The Fate of the Third Chimpanzee

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Session 1
The More Things Change, The Less They Stay The Same

I
Introduction

In this presentation, I will begin by outlining a "standard model" of human cognitive evolution, and of our evolved cognitive architecture. I will then contrast that model with an alternative (based on Thought in a Hostile World and more recent work). That alternative proposes both a contrasting model of the selective regime that drove hominin cognitive evolution, and of the evolved architecture of the mind. In developing this alternative, I aim to show its explanatory and heuristic advantages, and to prefigure the delights to come in the next three sessions. But the standard model does capture some central features of hominin evolution, so it is important to identify those insights of the standard model, and to incorporate them into the alternative.

As I see it, the standard model conjoins a selective and an architectural hypothesis. The selective hypothesis supposes that the key features of hominin environments are other hominins. A hominin's fitness largely depended on patterns of interaction with other hominins. Those who were more successful in forging co-operative relations, and those who were more adept in interaction with their rivals, left more descendants. Other features were relevant, but the social environment largely shaped our cognitive and behavioural evolution. For the demands of an increasingly complex social life require an increasingly sophisticated cognitive response. This basic idea — the Social Intelligence Hypothesis — can be developed in several ways. Robin Dunbar, for example, supposed that increasing group size increases social complexity and put stress on our memory and conflict management time budgets, selecting for more efficient mapping of the social environment and more effective communication. Geoff Miller's model stresses sexual competition. But probably the most influential variant of this hypothesis derives from Nick Humphrey's Machiavellian model. According to this model, in hominin social worlds every agent is forced to play social chess, trying to leverage as much profit from social interactions as possible, while paying minimal costs. Clearly, as players become more intelligent, social chess becomes more complex, and there is selection for still greater intelligence.

Hominins are distinctively intelligent, then, largely through selection for social intelligence. This selective hypothesis is conjoined to an architectural hypothesis; the famous modularity model. Notoriously, evolutionary psychologists have developed a modular model of the cognitive engine that has emerged from the complex social worlds of hominin evolution. The idea that our minds are "massively modular" has three sources. (i) One is the example of language: evolutionary psychologists have followed cognitive psychologists in treating nativist linguistics as a paradigm of how cognitive competence is to be explained. (ii) The second is the idea that the environments in which humans evolved posed a set of informationally challenging, distinctive, re-occurring but quasi-independent problems. There was intense selection on human agents to solve those problems, and as a result we evolved specific adaptations to help us do so. (iii) As a consequence, we solve many day-by-day problems effortlessly, efficiently and unreflectively. Since the problems are difficult, this cognitive efficiency requires special explanation.

In my view, the standard model understates the dynamism of hominin evolutionary environments, and hence mis-characterises the information-using preconditions of a successful hominin life. The questions hominin environments asked of our ancestors are not quasi-independent. The evolution of social, co-operative foraging (I shall argue) is one central aspect of hominin evolution, and as a result of that economic transformation, foraging practice, technology, social organization and human demography all interact. In the "broad spectrum revolution", for example, there were striking and causally interrelated changes in human group size, social organization; technology and foraging practice. Specialisation, differentiation and population density all increase together. Changes in any one of these variables affect the others.

Moreover, change was pervasive. Hominins evolved in times of increasing climatic variability, and (by about two million years ago) they had spread far and wide from their original East African epicentre. So the physical environments of our ancestors became more variable and heterogeneous. Furthermore, and most importantly, hominins became increasingly potent ecological engineers. The hominin footprint on the local environment became ever more marked and more pervasive. Thus the environments of hominin evolution have been unstable both physically and biologically. They have also been unstable socially. Group size, the extent and nature of the division of labour; the extent of social hierarchy; the importance and nature of interactions with other groups all impact on an agent's social world. None of these factors has been constant over the last 100,000 years. In my view, human worlds have been unstable psychologically as well: the psychology of other agents has also varied over the last 100,000 years. The standard model rules this possibility out. If our minds are (mostly) ensembles of (largely) pre-wired modules, then human nature is largely the same every where and when. But I shall argue we are pervasively and profoundly phenotypically plastic: our minds develop differently in different environments. If so, important differences in human socio-foraging worlds will result in importantly different inhabitants of those worlds.

