Research

Human nature, cultural diversity and evolutionary theory

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Incorporating culture into an expanded theory of evolution will provide the foundation for a universal account of human diversity. Two requirements must be met. The first is to see learning as an extension of the processes of evolution. The second is to understand that there are specific components of human culture, viz. higher order knowledge structures and social constructions, which give rise to culture as invented knowledge. These components, which are products of psychological processes and mechanisms, make human culture different from the forms of shared knowledge observed in other species. One serious difficulty for such an expanded theory is that social constructions may not add to the fitness of all humans exposed to them. This may be because human culture has existed for only a relatively short time in evolutionary terms. Or it may be that, as some maintain, adaptation is a limited, even a flawed, aspect of evolutionary theory.

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1. INTRODUCTION

More than 40 years ago, the ethologist Konrad Lorenz wrote that ‘the stratified structure of the whole world of organisms absolutely forbids the conceptualization of living systems or life processes in terms of ‘disjunctive’—that is to say, mutually exclusive—concepts. It is nonsense to oppose to each other—‘animal’ and ‘man’, ‘nature’ and ‘culture’, ‘innate programming’ and ‘learning’—as if the old logical diagram of alpha and non-alpha were applicable to them. . . human nature persists in and is the basis of culture; and all learning is very specifically innately programmed’ [1, pp. 20–21]. Nonsense indeed. Four decades on, few would now argue against the notion that the natural place for humans is in culture, and culture is the quintessence of human nature because it is our biology that enables us to enter into culture. The challenge is to find a theoretical framework that provides the causal linkage between the biological and social sciences. Evolution, along with recent important theoretical additions, such as niche construction and ecological inheritance, is the undisputed central theory of biology [2,3]. Lorenz’s assertion that the biological and social sciences can be, and must be, married within a single theoretical structure can only be realized within an expanded theory of evolution.

However, if any attempt to extend evolution to culture is to gain credibility among social scientists, then it must grasp the most complex features of human culture and not be reliant upon some simple-minded extension of evolution to incorporate only the most basic forms of culture such as the imitation of motor

acts or to aim at some form of atomization of culture within the incorrect assumption that cultural traits are particulate [4]. Human culture, the most complex phenomenon on the planet, comprises many entities, some of which are indeed simple motor behaviours, but others are complex higher order knowledge structures (HOKS) such as the concepts of schools or shops, and yet others embody beliefs and values within social constructions like patriotism and marriage, which only exist because individual humans believe in such things. Belief is a complex set of psychological states caused by currently poorly understood psychological mechanisms and serving as yet unknown evolutionary ends. Nonetheless, social constructions have enormous causal force in human affairs and are one of the most potent engines of human diversity. If social constructions can be incorporated into some form of evolutionary analysis, then we begin to approach a true theoretical amalgam of the biological and the social. We are not yet able to do this, but what follows points to what must be done if we are ever to achieve such a synthesis, a synthesis that when it comes would have equal importance to the synthesis of natural selection and genetics that occurred in the 1920s.

2. EVOLUTION, LEARNING AND CULTURE

The core quality of culture, in any species, is that something is shared by way of a specific process of learning. Thus, if culture is to be causally linked to the processes of evolution, then the first step Lorenz would have demanded is understanding the relationship between learning and evolution. In a seminal paper delivered at the Villa Serbelloni in the 1960s, C. H. Waddington declared ‘the systematic exploration of the evolutionary

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strategies in facing an unknown, but usually not wholly unforecastable, future' as 'the most challenging... of the basic problems of biology' [5, p. 122]. Learning, the process by which behaviour becomes adapted to local environmental circumstances which change faster than evolution acting only on gene pools can adjust to, is one possible solution to Waddington's uncertain futures problem. We cannot know when learning first evolved, but its adaptive advantages are such that it probably appeared soon after the first appearance of primitive nervous systems in early multicellular organisms; molecular evidence points to something in the region of 600 Myr [6]. Whether learning can occur in single-cell organisms is controversial and probably doubtful; but learning is well-documented in five of the 25 or so major phyla of Animalia, these being both flat and segmented worms, molluscs, arthropods and chordates. It is likely that learning evolved independently in each of these phyla, and it is certainly not the case that all species in all of these phyla have evolved the capacity to adjust their behaviours through the process of learning.

