HOMO SAPIENS, HOMO FABER, HOMO SOCIANS: TECHNOLOGY AND THE SOCIAL ANIMAL

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1. INTRODUCTION

Modern technology is a pinnacle of human progress, the perfection of reason mirrored in design. It maintains that bit of Enlightenment hubris captured in the term *Homo sapiens*. Why, then, does it seem easier to design technology than to make decisions about how to use it? That technologies can puzzle or disappoint or seem out of control, is explained - by their opponents - as temporary yet resoluble oversights of rational solutions, or - by their supporters - as the failure to demonstrate to all concerned the reasons that the benefits outweigh the costs. (In spite of the acronym MAD, nuclear armaments debates are conducted in this vein). Alternatively, some of our technologies may puzzle, disappoint, or seem out of control because the model of human nature is inappropriate. Despite economic, hedonic, and normative justifications, the technology or its implementation somehow doesn't 'make sense' or 'feel right'.

This has not always been the case. Until very recently, the technology invented by humans was naturally accommodated to the human physical form. Its requirements are obvious - no one would design a hand spade that was four feet wide or chopsticks that came in trios. Technology connected body and habitat. Moreover, the consequences of technologies with undesirable effects was limited to local populations and habitats.

Contemporary technology is qualitatively different and the dimensions of difference not clear-out. Its requirements are often far less obvious because the technological accommodation is less to form than it is to mind (e.g., communication technologies). Its consequences, desirable and undesirable, can have global effects. But most important, I think, is how technological innovation intersects with what it means to be a social species.

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In this paper, I will suggest we are neither *Homo sapiens*, nor even *Homo faber*, but rather *Homo socians*, and that technology has been hostage to a sociality that represents the wisdom of past selective environments. Without understanding that sociality, we cannot know if our wisdom *should* apply to the current scene or whether we should construct (rather than be selected for) a new wisdom. Campbell (this volume) distinguishes between "biological evolutionary epistemology" and "evolutionary theories of science". It is his epistemology of the first kind that is at present most important for considering technology.

In the following section, I shall put aside the issue of technology in order to consider in some detail a biosocial theory of general epistemological significance. Its central proposition is that among human biological adaptations is *sociality*, a class of species-specific perceptual and behavioral mechanisms sensitive and responsive to social stimuli. Sociality mechanisms function in the development and maintenance of group membership. Two dualisms are of direct interest. The first is that biological human nature is both competitive and cooperative. The second is between two kinds of rationality - a constraining, (usually) subcognitive, nonverbal social rationality and a potentiating, striving-toward-normative, symbolic rationality. The biosocial theory provides the grounds for integrating human evolution into considerations of technology.

2. INTERPERSONAL SELECTION

Much contemporary discussion of human evolution adopts the sociobiological framework that has been subject to numerous criticisms (cf. Brandon & Burian, 1984; Caplan, 1978; Sober, 1984). There are three shortcomings that are especially serious flaws. First is the presupposition of sociality in evolutionary reconstructions to explain (and this is common in non-sociobiological scenarios as well). For example, Trivers (1971) posits 'mutual dependence' as a prerequisite for the evolution of reciprocal altruism.

Second, natural selection does not act on analytic categories such as 'altruism,' 'competition,' 'aggression,' or 'cooperation.' These complex constructs are more usefully conceived in the ecological sense as *events*, that is dynamic, multimodal changes over time (McArthur & Baron, 1983). The mechanisms on which selective pressure might operate would be those involved in the interpretation and organization of responses to properties of social events. 'Mechanisms' is used here in an very broad sense to include generative rules, prototype formation, microbehaviors, cognitive constraints, affect, and maturational sequences. The properties of social events include not only the stimulus properties of interactants, but also higher-levels principles of social organization (Campbell, 1974).