A central idea of these lectures, then, is that the informational prerequisites of adaptive action are neither stable nor relatively discrete. The standard model is right to insist that many everyday challenges of human social life impose a high cognitive load, and that our response to these challenges is typically competent. Such ubiquitous competence does indeed require special explanation. How is it (for example) that almost all of us master and respond to the norms of our immediate circle? Yet we are competent despite the fact that in many cases, we cannot be pre-wired with most of the crucial information needed for adaptive response. Often, though not invariably, we respond competently to novel high-cognitive load problems. The standard model overstates the informational independence and stability of the challenges we usually meet.

Two caveats before continuing. First, Massive Modularity and the Social Intelligence Hypothesis (Machiavellian-Version) are natural partners, and are often defended together. But they are not a package deal: it is possible to accept one while rejecting the other. Second, for ease of exposition I shall present the standard and alternative models as if they were exclusive alternatives. That is an over-simplification. Many hybrid models are possible, and some are plausible. Indeed, my own best guess is that some hybrid is the right model.

II

The Standard Model

The standard model is standard, so in expounding the central ideas I can be brief. I begin with Machiavellian feedback. Hominin cognitive evolution cannot have been driven mostly by external environmental change, as then we would expect similar trajectories in other species, and that we do not see. So proponents of this model are right in thinking that there is both a remarkable and a unique phenomenon to be explained. Five million years ago, our ancestors were unobtrusive elements of the East African mammalian fauna. We now inhabit essentially every terrestrial habitat, in numbers unprecedented for a large mammal, and we have transformed most of the world's ecologies. The speed and extent of this evolutionary transformation suggest that it has been driven by a positive feedback loop. The fact that it is unique — no other great ape lineage is a mirror site — suggest that the dynamics are internal, presumably triggered by some idiosyncratic feature of our early history. According to the standard model, the feedback loop derives from the problem of managing co-operation: a problem that becomes ever more crucial, and ever more difficult, as human agents become more intelligent.

As the standard model represents the problem of co-operation, it rests on the strategic aim of enjoying the benefits of co-operation without being exploited by others. Co-operation can be very profitable, because a group acting jointly can generate a higher return than the sum of each of them acting individually. Collective defence, for example, will typically be far more effective than individual defence. Hominin evolution, amongst much else, is one long lesson on the profit of co-operation, and the power over the world that derives from successful co-operation at and across generations. So there is a potential benefit to co-operation, but only if the costs of defection can be contained. For co-operative actions are not free, and the benefits of co-operation often do not fully depend on every agent paying the full co-operation cost. Collective defence can still be successful even if one defender lurks in the rear. These circumstances generate a temptation to avoid the costs of co-operation while collecting the benefits.

This analysis of the "hard problem" of co-operation is reflected in the traditions of both evolutionary models and experimental economics. Much evolutionary modelling of co-operation is based around variations on iterated prisoner's dilemma themes.

In these models, the rewards of successful co-operation (and those of defection and of trust betrayed) are free parameters, to be adjusted as the modeller chooses. The models explore the consequences of different patterns of interaction; the effects of punishment; of error; of the effects of the manipulation of rewards and costs. They do not explore the mechanisms that generate the rewards of co-operation. The same is true of experimental economics. For example, in typical public goods games, the central pool that is the reward of co-operation is simply by experimental fiat double the total of the individual contributions. The experimental subjects need to commit to co-operation, but co-operation involves no collective action or joint problem solving. Rather, these experiments investigate the conditions under which co-operation stabilises or decays, conditional on the ways the profit of co-operation is divided amongst the players.

Machiavellian hypotheses focus on this cognitive challenge of managing co-operation in an environment in which defection is a threat. Co-operation is so profitable that it eventually became an obligate feature of hominin lifeways. Going it alone has not been an option for tens, probably hundreds, of thousands of years. But in such environments, agents must calculate and police reciprocal bargains, scrutinize signals for honesty, decide on disclosure principles, negotiate alliances, decide whether to defect. As other agents become more intelligent, these decisions become more demanding. As cognitive sophistication increases, social environments become more demanding. This selects for further cognitive complexity.