The most frequently demonstrated kinds of learning, namely habituation and associative learning in the form of classical conditioning and instrumental learning, show many similarities in all of these phyla. This is probably the result of the common causal structures of the world, rather than some identity of neural mechanism, though common key biochemical bases cannot be discounted. However, habituation aside, the learning of all species occurs under conditions of specific constraint, which is why Lorenz referred to learning as innately programmed. Most forms of learning, then, gain knowledge that forms the basis of adaptive behavioural adjustment, which the main evolutionary programme cannot keep up with, even though evolution almost always points the learning processes to what, in general, needs to be learned. The evidence for evolutionary constraints on learning, including human learning, is overwhelming [7] and has given rise to notions such as 'the instinct to learn' [8].

There is a causal relationship between the individual gain of knowledge and the wider context of the collective knowledge of a species that exerts constraints on learning by way of the gene pool. Understanding learning within a theoretical structure that establishes this relationship will provide an answer to the old rationalist–empiricist argument in what the philosopher of mind Jerry Fodor called the 'new rationalism' [9]. It will also lay to rest the old fear of so many social scientists of a rampant biology providing false genetic reductionist explanations of social phenomena. Learning places causal explanations for adaptive behaviours as much within the neural network mechanisms that govern learned behaviour as they do within the genetic and developmental mechanisms which constrain that learning. A proper theoretical account of learning, a Lorenzian framework, means that genetic reductionist accounts of any behaviour that has a learning element belong to the rubbish bin of the history of ideas. This applies to all behaviours rooted within a cultural context as much as it does to any other forms of learned behaviours.

A relatively small number of species learn by observing, directly or indirectly, the behaviour of conspecifics. It has long been known, for example, that the acquisition of song in some species of songbird occurs by way of young birds hearing the song of adult conspecifics [10,11]. This is not universally true for all songbirds. For example, the song of the Eastern Phoebe, a species of North American flycatcher, develops normally in birds that have been raised in social isolation [12]. However, there are many species of bird whose song is atypical if they do not hear the song of conspecifics [13–15], which is evidence not only for species-typical constraint of learning, but also that song in some species of songbirds is a product of cultural transmission. Such birds are creatures of culture.

More convincing to many of the existence of non-human culture comes from the study of cetaceans [16], orangutans [17,18] and chimpanzees in their normal environments [19,20], as well as in laboratory experimental settings [21]. The 1999 *Nature* paper pooled the work of nine primatologists covering over some 151 accumulated years of observation [19]. A total of 39 separate behaviours, concerned with tool usage, signalling, courtship and grooming, are widespread across different chimpanzee populations, but significantly different in how they vary from population to population. Food pounding, for example, is customary among the Gombe chimpanzees, but never observed in the Mahale population just 200 km away which has a near-identical ecology to that of the Gombe Reserve. Similar differences exist between the chimpanzee populations of West Africa. One group opens nuts by placing them on a rock 'anvil' and striking them with a stone or wooden club, whereas no member of the chimpanzee population to the east of the Sassandra-N'Zo river has ever been recorded as doing this, even though nuts are plentiful in both environments. Neither genetic nor ecological differences explain such behavioural variations. These are animals of a single species that are acquiring different behaviours common to geographically isolated groups by way of learning mechanisms sited in the neural networks of individual animals. That such learning mechanisms have evolved, presumably from more basic forms of learning, is not in doubt; that they are subject to innate constraints is not in question; that they cannot be explained by some form of genetic reductionism is clear; and that they add to the diversity existing within this species is obvious.

Culture in non-human species thus conforms to Lorenz's demands for unified, if complex, evolutionary causation. What applies to sparrows, dolphins and chimpanzees, applies equally to culture in humans; the differences lie in what constitutes the elements of variation in human culture—in what is shared.

3. HUMAN CULTURE

Schemes or systems ('theories' would be too elevated a claim) of human learning and knowledge-gain range from the simplifications of associationism to the arcane complexities of structuralism. In their account of the major evolutionary transitions that encapsulates

the entire history of life on the planet [22], Szathmari & Maynard Smith list sociality (specifically the appearance of colonies with non-reproductive castes, which Moreton Wheeler described as superorganisms) and the move from primate societies to human societies, central to which was the evolution of language, as the last two crowning transitions in 3.8 Gyr of evolution. As will be argued below, singling out language as the defining feature of human evolution is probably incorrect. Human language as a form of communication is a uniquely human trait, but it is what is being communicated that is as important as the means of communication, and what is being transmitted from human to human, the heart of human culture, is at once a product of learning and occurs by way of learning. Associationism does not begin to encompass the complex mix of knowledge-gain, 'knowledge-invention' (see later) and communication of such knowledge that comprises human culture; something like structuralism might do so in the future. Ferdinand de Saussure founded the school of structural linguistics in the nineteenth century. Saussure had argued that language could only be understood within a framework of a closed system of elements and rules that account for the production and social communication of meaning within the context of Emile Durkheim's notion of 'social fact', which is close to the modern notion of 'social reality' [23]. Saussure viewed language as a system of discursive signs shared by a linguistic community, the relationship between signs and meaning being arbitrary and conventional [24]. Structuralism was significantly advanced by the French anthropologist Claude Lévi-Strauss and had important influence on the likes of Noam Chomsky in the development of his linguistic theory and also on Jean Piaget's general systems theory of learning, which he saw as a dynamic system of transformation and regulation [25].

