The Evolutionary Roots of Culture

At a recent assembly of the Académie Royale des Sciences de Belgique, **Professor Andrew Whiten FBA, FRSE,** *received the Delwart International Scientific Prize for 2001. The $10,000 prize is awarded every four years for a study linking ethology and cultural anthropology. Here, he offers an overview of this interdisciplinary enterprise.*

'Culture' is at once what sets our species so much apart from nature, and yet what defines our nature. It is humans' cumulative cultural achievements that have allowed us to dominate the planet as we do. Indeed, culture is seen as such a special human attribute in some quarters that I and my co-authors were somewhat taken aback by media response to a recent article we dared to entitle 'Cultures in chimpanzees'. In the *New York Times* alone our findings reached the front page and elicited not only an extended commentary by the celebrated Stephen Jay Gould, but an alarmed editorial. The anxiety prompting the latter was that any study with a title like ours must be challenging humanity's supposed cultural uniqueness.

To anyone familiar with the ethological literature this reaction is misplaced. During the last century, students of animal behaviour identified numerous examples of what they termed 'cultural transmission', in which continuity between the behaviour patterns of one generation and the next is maintained not genetically but through some form of social or observational learning. Some of the most elegantly and amply documented examples are the 'dialects' that have evolved amongst songbirds.

It is therefore not so very revolutionary, after all, to talk of 'cultures in chimpanzees'. The real news is in the details – in a word, the *richness* of the phenomena now being uncovered. At a recent meeting on the topic at the Collège de France, attended by an interdisciplinary group of biologists, anthropologists and archaeologists, I suggested that rather than engage in ultimately fruitless debate about which species do or do not 'have culture', we are now in a position to recognise an array of different ways in which human culture goes far beyond biologists' basic notion of 'socially transmitted traditions', and to assess how far our closest living relatives, chimpanzees, go in displaying the beginnings of these. Such comparisons open the way for reconstruction of the cultural propensities of our common ancestor of about six million years ago, a critical juncture in reconstructing the evolution of the human mind.

Contemporary human cultures are of course much mediated by language. Any shared elements with chimpanzees must perforce be essentially non-verbal. With this proviso, our comparisons can be summarised under two main headings: first, cultural patterning at the population level; and second, the nature of the transmission processes responsible.

Contrasts in Cultural Patterning

Cultural variations amongst humans have for long been documented by historians describing temporal change, and of course by anthropologists charting regional differences. Yet despite the fact that we and our ancestors have shared the planet with our closest relatives for millennia, it is only now that we can begin to contemplate a similar analysis for chimpanzees. Forty years ago we knew virtually nothing about their behaviour in the wild. Now, we know much. In recent years, together with the research directors of the most long-term field stations across Africa, I was able to instigate a systematic comparison that drew on a total of over 150 years of observation of the nine communities concerned.

In a first phase, we drew up a list of behaviours that workers judged likely candidates for cultural variation. This may sound simple but in fact necessitated a complex iterative process of definition, redefinition, splitting and lumping between the expert contributors. We arrived at a suprisingly long list, of no less than 65 candidate behaviour patterns, testament to the inventiveness of this species.

In Phase 2, the research directors assigned each behaviour pattern to one of several categories describing their prevalence at the fieldsite concerned. Collating this material, we identified as cultural variations those behaviours that are common in at least one community, yet absent in at least one other, without discernible direct ecological explanation. We also required grounds for believing variations were socially rather than genetically transmitted. Thus, for example, 'nut-hammering' (using natural hammers of wood or stone to crack open nuts) met our criteria because it is customary in two communities in West Africa, yet absent in others where all the raw materials are present; moreover, its distribution is not correlated with subspecies boundaries, but instead halts at the