Third is the selection of altruism as sociobiology's central problem (Wilson, 1975). In its restricted sense (reproductively self-sacrificial behavior) it usually fails to be meaningfully mapped to human behavioral altruism. Symons (1980) characterizes Medea thusly: "(...) from the standpoint of reproductive success, a woman who betrays her father, sets up her brother's murder, and murders her children ought to be regarded as a paragon of altruism" (p. 205). In its expanded sense, any time or energy expended on behalf of a beneficiary is altruistic because it can be used by the donor (Barash, 1977, pp. 77-78), but this formulation breeds the much criticized adaptationist program and has little explanatory power in the face of complex social behavior.

We need to further examine human sociality in its biological context. The 'first family' collection of australopithecines, three million years old, suggests group living is an ancient adaptation. Their descendants are an extraordinarily social species. The central problem in human evolution is the same as for all species, reproduction and development of offspring to reproductive age. Human sociality represents a *solution* to these problems. The theoretical and empirical issues are to determine the mechanisms of this solution, how it contributed to the reproduction of offspring and their survival and development to reproductive age, and how these mechanisms combine to achieve the flexibility characteristic of human behavior.

Kin selection, a favored sociobiological process, certainly allows for protohuman aggregation: proximity is a necessary condition for sociality and a substitute mechanism for kin recognition (Holldobler & Michener, 1980; Holmes & Sherman, 1983). The impetus to aggregation is likely to be overdetermined, associated with a collection of interrelated factors. Protection from predation is one often mentioned factor; Kurland and Beckerman (1985) provide an extended argument for information exchange about potential food resources in foraging; I suggest (Caporael, 1984) increased demands of offspring associated with the beginning evolution of the lengthy post-natal development. The consequence of such a concatenation of factors is that the group would eventually come to intervene between the individual and the selection pressures of the habitat and itself become a selective environment. Campbell (1983) calls this crucial human evolutionary process 'selection by functioning social unit'; I prefer the term 'interpersonal selection' because it is briefer and avoids confusion with 'group selection'. Interpersonal selection means that to the extent that group living conferred a selective advantage over solitary living, individuals better adapted to life in groups had greater reproductive success than those not so adapted.

Interpersonal selection placed a premium on the evolution of perceptual, affective and cognitive mechanisms sensitive and responsive to social stimuli. These are 'low-level' constructs, some non-controversial examples being the capacity for individual facial recognition, the identification of certain emotional states, and imitative learning. Tentatively, they are restricted to mental processes below the level of language (i.e., we are not instructed on how to recognize biological movement); they require for their functioning interface with the environment and are thus 'open programs,' (e.g., learning to communicate), they may take the form of constraints on learning, they may be quite complex (e.g., stereotyped play patterns), they may be brought together to form complexes amenable to analysis at higher orders, and they may be brought into service in contexts outside their evolved functional context. (My research on baby talk to institutionalized elderly adults (Caporael, 1981; Caporael, Lukaszweski & Culbertson, 1983) demonstrates these last two points).

The distinctively human complex may be viewed as the outcome of an evolutionary pathway where developments at one diachronic point may (a) constrain developments at a future point, and (b) provide the foundation for future developments not only by direct selection, but by coaptation and exaptation (Gould & Vrba, 1982). Individuals evolving mechanisms enabling them to maintain positions closest to the center of the group would be reproductively favored relative to marginal individuals. The analogy would be to a school of fish where a position in the center of the school reduces the risk of predation. Unlike fish, however, the characteristics defining this center can shift as differing group strategies become more effective in differing environments. Depending of the availability of resources, the center might be relatively flat and inclusive or steep and exclusive. Similarly, the proportion of marginal to central individuals would also vary with social and habitat conditions, in some periods there being a higher proportion of tolerated marginals and greater diversity among them. Interpersonal selection for mechanisms favoring individual success in group-living (e.g., behavior related to prolonged caregiving and dependency, maintenance of group membership, and prediction of others' behavior) would be available for supporting increasingly complex social coordination, the end result being 'intense sociality' (a psychological concept not to be confused with Campbell's (1975) sociological ultrasociality). Barriers to cooperation such as aggression, competition, or spite are thus not eliminated, but such behaviors are constrained. Campbell (1983) proposes that these behavioral tendencies are accompanied by 'criterion images,' mechanisms integrating instinctive and learned responses for assessing and evaluating primarily other group members and secondarily the organism's own behavior.