The details of different structuralist conceptions are not relevant here. What is is that much of human culture is based upon the acquisition and transmission of knowledge, not muscle twitches; and that knowledge must be understood within a social context, much of it arbitrary and conventional. This is not a denial that humans learn to do things like manipulating utensils or tying shoe laces by observing others, and that this is a form of culture and cultural transmission. Nor is it a denial that early human cultures were much like that of modern chimpanzees, though we can never know with any certainty. But it is an assertion that a great deal of the culture of modern humans, and much the most important part, comprises the sharing, by way of learning, of other entities that cannot be causally linked to motor behaviour.

These entities, at a minimum, are HOKS and social constructions. There is no simple way to separate these from one another; HOKS are essential components of social constructions. The latter, however, are the quintessence of human culture and will be dealt with separately in subsequent sections of this essay. What, then, are HOKS? HOKS are an essential part of semantic memory comprising inter-related clusters of meaning [26]—meaning derived from reference to states or objects in the world. HOKS begin to form

early in a child's cognitive functioning, and the clusters of knowledge, concepts, are constantly enlarging and altering. For example, living forms in Western cultures revolve around creatures like cats and dogs but will also come to incorporate birds and spiders. All of them have autonomously generated powers of movement; only much later are plants seen to be living forms as well. Even within clusters there are complexities. Birds fly and sing; but later penguins and ostriches enter the category of birds, and these do neither. There are two main theories of how HOKS are formed. One postulates the archetypal models made up of necessary and jointly sufficient attributes—children come to understand that it is the presence of feathers that define animate objects as birds. Other theories centre upon the Wittgensteinian notion of prototype theory in which family resemblance leads to rather fuzzy concepts comprising the common elements of the HOKS being assembled.

Some cognitive scientists have argued for the centrality of inter-related structures of meaning of semantic memory. However, while dogs may be structured as warm-blooded land-living and barking, and subsumed under broader categories such as vertebrates, dogs are also defined in terms of being fun, companionable, a working beast or a danger to those who deliver the mail. HOKS are defined by shifting frames of reference, and are not only developmentally determined, but also culture-specific. Dogs do not form part of the HOKS relating to hazards of work in cultures that do not have postal systems. And the HOKS of shops and restaurants are characteristics of recent human cultures that have economic structures such as exchange through trade.

So brief a review as this does scant justice to the complexity of HOKS, but no discussion of semantic memory and its inter-dependence on culture can leave out mention of the work of Bartlett [27]. Prior to Bartlett's seminal work, memory was studied by psychologists largely through the learning of word-lists embedded within the simplistic framework of memory as atomistic, and the contents of memory as unrelated to one another. Bartlett's work changed all that. He considered memory as dynamic and creative reconstruction of events and not as some kind of passive remembering of disjointed elements. Memories are constantly changing as we rework and reinterpret our memories, in part because our goals and wishes reshape our memories as expectations of our past, and partly through the effects of unconscious generic knowledge structures, culturally determined, that form the anchoring points around which memory is structured. He called these knowledge features, or structures, schemata, which are abstractions of the world we have experienced. Schemata are the equivalent of mental structures of gravity that attract memories and shape them. In one culture, knowledge is gained within schools that comprise a set of rooms with desks, instructors and children grouped in terms of age; in another culture, schools may be all the children within a community gathered in some single outdoor site. Remembering stories about school life, he found that people systematically altered their memories to accord with the cultural norms of

what a school is; in neither case are dangerous animals or deranged adults a part of the school schemata and if such were present in the original stories, Bartlett observed how they were systematically degraded and eliminated as familiar features such as teachers and desks were inserted into remembered tales.

Bartlett's ideas were 40 years ahead of his time but when the cognitive revolution of the 1970s ousted the associationist and atomistic traditions of behaviourist psychology and incorporated cognitive science into newly developed fields such as artificial intelligence, it was to the ideas of Bartlett on generic forms of knowledge that people turned. Marvin Minsky, computer scientist and one of the pioneers of machine intelligence adopted Bartlett's conception of schemata, which he renamed frames, and developed formal computer programs in which generic clusters of knowledge played a central role in machine intelligence. Schemata found their way back into cognitive psychology through the work of David Rumelhart, who stressed how, as products of experience, schemata are culturally determined: schemata 'represent knowledge at all levels,—from ideologies and cultural truths to knowledge about what constitutes an appropriate sentence in our language to knowledge about the meaning of a particular word' [28, p. 215]. Shank & Abelson [29] expanded the notion of generic knowledge to what they termed scripts, which constitute a form of knowledge of how to behave and what to expect in specific settings—how to act in a school as opposed to a restaurant.