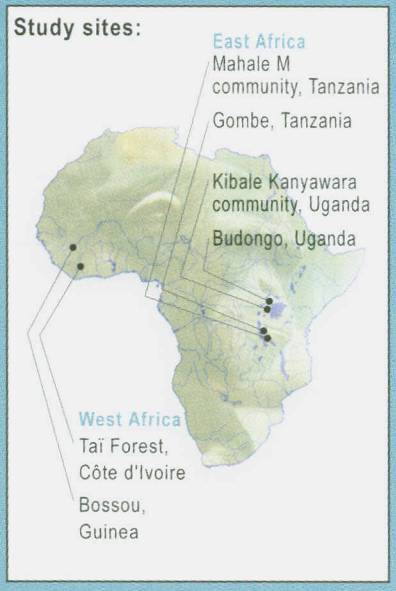
Professor Whiten held a British Academy Research Readership, 1999–2001.

Figure 1.

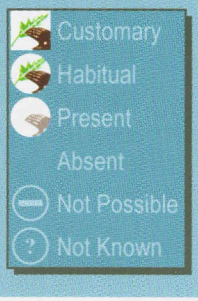
Cultural Variation Amongst Chimpanzees at Six Long-term Study Sites

Putative cultural variation amongst chimpanzees at six long-term study sites, identified as behavioural patterns absent in at least one location yet habitual or customary in at least one other.

Behavioural patterns are organised in rows such that high frequency occurrences (customary, habitual) occurring in the same regions of Africa are as far as possible clustered, forming a ragged diagonal band from top-left to bottom right (the nature of the distributions means this can be achieved only approximately).



For full descriptions of behaviour patterns see:
Whiten et al. (2001)
also:
http://culture.st-and.ac.uk/chimp



massive Sassandra N'Zo river. Hammer-users are found only on one side, yet chimpanzees, nuts and appropriate rocks occur on both sides.

Charting the differences between communities (Figure 1) allows us to ask whether chimpanzees show evidence, similar to humans in several respects, of going beyond the basic biological definition of 'culture' as transmitted traditions. Here I consider four. First is the number of cultural variations. Although animal studies have identified traditions, each study has typically identified only a single variation; for example, there is no evidence that populations of songbirds with different dialects also vary in other behaviours. In humans, of course, the scale of variation is vast. Chimpanzees, we discovered, are intermediate insofar as the chart identifies as many as 39 cultural variants, covering aspects of tool use, communication and grooming rituals (indeed, we now know that more await formal inclusion in our next survey).

A second, related respect in which the overall picture shows some affinity with human cultures is that each community exhibits its own distinctive profile of variants, some of which are unique to it and some shared with others. Each community's profile is illustrated in the columnar 'bar codes' of the chart illustrated here. Thus, any one chimpanzee can be assigned to its community on the basis of its cultural behavioural profile. Clearly, the scale and patterning of variations in chimpanzees is rudimentary by comparison to what has evolved culturally in humans, but equally, it goes far beyond anything demonstrated before among non-human species.

A third issue is whether there is evidence of what some anthropologists have described as cultural 'cores' that represent central, organising ideas underlying clusters of behaviour patterns. We find little solid evidence that anything equivalent exists in chimpanzees, although we are perhaps the first to have the kind of database at our disposal to begin to assess such a possibility. Two hints that some phenomena of this kind may exist are, first, that the prevalance of tool use in the Taï Forest, so much greater than at other sites where it would appear useful (Budongo, Kibale), raises the possibility that some general technological orientation is at work at Taï; and second, there is evidence that brush-like tools are used in central Africa to harvest ants and termites, whereas in east Africa finer probes are used, similarly 'across the board', to fish out these very different species.