The task of negotiating one's way through the social environment is enormous. With Gould & Vrba (1982) I hypothesize that what we call human intelligence is an exaptation of the sheer complexity of the human brain, and further hazard the guess that this complexity evolved for 'social intelligence'. An analogy might be our ability to ride bicycles, which is not an evolved adaptation, but is made possible by adaptations associated with locomotion.

A full elaboration of selection for human sociality will include (or be) an ontogenetic theory. The infant, biologically adapted to survive as an infant, has as its most sophisticated adaptations (e.g., crying, imitation, the perception of biological motion) those allowing it to interact with the social environment. This social environment constitutes the initial buffer between the infant and the non-social, material environment. The environment, both social and material, then expands, modifies, and ritualizes the functioning of these perceptual and behavior mechanisms. Ontogenetically, then, these mechanisms support the transformation from the biological adaptedness of infancy to cultural identification, *and* these mechanisms are reciprocally transformed by, and support the maintenance of, adult membership in a small functional group sharing customs, rituals, norms, history, and bonds of attachment. I emphasize small in this discussion because the predominant part of human evolutionary history has been written in hunter-gatherer sized groups.

3. TECHNOLOGY IN HUMAN EVOLUTION

What are the effects of technology on human biological evolution? For many years, lithic technology (usually associated with hunting behavior) was believed to be a 'prime mover' in human evolution. This view has been challenged from three quarters: first, research on animal tool use and the primacy of foraging and scavenging techniques used by hominids (Kurland & Beckerman, 1985); second, by the interpretation of paleoanthropological evidence indicating a decoupling of technological advance and morphological transitions (Eldredge & Tattersall, 1982); and third, by analysis suggesting that the notion of a 'prime mover' of any sort may be a mere artifact of the narrative structure of evolutionary scenarios (Landau, 1984).

I believe that technology is subsidiary to adaptations for sociality and thus their role in human biological evolution (but not cultural evolution) is minor. For most human evolutionary history, technology has been 'body-extensive' and in the same category as animal tool use. The significance of technology is that it provides the opportunity for ultrasociality, which cannot be achieved by selection for intense sociality.

The genetic scope of interpersonal selection is likely to be limited to the size of a microband, a primary group of about 20 to 30 (mostly related) individuals. Until about 10,000 years ago this was the typical form of social organization. One characteristic of hunter-gatherer social organization is the seasonal formation of impermanent macrobands from permanent microbands. That is, a macroband is not merely a scaled-up microband, generating the same selective pressures and having the same functions. Its members do not randomly form new groups when the macroband disperses, nor does the macroband eliminate intergroup competition - indeed, macrobands often form to conduct formalized intergroup competition.

In addition to (and based on) evolved mechanisms for sociality, *Homo sapiens* culturally constructed and to some extent controlled behavioral events such as competition, cooperation, and reciprocity within the group. Between groups (i.e., microbands), sociality mechanisms, events, and their constructions must be reorganized. Norms, cultural definitions of the environment, and strategies for interacting among groups, are developed largely by exploiting the lability of group membership and redefining it along different dimensions (cf. Brewer, 1981; Brewer & Campbell, 1976; Tajfel, 1981), important functions of myth, ritual, and moral preachings. For the better part of human history, however, between-group association has been temporary, limited not by the cognitive capabilities for forming larger (albeit often unstable) groups, but by the lack of technologies to more effectively exploit the habitat to support a higher density of individuals over extended time periods. Given extremely favorable habitat conditions and the development of technology for more effectively exploiting the ecology, the flexibility for maintaining and redefining group membership lent itself to patching together primary groups into supraordinate *social systems* - ultrasociality.