What is common to all of these formulations is that, unlike the much more stringently constrained forms of learning that build more basic sensory and motor skills, and perhaps even the learning of language, for HOKS the knowledge that is acquired is highly dependent on culture and cultural experience. If knowledge varies across different human communities, that variation is culturally determined. Culture is not just the expression of different forms of knowledge within social groups, it is that which causally gives rise to human variation and diversity of culture. However, no formulation of what makes human culture different from non-human cultures should ever step outside of the Lorenzian demands that ultimate causal explanation must link human culture back to the cognitive functioning of individuals, and hence to the evolution of the knowledge-gaining mechanisms that are specific to our species.

4. SOCIAL CONSTRUCTIONS

Human culture is a natural phenomenon, but a natural phenomenon that has the curious property which Searle [30], in his masterful analysis, labelled the characteristic of being able to induce a kind of 'metaphysical giddiness'. The source of that giddiness lies in the capacity for this aspect of human culture to generate an endless array of cultural variants of seemingly insubstantial form whose very existence, like the existence of omnipotent beings, can be questioned. These are the social constructions of human culture, things that we construct within our minds, which we imagine, and then share with others, and in so doing generate

diversity which is at once fragile and causally hugely powerful. Money and ideology are examples of social constructions that rule, and often destroy, the lives of almost all living humans. I rely almost entirely on Searle's analysis in the following pages.

Searle was not able to provide any kind of account of how the human mind evolved the properties that it currently has—and neither can anyone else. However, he assumes, rightly, that evolved it has, and the crucial capacity that underlies social constructions is conscious intentionality, which he defines as 'the capacity of the mind to represent objects and states of affairs of the world other than itself' [30, pp. 6–7]. Conscious intentionality is caused by the mechanisms of the human brain, and hence is a physical process. Thus, all that stems from intentionality does not in any way violate a materialist approach to human culture. It does, however, provide the basis for drawing a fundamental distinction between 'brute' facts, such as the presence of sand with minimal water content in a desert, and the 'institutional' or 'social' facts, like marriage or money, which are wholly dependent upon human intentionality. Deserts would exist had humans never evolved. Marriage and money are caused only by the existence of humans with specific neural and psychological mechanisms. Money does have a physical manifestation in coins, banknotes, cheques and the like, but the value of a banknote in terms of the paper on which it is printed (value itself is a social fact) is of little consequence to those who accept it in exchange for a loaf of bread or a flight to Edinburgh; marriage is a contract (a form of social fact) written on a piece of paper, but entails a string of obligations regarding children and ownership of certain goods. Brute facts are intrinsic to nature; social or institutional facts are wholly dependent upon human nature (which, of course, is itself a brute fact, if a special one). This distinction between brute facts and social facts is central to Searle's analysis. In the nineteenth century, Birmingham industries manufactured hundreds of different kinds of hammers [31], different from one another in terms of their shapes and the ways in which steel and wood were blended into a single object. The wood and metal were the brute facts of hammers—the hammers' intrinsic properties. That hammers are used to drive objects together is an epistemic addition to the wood and metal that is bestowed upon it by users and observers—humans with specific psychological processes and mechanisms. What Searle did was apply this basic distinction to human social interactions. He did this by arguing for three essential elements in the creation of social facts.

The first of these elements is the psychological property of assigning function, a specific aspect of human intentionality, though he allows the possibility for some rudimentary form of it in a small number of other species. We assign functions to natural objects, such as trees providing cooling shade, but we also construct objects that fulfil specific functions, like huts and houses that give shelter. Function is thus agentive and guided by specific purpose (this is a hammer and its purpose is to drive objects together); and non-agentive, by which we ascribe functions which do not serve our intentional goals (the function

of the liver is to remove toxins). One crucial form of agentive function involves our understanding that one thing stands for another. 'Standing for something' is the function that they have, what their purpose is. A map, whether printed on a page, drawn with a pen or scratched out in sand is a representation of spatial relationships in which intentionality stands between the person drawing the map and the person being guided by it. Maps thus convey the function of meaning in which one thing stands for another. Language, whether spoken, written or signed, is the most important form of agentive function that we impose on the brute facts of sound, vocal tract movement or the movement of our hands.

