA.

Deacon, T.: 1997, *The Symbolic Species*, Penguin Books, London.

Dunbar, R.: 1997, *Grooming, Gossip, and the Evolution of Language*, Harvard University Press, Cambridge, MA.

Enard, W., Przeworski, M., Fisher, S.E., Lai, C.S.L., Wiebe, V., Kitano, T., Monaco, A.P. and Pääbo, S.: 2002, 'Molecular Evolution of *FOXP2*, a Gene Involved in Speech and Language', *Nature* **418**, 869–872.

Feldman, M.W., Aoki, K. and Kumm, J.: 1996, 'Individual versus Social Learning: Evolutionary Analysis in a Fluctuating Environment', *Anthropological Science* **104**, 209–232.

Galef, B.G.: 1992, 'The Question of Animal Culture', *Human Nature* **3**, 157–178.

Henrich, J. and Boyd, R.: 1998, 'The Evolution of Conformist Transmission and the Emergence of between Group-Differences', *Evolution and Human Behavior* **19**, 215–241.

Inoue-Nakamura, N. and Matsuzawa, T.: 1997, 'Development of Stone Tool-Use by Wild Chimpanzees (Pan Troglodytes)', *Journal of Comparative Psychology* **111**(2), 159–173.

Kohlberg, L.: 1981, *The Meaning and Measurement of Moral Development*, Oelgeschlager, Gunn and Hain.

Lai, C.S.L., Fisher, S.E., Hurst, J.A., Vargha-Khadem, F. and Monaco, A.P.: 2001, 'A Forkhead-Domain Gene is Mutated in a Severe Speech and Language Disorder', *Nature* **413**, 519–523.

Laland, K.N., Richerson P.J. and Boyd, R.: 1996, 'Developing a Theory of Animal Social Learning', in C.M. Heyes and B.G. Galef (eds.), *Social Learning in Animals: The Roots of Culture*, Academic Press, London, pp. 129–154.

Lumsden, C.J. and Wilson, E.O.: 1981, *Genes, Mind, and Culture*, Harvard University Press, Cambridge, MA.

Nowak, A.M. and Krakauer, D.C.: 1999, 'The Evolution of Language', *Proceedings of the National Academy of Sciences USA* **96**, 8028–8033.

Nowak, A.M., Plotkin, J.B. and Jansen, V.A.A.: 2000, 'The Evolution of Syntactic Communication', *Nature* **404**, 495–498.

Nowak, A.M., Komarova, N.L. and Niyogi, P.: 2001, 'Evolution of Universal Grammar', *Science* **291**, 114–118.

Pinker, S.: 1994, *The Language Instinct*, William Morrow, New York.

Pinker, S. and Bloom, P.: 1990, 'Natural Language and Natural Selection', *Behavioral and Brain Sciences* **13**, 707–784.

Premack, D.: 2004, 'Is Language the Key to Human Intelligence?', *Science* **303**, 318–320.

Premack, D. and Premack, A.: 2003, *Original Intelligence*, McGraw-Hill, New York.

Seyfarth, R.M. and Cheney, D.L.: 1992, 'Meaning and Mind in Monkeys', *Scientific American* **267**, 122–129.

Simon, H.: 1990, 'A Mechanism for Social Selection and Successful Altruism', *Science* **250**, 1665–1668.

Tomasello, M.: 1996, 'Do Apes Ape?', in C.M. Heyes and B.G. Galef (eds.), *Social Learning in Animals: The Roots of Culture*, Academic Press, New York.

Tomasello, M.: 1999, *The Cultural Origins of Human Cognition*, Harvard University Press, Cambridge, MA.

Tomasello, M. and Call, J.: 1997, *Primate Cognition*, Oxford University Press, Oxford.

Tomasello, M., Kruger, A.C. and Ratner, H.H.: 1993, 'Cultural Learning', *Behavioral Brain Sciences* **16**, 495–552.

Visalberghi, E. and Fragaszy, D.M.: 1990, 'Do Monkeys Ape?', in S.T. Parker and R.K. Gibson (eds.), "*Language*" *and Intelligence in Monkeys and Apes. Comparative and Developmental Perspectives*, Cambridge University Press, Cambridge, MA.

Waddington, H.C.: 1960, *The Ethical Animal*, Allen and Unwin, London.

Whiten, A.: 1998, 'Imitation of the Sequential Structure of Actions by Chimpanzees (*Pan Troglodytes*)', *Journal of Comparative Psychology* **13**, 270–281.

Zhang, J., Webb, D.M. and Podlaha, O.: 2002, 'Accelerated Protein Evolution and Origins of Human-Specific Features: *FOXP2* as an Example', *Genetics* **162**, 1825–1835.