While the problems of deception and defection are more serious in contemporary mass societies than in the social worlds in which the co-operative framework of human life evolved, these problem have always been real and important. But defection management is not all that is needed to keep co-operation stable. To be stable, it must also be profitable, and profitable co-operation often requires co-ordinated co-operation. Indeed, in small scale, traditional socially worlds, the cognitive problem of effective co-ordination is more demanding than that of detecting defection. So while the standard model is right to identify the evolution of stabilised, extensive, obligate co-operation as the core, distinctive feature of hominin selective environments, that model misrepresents the task demands on co-operation. The standard model focuses on explaining how the profit of co-operation is distributed in ways that do not undermine the temptation to co-operate. The alternative model focuses on a prior question: how does hominin co-operation generate a profit?

There is a natural link between this version of the social intelligence hypothesis and a modularity hypothesis, for most candidate modules are tools for social life. If prudent co-operation was central to a successful hominin life, and prudent co-operation was stable only through vigilant mutual scrutiny, we might well expect special adaptations to monitor social exchange and to monitor norms and norm violation. Most obviously, folk psychology will be a crucial resource in co-operation management. Tracking the beliefs, preferences and intentions of others is essential in a world in which partners are essential, but in which they are at best reluctantly honest, and kept so only by sleepless vigilance. The Social Intelligence Hypothesis (M-V) seems to a predict minds with a suite of adaptations for a social life revolving around bargaining, exchange and honesty assessment, and that is the kind of mind advocates of the MM hypothesis think we have.

Moreover, the cognitive complexity of other agents, and the social complexity that generates, explains why routine human decision making has a high cognitive load, and hence why everyday competences need to be supported by special tools. We are individually complex agents living in, and contributing to, socially complex worlds. The factors that ramp up the informational demands on routine decisions include:

(i) We have many needs, so trade and exchange is complex, with multiple trade-offs

(ii) We are long-lived, with good memories, and form long-lasting high stakes relationships. Entering into a sexual or social alliance is often a high-risk high-reward decision.

(iii) Sex is complex, as we are social, quasi-monogamous primates with male investment and somewhat concealed female ovulation. Moreover, we live in a fission-fusion society with a sexual division of labour. Males cannot guarantee paternity by direct vigilance of female behaviour.

(iv) We pool information, as well as co-operating to make direct economic gains

(v) Agents are only partially transparent to one another. We signal richly, but some of those signalling systems are arbitrary, referential systems with low intrinsic reliability. We have considerable voluntary control over facial expression, stance and voice, and so can partially fake and suppress many natural cues. We have stealth and deception capacities.

Ordinary human decision making, then, takes place in a translucent social world. There is, typically, relevant information available; information that would guide adaptive decision making were an agent aware of it, and able to assess its relevance and reliability. But, often, cues are not perceptually salient. Their relevance are often not obvious, and their reliability are difficult to assess. Our social world is translucent because it is the result of a Machiavellian evolutionary dynamic.

I do not think this picture of the informational demands on human agency is mistaken. The cognitive challenges of policing the division of collective and co-operative products are real. But this picture is one-sided, and it does not support a modularity hypothesis.

III
An Alternative Model: Co-operative Foraging

There has certainly been an increase in hominin social complexity. But there has also been a transformation in the ways hominins interact with, and extract resources from, their environment. The (gracile) australopithecines, and early *Homo* were, as far as we can tell, generalist scroungers, subsisting on the proverbial nuts and berries, with the odd grub, slow lizard, and scavenged carcass fragment thrown in. By (perhaps) 200, 000 years ago, they were dominating predators. In sharp contrast to other predators, those hominins often specialised in the prime adults of their target species; typically large ungulates. Hominins went from being food to taking food from other members of the predator guild. The shift from marginal scrounging to major predator status most likely took place via increasingly aggressive scavenging. Thrown volleys of rocks would be no great threat to (say) a mobile leopard. But they would genuinely endanger one immobilised by the need to defend a kill. For, strikingly, we seem to have become major predators without long-distance lethal weapons; i.e., before the invention of spear-throwers; bow-and-arrow technology or poison-tipped weapons. Spears (and perhaps killer frisbees) sufficed.