The fourth and final phenomenon to consider under this heading is the cumulative aspect of cultural evolution, so evident in the human case. Every complex human culture has been built by progressive elaboration of what went before. Several aspects of the overall African distribution of chimpanzee behaviours are consistent with some form of cultural evolution, in which communities display what appear to be differentiated forms of certain behaviours found in their neighbours. An example is that ecto-parasites removed in grooming by Taï chimpanzees are squashed on the forearm using a finger, whereas in east Africa they are either squashed on a leaf (Gombe) or placed on a leaf for inspection before being eaten or discarded (Kibale); the leaf use in these two communities may have differentiated from a universal habit amongst east African chimpanzees in which occasional 'leaf-grooming' is incorporated into social grooming episodes. However, such differentiation embodies little if any rise in complexity. Accordingly, a capacity for substantial cumulative cultural evolution may be the feature that most fundamentally distinguishes humans from the species that in other respects shows significant cultural richness.

Contrasts in Social Transmission Processes

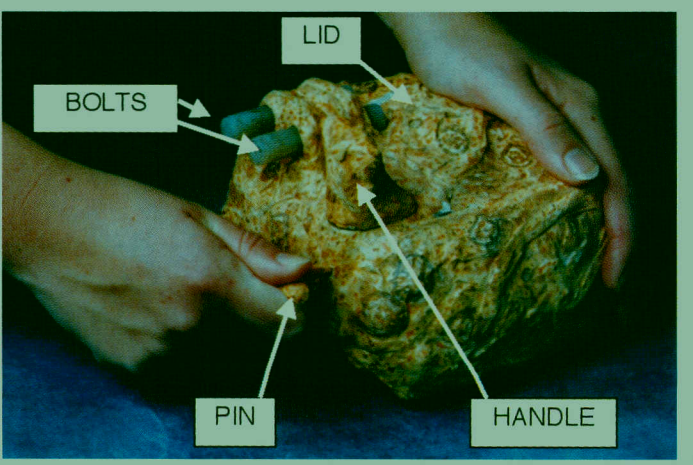
The transmission of human culture can rest on the relatively active donation of information that we see in teaching; alternatively, the active role may be restricted to the learner, as in imitation and other forms of 'observational learning'. In chimpanzees or indeed other animals, there is relatively little sign of teaching, although there is evidence that mothers may at least support the acquisition of the most complex skills such as nut-cracking, by facilitating access to appropriate hammers and nuts.

By contrast, youngsters appear to be active acquirers of social information, intently watching the skilled actions of their elders. The problem in establishing the consequences of such attention in the wild is that it is difficult to discriminate the effects of observational learning from those of personal practice as the skill develops, typically over many months or even years. For this reason we have turned to experiments with captive chimpanzees, most recently in sanctuaries in Africa where we can work with wild-born apes in semi-natural contexts.

One of the most instructive approaches has been to offer what we have called 'artificial fruits' (Figure 2), opened by skills like those needed in the wild. These 'fruits' are designed so that they can be manipulated succesfully in at least two very different ways, only one of which each experimental subject sees. This enables us to establish quite precisely just what is acquired by observation. There is room here to highlight just four main findings.

First, we have found chimpanzees to copy the particular sequential structure of succesful methods they witness (the first non-human

Figure 2. An 'artificial fruit' showing pin, handle and two bolts, all of which must be dealt with by removal or twisting out of the way, before a lid can be opened and the edible core extracted.



species to be shown to do so), together with some of the detailed techniques (Figure 3). Young children exposed to the same models copy in similar ways, but with greater fidelity. The apes are more ready to use their own approach where they can see it is more efficient; children are more likely to copy so faithfully that they are slower to succeed than the apes, but overall this is presumably a strategy that pays off for the supreme cultural species!

The second finding concerns the related phenomenon of human cultural conventions;

Chimpanzee with 'artificial fruit'.