The second of Searle's elements is what he refers to as 'collective intentionality'. The notion that individuals may be drawn into a collective identity based upon a common goal has been offered by other philosophers attempting to identify key aspects of human culture [32,33]. Collective intentionality is a shared intentional state, and may embrace any number of individuals, drawing them together into a loose unit of commonly held desires and plans. A football team, with its shared desires for victory, and agreed tactics and common understanding of their opponents' weaknesses, has the properties of collective intentionality; as do the supporters of a football team. The defining feature of collective intentionality for Searle is that the collective intentionality exists and stands prior to individual intentionality, the former actually being a cause of the latter. What the individual wants and knows may be caused by the group of which they are a part. Collective intentionality is central to Searle's conception of social reality. It is not simply the sum of individual intentionalities making up a group and it is not reducible to them. It is the property of human social groups essential for the construction of social reality. 'We intend' is not simply the sum of 'I intend'. It is a social force in its own right, and every social or institutional fact is in part caused by collective intentionality. It is the glue of human culture and the reason why humans gain pleasure from acting together, whether that acting together involves eating with others, gossiping in the office, or going to the cinema with a friend. It is, along with language, one of the things that makes us human.

The third essential element of social reality is what Searle refers to as constitutive rules, which create the conditions for specific social activities such as playing a game, being a shareholder in a company, or entering into religious beliefs and activity. Constitutive rules form the basis of institutional or social facts. When I buy shares in a company I hand over some money (itself a social fact) in order that I may participate in the profits and losses of that company (another social fact), but do not own the enterprise yet have some small part annually in determining how that company operates. As the citizen (a social fact) of a country (also a social fact), I have certain rights and obligations within that country, but not in other countries. Humans live in a world awash with social facts, the constitutive rules of which determine how we live our lives.

Constitutive rules, the assignment of functions and collective intentionality are all necessary ingredients of

social reality, which is the collective imposition of functions within a social group. Searle argues that all social reality conforms to the structure of 'X counts as Y in C'. A share certificate (X) counts as proof of being a shareholder (Y) in the UK (C). A marriage certificate (X) counts as proof of marital status (Y) within certain countries and religious organizations (C). X counts as Y in C is iterated repeatedly to form a complex, inter-related social reality. Being a citizen of the UK (X) allows me legal status to work in Poland (Y) because both countries are members of the European Union (C), but is a form of social reality that does not extend to the United States or Brazil.

'The connecting terms between biology and culture' Searle concludes 'are, not surprisingly, consciousness and intentionality. What is special about culture is the manifestation of collective intentionality and, in particular, the collective assignment of functions to phenomena where the function cannot be performed solely in virtue of the sheer physical features of the phenomena. From dollar bills to cathedrals, and from football games to nation-states, we are constantly encountering new social facts, where the facts exceed the physical features of the underlying physical reality' [30, pp. 227–228].

That social facts, money, legal obligations, the existence of the UK as a social fact which makes it other than a small island off the northwest coast of a northern continent, constitutes the fabric of our everyday lives, yet which is based only upon agreement, and continuing agreement, is what gives social constructions the property of 'metaphysical giddiness'. In the recent global financial crisis, one possible solution to the UK's woes was what is called 'quantitative easing', which did not even entail the actual physical printing of money by the Royal mint, but merely changing the figures on the balances available to the major banks for lending to businesses. What, one is led to ask, is money but the collective agreement that it has value—but what is value? Several times in different parts of the world in the twentieth century, people stopped agreeing that money had value and traded instead in other commodities, often cigarettes. For decades, a specific ideology ruled the lives of hundreds of millions of people in Europe. The ideology, created by one person in the previous century, dictated where people could live and work, what they could earn, whether they lived free or in prison, and what they could read and, often enough, what they could say. Then in a brief period in the late 1980s, communism collapsed because people in sufficient numbers refused to agree that it was a social system of any value. About the same time, apartheid in South Africa was abandoned and the lives of non-white peoples in that part of the world changed radically. Scottish nationalists in the UK do not accept that they should be ruled by a parliament in London, just as the majority of the people of Ireland and India ceased in the twentieth century to subscribe to the belief that they were a part of Britain. Is the UK really United? Is there a European union? No one questions the existence of dry sand in the Sahara desert. But it is not difficult to look at a £20 note and wonder at its value. All social facts hinge upon the existence of some degree of

agreement, of concerted and sustained agreement. The move from individual intentionality to collective intentionality may be, probably is, as important to the most recent evolutionary transition as the evolution of language itself.