Later still, probably as a result of living in larger groups and of our increasing ecological footprint, the range of resources humans harvested expanded greatly. There was much more systematic exploitation of plant-based resources. Fish and other marine and riverine resources became important. Water fowl and smaller game were taken with specialist equipment. Indeed, in general, this expansion of the resource base is paired with an expansion of specialised toolkits. To grind grains and make bread; to harvest water-based resources; to catch smaller game economically, foragers needed and developed specialised toolkits and techniques. At about the same time as this increase in technological specialisation, there are other changes in material culture. "Style" becomes noticeable. Regional variation in material culture came to reflect more than regional differences in local resources. The signs of burial of the dead with grave goods; physical symbols and physical decorations (ochre, pierced and shaped shells) all begin to appear regularly in the record. The pace of technical change increased. For the first two million years and more of hominin evolution, technology seems to change extraordinarily slowly. At some stage in the period 150,000 bp to 100,000 bp, that changes. Collectively, this ensemble of ecological, material and (apparent) ideological changes are known as the establishment of behaviourally modern humans. Still later, humans began to actively manage the processes which generate resources.

We will return to these changes and their significance., but I take these shifts in ecological role to be a clear paleoanthropological signal of the invention and establishment of a new lifeway, built around a new mode of foraging. By 200,000 bp, hominins had evolved into social foragers. Such foragers depend on harvesting high value, but heavily defended resources. The regular exploitation of those resources (at tolerable risk loads) depends on some mix of (i) rich, targeted ecological information (so, for example, tubers are a rich carbohydrate store, but they must be found, recognised, detoxified, processed); (ii) co-operation, and (iii) technology. Typically, all are needed, though the exact mix will vary with time, place and target. Thus the Cape Buffalo of my image were targeted without the capacity to kill at a distance. But technology was required, and it must have been allied to a detailed understanding of the prey, its capacities, habits and likely reactions, and to skilled, co-ordinated group hunting.

Truly lethal weapons are needed before individuals and small groups can take such large and dangerous prey.

As with Machiavellian models, on this view of hominin evolution, co-operation is central to our evolving cognitive capacity. But our conception of the informational challenge changes. Co-operative foraging (and especially co-operative hunting, and co-operative defence against predation) requires co-ordination, and hence communication. Co-operative hunters must plan and co-ordinate before targeting potentially difficult and dangerous targets (especially if there is task specialisation). But even if there has been advanced planning, on occasion, not everything will go according to plan. Agents will have to react on the fly, sometimes in novel situations, and often with imperfect information. They will make high-stakes decisions under time pressure, based on their reading of the physical and biological context, and on their expectations of others' reactions, and with rather limited prospects for communication and consultation. No doubt those on the fly-decisions were often not optimal. But they were typically good enough for lifeways based on co-operative foraging to establish and spread, and that is impressive in itself. For these are high-load decisions. Hunting and killing 1,000 kg plus animals with a sharp stick is no easy project.

Co-operative foraging is one key transition in hominin evolution, and the capacity to co-ordinate effectively in informationally translucent environments is a cognitive precondition of such foraging. More generally, it is a precondition of stable co-operation that involves the division of labour and role specialisation in un-stereotyped circumstances. Hunting large game co-operatively with limited technology depends on effective co-ordination in the light of transient target information. But it also depends on a rich understanding of stable features of the physical, biological and technological environment. Typically, much of this information is acquired culturally. So a second cognitive precondition of co-operative foraging is cross-generational information pooling. Not all cultural learning depends on the source of information co-operating. Agents leak information in their everyday activities. Moreover, they often adaptively structure the learning environment of their young as a byproduct of their own utilitarian activities. However, high-volume, high-fidelity cultural learning depends on information co-operation between source and soak in an appropriately organised environment, and on specific perceptual and cognitive adaptations, probably of the source as well as the soak.

Behaviourally modern human cultural worlds depend on high volume, high fidelity cultural learning. For the elaboration of technology (and hence of technique) depends on a group being able to retain the cognitive capital it inherits, occasionally adding an innovation to it, then transmitting that enhanced capital to the next generation with high fidelity. Indeed, it is arguable that behaviourally modern humans differ from their predecessors just through the establishment of social environments in which high volume, high fidelity social learning is robust (more on this, in Session 3). But while there is something to this idea, earlier humans depended on quite high volume, high fidelity social learning. It is true that until behavioural modernity was established, hominin toolkits were not elaborate. But while high volume, high fidelity social learning is necessary for elaborate technology, it is not sufficient. Such technology has demographic and economic preconditions. For it is profitable for an agent to invest in specialised tools (for, say, catching fish or wildfowl) only if he or she tends to specialise in those targets. Specialisation, in turn, has economic and demographic preconditions. A group of 20 cannot support a specialist artisan tradition; the market is too small. A group of 250 may well do so.