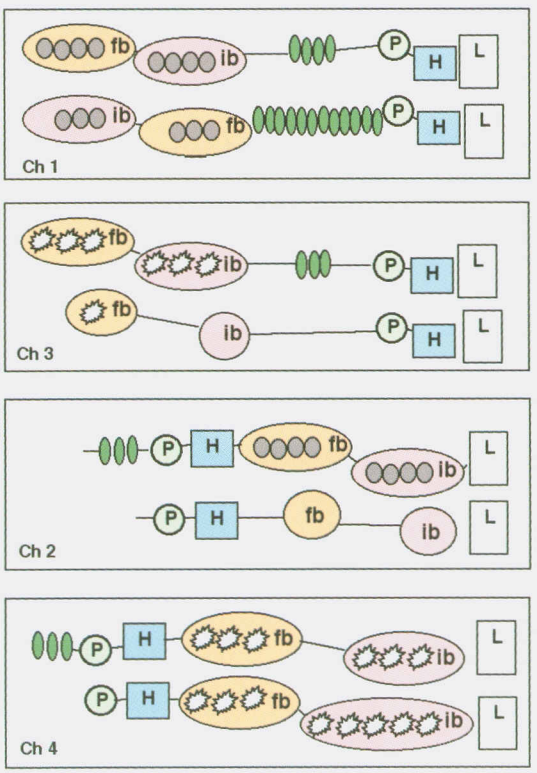


Figure 3. Schematic representation of results of observational learning experiment. For each of four chimpanzees (Ch1–Ch4), the actions of the model are portrayed above, and immediately beneath them the actions used to open the fruit by the chimpanzee who saw this model, in the third and final trial. Note the close matching of sequence of fruit-defence removal, together with variable matching of form of actions used.

Key
Removal of: fb = far bolt, ib = inner bolt, P = pin, H = handle, L = lid
= twist and pull bolt
= poke bolt through
= turn pin

children may copy certain behaviour just because 'that is what is done'. Interestingly, those chimpanzees that copied the sequencing of actions they witnessed did not do so initially, but instead converged on the model sequence after several iterations. In this case, despite the success of other actions they tried, they converged on a model apparently just so as to 'be like them'.

Third, to test not merely what chimpanzees *do* tend to copy, but what they *can* copy, we trained two juveniles to imitate to order (on the request, 'do this!') then tested them with a battery of novel actions, a significant number of which they copied – although again, not nearly so faithfully as young human subjects. The finding I highlight here is simply that they could learn this 'game', showing that they have some understanding of when they are copying what the other does; to this extent their acquisitions can become self-conscious, as they do in the course of human childhood.

Fourth and finally, neither child nor chimpanzee ape all they observe; they are selective. In the case of children, this selectivity has been shown to include preferential copying of elements of the act seen that are causal as opposed to incidental, or intentional rather than accidental. Our most recent experiments have shown some sensitivity of these kinds – a 'search for meaning' – in the imitation of chimpanzees.

In this brief overview I have perhaps appeared to emphasise the similarities of ape and child. But our conclusions are emphatically not that apes' cultural propensities and achievments are like ours – manifestly the differences in cultural propensities and achievements are vast in scale. What we *are* achieving at last, I believe, is a focus on just where the fundamental equivalencies lie (and where they lay ancestrally) and just where the crucial differences begin.

Further reading

Joulian, F (ed.) 'How the Chimpanzee Stole Culture: Culture and Meaning among Apes, Ancient Hominids and Modern Humans'. Balland, Paris, in press.

Whiten, A. (2000). 'Primate culture and social learning'. *Cognitive Science* 24, 477–508.

Whiten, A. Goodall, J., McGrew, W.C., Nishida, T., Reynolds, V., Sugiyama, Y., Tutin, C.E.G., Wrangham, R.W. & Boesch, C. (1999) 'Cultures in chimpanzees'. *Nature* 399, 682–685. An associated, illustrated, graphical database can be found at: http://culture.st-and.ac.uk/chimp

Whiten, A. Goodall, J., McGrew, W.C., Nishida, T., Reynolds, V., Sugiyama, Y., Tutin, C.E.G., Wrangham, R.W. & Boesch, C. (2001) 'Charting cultural variation in chimpanzees'. *Behaviour* 138, 1481–1516.