Strange as social constructions might seem to be, there is no need to subscribe to a kind of Cartesian dualism in which this particular aspect of human culture is assigned some immaterial existence that floats ethereally between the individuals making up a culture. Social constructions are made up of the collective neural network states of individuals within social groups. There are, there must be, neurological and psychological mechanisms that give rise to social reality, and which place human social reality within the same causal framework as all other forms of human learning and knowledge. There are at least three identifiable psychological mechanisms whose neurological bases remain to be understood. The first is undeniably language, and there is no serious opposition to the Chomskian notion of language as an innate and evolved organ of mind [34,35]. Language alone, however, is unlikely to support modern human culture as it has evolved over the last 100 000 years or so. 'Theory of mind', the understanding that others have intentional mental states, has during the last few decades come increasingly to be understood as equal to linguistic communication in allowing us to comprehend the beliefs and knowledge of others [23,36,37], with the mirror neuron system of the brain implicated with increasing frequency as one of the mechanisms responsible for theory of mind [38–40]. Mirror neurons have been observed in the brains of a number of different species of other primates, and may provide one of the bases for culture in other animals, though it should be emphasized that mirror neurons are very unlikely to be the lone causal sources of culture in any species.

There is widespread agreement on the importance of language and theory of mind in the evolution of human culture, as well as of HOKS. What is paid relatively little attention is what I have previously referred to as social force, though the notion of a conformity bias in the work of Boyd & Richerson [41] on gene–culture coevolution is a rare exception in placing social force at the centre of human culture. In the 1930s, the social psychologist Muzafer Sherif published the results of a series of studies [42] on how people within a small social group reach agreement about uncertain events. He used the visual illusion known as the autokinetic effect, where people were told to fixate their gaze on a stationary spot of light in a darkened room and after a short time the light appears to move. The subjects, not told that the apparent movement was an illusion, were asked to say how far the light had seemed to move. When tested in groups and requested to say aloud what they experienced, Sherif found that, in every case, people would rapidly home in upon an agreed amount of movement, which would eliminate the initial variation in the experienced and reported movement. People used the reported views of others to establish a frame of reference for their own judgements; in short, Sherif was observing the establishment of group norms, a

kind of constructive conformity which Sherif believed is a fundamental feature of human social interactions.

Sherif's work was extended by another social psychologist, Solomon Asch, in the 1950s [43], using a simple experiment that has subsequently been replicated and extended in a host of different cultures. Asch presented to a small group a vertical line on a card. He then presented to each subject another card with three lines on it and asked which of the three lines matched the length of the original. It was a simple task but only one of the group was a naive experimental subject, the rest being confederates, plants of the experimenter instructed to give in two out of three occasions the wrong answers. The situation was also rigged such that the single naive subject was always asked for their response after most of the stooges had deliberately given the wrong answers. Asch found that only one-quarter of the naive subjects stuck to their views and gave the correct answers; the majority gave a clearly incorrect response that conformed with what most of the stooges had declared, or they wavered and gave answers that were uncertain and changeable. When asked why they had given what were clearly the incorrect answers, most people expressed anxiety at going against the majority view. The need to conform was greater than the evidence of their own visual experience and judgement. Subsequent studies of the Asch experiment in many different cultures have shown that while the strength of the bias to conform varies across cultures, the effect is always present. The need to conform is a universal human psychological trait.

Jacobs & Campbell [44] described an interesting variation on Sherif's original experiment with the autokinetic illusion. They put together a group in which all but one of the so-called subjects was naive, the rest being plants who grossly overstated the amount of perceived movement and the naive subject delivered her or his judgement last. In line with Sherif's findings, the single naive subject gave an overstated judgement of perceived movement. Then, one by one, the stooges were withdrawn and replaced by naive subjects until eventually the entire group comprised naive subjects. Yet the 'cultural tradition' of overstating the perceived amount of movement was maintained even when the group was made up of individuals none of whom were stooges. Here was a case of conformity operating across 'generations' of individuals regarding a belief based upon an illusion.

But the most powerful demonstration of what social psychologists call conformity, obedience or group cohesiveness was reported in a series of papers in the 1960s, summarized by Milgram [45]. Using actors and stooges, Milgram repeatedly demonstrated how people without any history of cruelty or violence would, when ordered to do so by a figure of authority, inflict violent punishment upon others. Milgram's studies were merely a replication under controlled conditions of what we all know of from the Holocaust inflicted on the peoples of Europe by the Nazis, depicted by Hannah Arendt as the 'banality of evil' in which ordinary people living ordinary lives will commit unspeakable acts of evil against others when those acts are sanctioned by authority and interwoven

into the ordinariness of everyday life. Subsequent events in Rwanda, the Balkans and the Middle East show how the death squads and death camps of the Nazis were an expression of a universal feature of human nature, social force that leads to obedience and conformity.