Humans did not biologically adapt to higher density units created through technology because there was no (or insufficient) selective pressure to do so. Sociality and the intelligence it gave rise to presented such a tightly integrated biological organization (i.e., canalization) that by the time high residential density was viable, suitable biological mechanisms already existed for reorganizing at a supraordinate level. Fundamentally, the 'natural environment' of humans did not change - nor has it changed yet. It was maintained by psychological and cultural factors. The sociality mechanisms, which constitute the capacity for culture, 'parse' the stimulus information of the social environment into small group 'grammar'. For the practical exigencies of daily living, individuals still organize themselves along dimensions relevant to small groups - for example, colleagues, friends, relatives, and strangers - with various levels of intimacy, strengths of coalitions, and expectations for reciprocation.

Thus far I have proposed that the role of technology in human evolution has been to facilitate the functioning of existing morphological and social adaptations. Technology does alter the gene pool by allowing forms to reproduce that otherwise might not (e.g., near-sighted individuals), but there is no systematic selection effect because the distribution of any single technology across habitats is variable. Dobzhansky (1962) discusses some cases where technology might select against certain genotypes, for example among the 1% of South Afrikaner porphyriacs fatally sensitive to barbiturates. Such effects, however, are limited to local populations and have little species-wide impact. Invoking such selection effects in the context of the evolution of sociality or intelligence assumes not only directional effects, but also assumes that if there are somatic consequences of technology, there are psychological consequences as well, and the consequences are analogous. The evidential status for these assumptions are problematic. In summary, technology, like group living, may act as a buffer against selection pressures in the habitat, but unlike group living, it is not itself a selective agent.

4. HUMAN EVOLUTION IN TECHNOLOGY

I have argued that technology has had little effect on human biological evolution. But technological design and implementation is generally conformed to human evolution. This is most apparent, as I stated in the introductory paragraphs, with body-extensive technologies. The salience of technology in our lives often results in a confusion as to whether or not the locus of an effect is technological or psychological. My favorite example of this point is the advent of computing bringing with it a fear that the technology would result in a heretofore impossible level of regimentation and order in human life - a fear epitomized in Orwell's *1984*. But *1984*, and its more powerful and evocative precursor, Zamiatin's *We*, written and banned in Soviet Russia in 1929, are remarkable for what their highly structured, alienated worlds lacked - the computer. They are tales not about the regimenting effects of technology, but of the human ability to conform and adapt, the human vulnerability to social influence.

We are becoming increasingly aware that technology brings chaos. (The American Internal Revenue Service with its new computer is the most recent constituency making this observation.) The chaos is a consequence of the conflict between 'mind-extensive' (1) technology and adaptations for sociality. The problem is that we do not know by simple observation the salient features of the mind the way we know the salient features of the body. Thus, we can use technology to build bureaucracies, but as Campbell (1982) has argued, distortions in bureaucratic rationality are observed when mechanisms that evolved to support clique solidarity interests (e.g., mutual monitoring and ingroup favoritism) thwart higher-order collective interests. Both technology and social systems are products of the flexibility of human behavior. But other characteristics, specifically adaptations for sociality that evolved in the context of small functional groups, appear to be evolutionarily stable and show little evidence of change. We still have conflict between groups, although our methods for killing are technologically advanced. Familial systems still exist even though maintained through the telephone wires. Such apparent immutability of some categories of behavior would be expected if the social context attenuated natural selection pressures from the physical environment and itself functioned as a selective agent.

A number of ideas and hypotheses, many of them complicated by trying to describe continuously reorganizing systems, have been compressed into the previous pages, but I hope an example may prove illustrative. Individual identification is a species-specific characteristic, and infants have a preference for facial features organized as a face rather than randomly organized. This general face schema is a biological adaptation. Infants subsequently develop the ability to remember and recognize faces, an interaction between biology and experience. But the evaluation of and preference for faces having 'handsome' features is learned in the social group. With individual experience we may incorporate the group's evaluation and preference, reject it and influence a shift in the ideal, remain marginal with respect to the group in our preference or even find a new group.