Thus a generalist, low-variety technology may reflect economic constraints rather than an inability to reliably preserve and amplify the informational substrate of a varied technology. Moreover, exploiting high risk, high return resources it itself a signature of the preservation and transmission of informational resources. The Neanderthals that regularly exploited elk and other large European ungulates, and the pre-behaviourally modern Africans who specialised in similar targets, were skilled and knowledgeable. Expertise (and co-operation) compensated for limited technology. So too were the ancient tuber and corm harvesters, if underground storage organs really were important resources from *erectus* on. Fruit are designed to be eaten. But plants do not welcome herbivore consumption of their storage organs, and hence they are protected both mechanically and chemically. So they are inedible without sometimes elaborate processing. So while the capacity to add to cognitive capital, by reliably preserving and amplifying innovation, may be relatively recent, it is likely that the reliable preservation of expertise is ancient. Both hominin minds and hominin social environments are adapted to the social acquisition, use and transmission of ecological and technological expertise. Without such adaptations of minds and social environments, life as a social forager could not have evolved. (Learning biases and cognitive attractors have followed such social learning, and have evolved because of the centrality of such learning to hominin life. As sophisticated nativists recognise, such innate factors do not substitute for such learning but amplify it, as in, for example, Avital and Jablonka's assimilate and stretch models).

Social foraging, then, is informationally demanding over short time frames through the requirements of joint and co-ordinated action. It is informationally demanding over longer time frames through resting on a reservoir of skill and expertise. A final important point. It requires the integration of ecological, technological and social information. So, for example, effectively responding to an emergency requires an agent to integrate what they know of the situation — the level and nature of the threat; the lie of the land; the potential responses — with their knowledge of their social partners. An agent responding to an threatened attack needs to understand who stays calm; who panics; who is a hothead, and they need to factor in the physical condition of their partners. The right response to injury, fire or flood is dependent on specific local circumstances, and the capacities and frailties of those who face emergency. Response cannot be too stereotyped. No doubt social foragers quite often made poor decisions in response to crisis. But equally clearly, the persistence of this lifeway in a dangerous world (the world of 150,000 bp was much more dangerous than it is now) shows that the response of social foragers to the unexpected often satisficed. Paleodemography is very controversial (as we shall see in Session 4) but the basic structure of human life history, with its extended periods of juvenile dependence, requires that on average, mortality is low once adulthood is reached. Social foragers had many dangers to negotiate, and usually did so successfully. Moreover, it is not just in emergencies that social foragers need to integrate social, ecological and technological information. Routine planning and co-ordination rests on such integration. So, I shall shortly argue, does the organization of the social learning of expertise.

IV

An Alternative Model: Managing Novelty

Hominins have not evolved in a stable world. As Rick Potts emphasises, the world of hominin evolution has been increasingly climatically unstable: the Holocene is an aberrant stretch of stability against a shifting background. But more importantly still, co-operative foraging is such a powerful mode of interacting with the environment that it directly and indirectly transforms the hominin environment, and hence the ways in which selection has acted on our ancestors. Co-operation (perhaps in conjunction with other adaptations) has allowed the hominin lineage to penetrate new regions and habitats. At a time, hominin environments have become increasingly variable, as hominins have become increasingly widespread ecologically and geographically. Moreover, co-operative foraging has an increasingly heavy ecological and physical footprint over time. The populations of target species are depleted; landscapes are altered (for example, by the use of fire as a tool). Predators become increasingly rare, wary, or both. These environmental effects create coevolutionary opportunities for species which will eventually domesticate, and for scavengers of various sizes (rats, mice, cockroaches, lice). Changes in mobility, residence and population size change the pathogens humans experience. So co-operative foraging caused direct and highly consequential changes. As I noted earlier, the Broad Spectrum Revolution is often read as a response to the depletion of most favoured target species.