Exactly how the psychological mechanisms of language, theory of mind, and social force act in concert to generate human culture, is unknown. Understanding intentional mental states in others may be present in rudimentary form in chimpanzees [46], and the existence of something like social force in other species of apes has been consistently advocated by some primatologists [47]. It may be that culture in any primates which have been observed with certainty to share knowledge, is built upon similar psychological mechanisms. And it may be that the integrated functioning of communication by way of language, the ability to comprehend the intentional mental states of others, and the existence of social force of whatever kind, is a present-day, naive, assemblage of the mechanisms of human culture. We certainly have no knowledge whatever at present as to the causal structures that will one day be understood regarding the linkages between genes, neural and psychological mechanisms. But that such causal linkages do exist, and that human culture in whatever form is a product of evolutionary forces, is not to be doubted. That is the Lorenzian lesson.

5. IMPORTANT QUESTIONS

It is not possible for a biologist in the twenty-first century to doubt that the most important and distinctive feature of humans, our universal capacity to enter into culture, lies within a causal framework of evolutionary theory. The genetics that predispose humans to the psychological mechanisms that allow human culture, the neural networks that form the basis of these mechanisms, exactly what comprises individual knowledge gain through learning, and the collective intentionality of linguistically communicating individuals—all of these pose huge challenges for a complete human science in the future. Social constructions are central to human culture; we ‘make things up’, and then communicate what we make up to others. These ‘made-up’ forms of knowledge are then adopted by others. Many people know what a unicorn is, even if no such creature has ever had corporeal substance outside of the neural networks of those who know what a unicorn is. That is why earlier in this paper culture was referred to as invented knowledge. The result is an additional source for human diversity. Cultures can take a huge number of different forms. But this poses a real difficulty for placing human culture within a biological context, that difficulty concerning the concept of adaptation.

It is a curious fact that the notion of adaptation is largely implicit in Darwin’s 1859 work. In the original, and in the subsequent editions of *The Origin of Species*, neither in the index nor in the ‘glossary of principal scientific terms’ later assembled by Darwin, does the word appear at all. He did make explicit references to the concept; for example, in the first paragraph of

chapter 3, ‘The Struggle for Existence’, he asks how ‘exquisite adaptations’ have arisen. But it is as if natural selection was so dominant in Darwin’s mind that what was being selected somehow took second place. This was not the case with the revival of evolutionary theory in the twentieth century. The concept of adaptation was central to the highly influential work of Williams [48], though he did refer to it as an ‘onerous concept’; and a glance at most standard textbooks on evolution will show adaptation being described as a ‘crucial concept’ (e.g. [49], p. 5). There have, however, been critics of the concept, the best-known being the eminent evolutionist Lewontin [50,51]). As the philosopher of biology Godfrey-Smith put it, for Lewontin adaptation was a ‘*bad organizing concept...*’, which has a larger negative role, in reinforcing an erroneous general picture of the place of humans within our environment, both biological and cultural’ ([52], p. 181, italics in the original).

Lewontin’s criticism has always been controversial. He simply did not believe in the ‘passivity’ of organisms implicit in the concept of a process whereby organismic change occurs ‘in response’ to the conditions of the world. For Lewontin, organisms, all organisms, are active and evolution is a constructive process. One of the most important additions to evolutionary theory in recent years is the notion of niche construction and ecological inheritance [53], and it is no coincidence that niche construction is a detailed extension of Lewontin’s constructivism, in particular, the two differential equations of his 1983 paper. It is also significant that Odling-Smee and his collaborators have always considered niche construction and ecological inheritance to apply to any consideration of human culture [53]. From handwriting to the Internet, written script is the classic case of cultural niche construction.

There is now a long history of applying evolutionary principles to cultural change. It began with Murdock [54], and was made popular by Dawkins [55]. While controversial (see [56] for opposing views), in recent years there have been a number of papers that make powerful cases for considering cultural change within an evolutionary context [57,58]. And while the advantages of some aspects of culture, such as capturing the energy of gravity acting on water in the form of mills is clear and indisputable [31], what were the adaptive advantages of the social construction of national socialism? The social construction of Nazism led to the deaths of tens of millions of people, including Germans, in the last century. It was, of course, not the only instance in recorded human history of a highly destructive social construction. One solution to the problem is a crude dissection of human culture into obviously adaptive aspects such as technology, and adaptively ambiguous features like social constructions. A more interesting approach might be to take a more subtle view of the overly broad conception that many biologists have taken of the adaptation concept.