So the direct effect of social foraging is significant and cumulative, as environmental change becomes more rapid and intense. But the evolution of social foraging has profound indirect effects as well, by both selecting for, and making possible (through an increased period of juvenile dependence), increases in the fidelity and volume of cultural learning. Investment in social learning changes social life directly; for example, it is arguable that a distinct form of social hierarchy, based on esteem and prestige, has developed because social learning is central to our lifeways. Not only does prestige depends on reputation, which depends on communication and hence social learning. Esteem is the price the less able pay to the expert for access to their expertise. Whatever the fate of this conjecture about the role of prestige-based hierarchy in traditional social worlds, it is surely true that groups with a rich tradition of information-sharing, and which are in part organised around information sharing, are different social environments that those in which social learning is less organised and central. Public symbols in various forms — song, ritual, physical symbols, public art — are part of the machinery of group identity; part of the machinery through which groups in themselves become groups for themselves. These symbol systems depend both directly and indirectly (via the technology needed to make them) on elaborated cultural learning. Elaborated social learning probably evolved because of selection for utilitarian expertise. But once evolved, the capacities can be exapted for other purposes, including such machinery for social cohesion. Moreover, once innovations are more reliably preserved, transmitted and built upon, individual and collective effects on environments increase. The elaboration of the control of fire (from true hearths to container-based cooking; pottery and technology that depends on the control of heat); of clothing; of shelters; of watercraft as well as tools and weapons all magnify human impacts on their environment.

The effects of social foraging on demography and group size also increase the pace and intensity of environmental change. All else equal, improving the efficiency with which humans extract resources from their environment will result in an expanding population and an increase in group size. Larger groups preserve informational resources more reliably, for learners have more expert models from whom they can pump information, and expertise is less likely to be lost by unlucky accident. But as Haim Ofek argues in Second Nature, size makes the benefits of specialisation more available. There is a market for special skills, so larger groups can divide labour more finely. Ofek conjectures that fire keeping was the first form of labour specialisation. If he is right, that specialisation preceded behavioural modernity, and perhaps even social foraging itself. But as the returns of social foraging increased, and especially, after behaviourally modern humans began to depend on the efficient harvesting of many different resources, amongst larger groups there would have been important incentives for specialisation. If specialists are more likely to successfully innovate in their field of specialisation, as seems likely, there will be positive connections between elaborating social foraging, increased group size, and the rate of innovation. In any case, the elaboration of social foraging coevolved with increasing specialisation, and hence with an increasingly heterogeneous social environment.

I have been labouring these points about environmental change for a reason. The informational requirements on adaptive action vary, as the environment varies. Because humans have lived in such variable environments, many high load problems cannot be solved by pre-wiring information into human heads. Our genes do not know what kind of world we will live in, and that has been true for a couple of hundred thousand years; perhaps longer. These changes are not small. In many cases, the problem of access to adaptively salient information cannot be solved by pre-wring human heads with much of the information necessary (or with partially specified schema), allowing learning to fine-tune pre-wired capacities. This plausible model of language does not export to most other competences. Even if we confine our attention to humans before the invention of farming and domestication, humans have experienced, and adaptively responded to, ecological challenges as varied as hot inland deserts (central Australia); the high arctic (the Inuit); tropical rainforests (Africa, Central America); shallow tropical seas (Indonesian archipelago); large game specialisation (savannah Africa). While some principles of biology and naive physics are constant across the ecological challenges those environments pose, the constant features are very coarse-grained. Most of what these different peoples need to know will be specific to their circumstances.

Moreover, ecology, demography, social structure and specialisation interact. The differences in ecology ramify. These foraging peoples live in different social and psychological worlds, not just different ecological worlds. The problem of novelty cannot be contained to a single domain. Change in ecology and demography are reflected in changes in specialisation, stratification, and investment in high fidelity cultural learning. These in turn impact on the social and psychological judgements an agent must make. For example, the problem of trust changes as we shift from relatively homogeneous and intimate social worlds to those in which differentiation and exchange play a more central role. As social stratification becomes important (and grave goods hint that some forms have deep roots), social and sexual decision making has ever high stakes, as the differences between winners and losers becomes more marked. Defection and deception become serious dangers (more on this in session 3). As group size increases, or as interactions with other groups becomes more common, interactions with relative strangers becomes important. The social world of (for example) the complex foraging societies of the Pacific Northwest, organised around salmon exploitation, were very different from those of the Australian aborigines of the first 20,000 years of their occupation. The Northwestern societies had a highly developed technology; intricate systems of public symbols; were densely populated, with marked social stratification. The early aboriginal world had very low population densities, with small, scattered groups; a very limited technology; few signs of social stratification and public symbol use. Australian aboriginal problems of social navigation and mindreading were very different from those of the Northwest.

V
An Alternative Model: The Skill-Niche Construction Nexus

Language is the organising exemplar for the standard model. I suggest that a traditional craft skill, acquired via apprentice learning, is a better organising schema. So according to this alternative model, humans respond adaptively to novel, high load problems by acquiring skill or expertise through something akin to traditional apprenticeship learning of crafts: a hybrid learning mode that combines trial and error learning in a learning environment organised, and sometimes supervised, by the expert. Phenomenologically, expertise is somewhat akin to the modules of the standard model. Think, for example of literacy, or of the precise quantitative reasoning our mastery of the integers and positional notation gives us. These are in some ways models of skills in forager skill sets. We see the appropriate physical patterns as words rapidly, automatically, without conscious effort; while being engaged in other tasks. Once the skill is fully acquired and installed, reading is no longer difficult; it no longer demands attention. But while phenomenologically, literacy and simple numeracy are akin to modular capacities, they are not so developmentally. Literacy is not triggered by experience: it is acquired relatively slowly, with considerable effort and variation. Literacy is not a pre-wired adaptations. Indeed, literacy illustrates our adaptive response to novelty. In contemporary mass societies, it is crucial. But the features of the world to which it is a response — frozen language, and long-distance decontextualised communication — are novel. Yet most individuals in first world societies become functionally literate: they are able to act adaptively in a world in which most language is not speech.

Of course literacy and numeracy are not good models of forager skill sets in one respect: their acquisition depends on formal educational institutions. But while forager skill acquisition does not depend on formal educational institutions, it does depend on engineering children's learning environment. So, for example, forager children are provided with toys (for example: miniature bows) and encouraged in games that practice crucial skills. In many forager societies, children, especially somewhat older children, contribute to the family economy. But to allow them to do so, they are provided with equipment appropriate to their size, strength, skill level, and local ecology: fishing lines or spears; nets, baskets and the like. They learn by doing, but what they do is engineered by adult experts via their equipment supply. Children are taken on adult foraging expeditions (and these are sometimes modified to make the trips safer or more educational for the children). Often, they begin to learn craft skills by first helping their adult relatives, combining practice with observation; again, learning by doing, but with skilled adults organising the sequence with which skills are acquired.

Language is important in skill acquisition too. As well as seeing expert practitioners in action, and helping them, children often have a chance to listen to experts talk about their expertise; to acquire the local lore as well as the practice. The general picture is that much skill learning in forager society is trial and error, but supervised and organised trial and error. Moreover it is trial and error in an environment seeded with props and other cognitive tools. The specialist vocabulary to which children are exposed marks salient distinctions. Tools and artefacts — finished, half-finished and broken — are available as sources of inspiration and comparison. In short: while the role of explicit teaching in traditional societies is often quite limited, adults can and do structure and engineer the learning environment, even without explicit teaching.

The expert organization of trial and error learning by a combination of (i) task decomposition: (ii) ordering skill acquisition, so each step prepares the next; (iii) well chosen exemplars is very powerful, as traditional craft apprenticeship learning shows. To the extent that skill acquisition in forager societies is similar to this mode of hybrid learning, it makes possible high volume, high fidelity social learning. Such social learning makes it possible for agents like us to acquire cognitive skills; even those that power responses to novel environmental challenges. In Session 2, I shall illustrate the power of this mechanism with a contemporary (and much discussed) example: moral cognition. In Sessions 3 and 4 I return to the themes of co-operation, its evolution, and the coevolution of co-operation and cognition. In session 3, the focus is on information sharing. In session 4, it will be on social foraging, and on the relationship between ecological and reproductive co-operation.

The bottom line, though, is that any good model of the evolution and architecture of the human mind must be built around two key phenomena. The first is that despite the usual examples of birth control and fatty foods, we are not in general incompetent in the face of novelty. We need to explain not the existence of adaptive lag, but rather, the fact that it is a relatively minor problem. Each of us has survived in a world unimaginably different from that of a Pleistocene forager. The second is that we survive novelty because we can accumulate and wield cognitive capital. We do not do so perfectly, but we do so well enough to be here, and to be almost everywhere else.