One such is that offered by the late Stephen Jay Gould, who had longstanding doubts about the adequacy of the adaptation concept [59]. Darwin had clearly understood that not all phenotypic features are adaptations and that not all currently adaptive

traits have always been adaptations. Gould & Vrba [60] extended Darwin's view by emphasizing the importance of what they termed exaptation, the process of 'cooptation' by which phenotypic features, either previously selected for a specific adaptive function and/or which cannot be considered to be the product of direct selection for any previously adaptive purpose, are co-opted for a different function in the present. Contrary to the often stated view that Gould was hostile to the application of evolutionary theory to the human mind, he stated in a paper explicitly addressing the difficulties of evolutionary psychology that 'it would be the most extraordinary happening in all intellectual history if the cardinal theory for understanding the biological origin and construction of our brains and bodies had no insights to offer to disciplines that study the social organizations arising from such evolved mental power' [61, p. 51]. Exaptation, including the extension of previous adaptive function to new adaptive function, was, he argued, a crucial conceptual tool for evolutionary psychology. It takes little thought to understand that many, perhaps all, complex psychological traits are adaptations arising from the cooptation of the already existing adaptations. Language, for example, is built upon specific auditory sensitivity, fine motor control and working memory among other cognitive traits, each likely an adaptation in their own right. Writing is an exaptation of exaptations, being based on language itself and motor control of the hand. All social constructions are also exaptations based upon other exaptations, including language, the attribution of intentional mental states and forms of social force. It is possible that such networks of exaptation may become loose instruments for adaptive function in its original Darwinian sense—may, indeed, give rise to traits that may be non-adaptive.

There is another possible explanation for the destructiveness of some social constructions. In a recent essay, Marc Hauser [62] considered the 'possibility of impossible cultures'. Hauser bases his argument on the observation that contrary to a once widely held view that evolution is able to give rise to unlimited variations in phenotypic form, he points to the evidence that this is not so: 'New molecular approaches have now sharpened our understanding of the sources of variation and of how developmental programmes interact with and constrain evolutionary processes' [62, p. 190]. Evolution is a set of historical processes, which means that the past always constrains the present; this applies in both the phylogenetic and ontogenetic realms. As Gould liked to point out, Darwin taught us that history matters, and it matters in imposing limits on what evolution can give rise to. However, it takes time for constraints and limitations to evolve.

In Szathmari & Maynard Smith's [22] scheme of major evolutionary transitions, the three most recent transitions present massive differences in time span. Multicellularity occurred in the region of 700–800 Myr ago. The existence of coherent social groups with a functional cohesiveness of a quality that led Wheeler [63] to describe them as 'superorganisms' first appeared about 100 Myr ago. There can be no

certainty as to the first appearance of modern human culture, but let us guess at a figure in the region of 70 000–100 000 years BP. Now the reason why the impressive social functioning of a hive of bees acting collectively as a 'superorganism' is nonetheless of a lower order than the functional integrity of the individual bees making up the colony is probably attributable to group selection in social insects having had only in the region of a sixth or seventh of the time for evolution at the group level to have occurred than evolution working upon each individual in the group. Six or seven hundred million years of evolutionary time is likely to have had significant effects on the degree of functional integration that might evolve. If there is any truth to this argument, then it must apply also to the evolution of human culture. This is highly speculative, but it may be that humans give rise to social constructions that are maladaptive because there has not been enough time for social reality to reach the point where such social constructions have been eliminated by the evolution of constraints that make such beliefs and values impossible to be held by groups of humans. However, it must be conceded that it is also possible that Lewontin was right and that the notion of adaptation is as bad an organizing concept for understanding the evolution of human culture as it is for understanding evolution at large.

6. CONCLUSION

The social reality of modern human culture is the single characteristic that marks our species off from all others. It is rooted within the capacity of individuals to learn, specifically within the ability to learn from other members of our species. Its uniqueness must lie within the combination of human cognitive and social mechanisms that give rise to social reality. Whether it be judged as a specific type of adaptation is questionable; what is not is that it lies within a continuum of selection processes that extends from evolution itself, through individual development and individual learning, and on to cultural change. What also cannot be doubted is its capacity to add hugely to human diversity in the form of cultural differences.

One of the unfortunate features of nineteenth century biology that extended into that of the twentieth century was a tendency to ascribe absolute causal difference to biological and social-cultural force. That was scientific nonsense that gave rise to some damaging, at times, deadly ideologies. We should never allow science to be distorted and to serve destructive forms of social reality. That is what is so puzzling about human culture. It is a part of human nature, and yet can give rise to calamitous beliefs and events for our own species.

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