We can also use the face in technological applications, as when Chernoff (1971) faces are generated by computer and used to present complex multivariate data. These are schematic faces (face-plots), in which the value of a variable is mapped onto a particular facial feature. Presumably a face-plot is like any other complex data representation plot (e.g., castles, stars, and ships) in that their information content is carried in distinctive feature representation. But social psychological research has demonstrated that facial recognition is better for faces judged on fuzzy attributes like friendliness or trustworthiness than for judgments based study of the physical attributes of the face (Patterson & Baddeley, 1977). This suggests the possibility that the utility of face-plot technology could be under constraints of a biologically based system for coding facial information. Most mind-extensive technologies are like face-plots. To a greater or lesser degree they may have some utility and be accommodated and assimilated into our social groups and social systems, but we do not understand how they work.

5. SUMMARY AND CONCLUSIONS

It has been fashionable to assert that humans, no longer living the life of hunters and gatherers on the savannah, have lost their 'natural environment' through the distorting influence of technologies, agricultural and onward (e.g. Symons, 1980). I have proposed that, on the contrary, the 'natural environment' has not changed since the emergence of *Homo sapiens*, largely because the small group as the field for action is maintained by psychological and cultural factors. Broadly speaking, innovations made it easier to exploit the habitat, separate the heads from the bodies of one's enemies, and increase the comfort associated with obtaining life's necessities and the enjoyment of the non-necessities - all selective tests of new technologies.

But many new technologies can alter the basic structure of our natural environment. The transportation and communications technologies of this century sever the temporal and spatial contiguity that was once fundamental to groups. Some technologies may not work under such conditions. For example, in discussing the failures of an international computer-mediated conference, Tombaugh (1984) concludes, "It may be that electronic mail and computer conferencing in small groups, where individuals know one another and have a relationship of trust, will prove to be one method of developing greater computer communication among scientists" (p. 142). Other inventions potentially increase the number of dimensions that can be used to define a group, the number of possible interacting groups, the number of different individuals that can fill roles within groups, and the possibilities for defining supraordinate groups. Still other technologies stretch beyond our imagination. The effects of exploiting the habitat may be felt on the other side of the globe, we no longer see the whites of our enemies' eyes, and life's necessities and non-necessities are obtained through a global marketplace.

The perception of technology as out of control or having an autonomy of its own may derive from the difficulty of assimilating it to the cognitive mechanisms selection has worked out for us or the cultural norms associated with those mechanisms. To reiterate, culture is built on the mechanisms for sociality - it may continually alter their expression, but it must accommodate their existence. Hence, our intellectual capacity to create new technologies expands beyond our capacity to comprehend, abstract, and control them.

The last decade has seen a flowering of research demonstrating the limits of human rationality (Kahneman, Slovic & Tversky, 1982, have produced a compendium, although there is yet no compelling theory). These limitations produce a problem for evolutionary theorists of Campbell's (this volume) first category - biological evolutionary epistemology -, to say nothing of the problem they poses to believers in the fundamental rationality of humans. The processes that demonstrate the boundedness of rationality are implicitly assigned a place beside such social processes as ingroup bias, conformity or groupthink: all are viewed as intruding on or disrupting the normative rationality by which we have developed control over the natural world. A revealing quote on the jacket of Kahneman, Slovic and Tversky's book tells us that we now know human ratiocination does not conform to normative theory; rather, people 'replace' the laws of chance with heuristics. But in fact, some people replace heuristics with the laws of chance - that is if they know the laws of chance, a knowledge usually gained after considerable study and training. Phylogenetically and ontogenetically, the achievements of reason are hard won, come in small increments, and are part of the cognitive economy of groups. It may be human behavior evolved to be 'rational' in a small group social sense, and that philosophy, science, mathematics, and technology represent a continual effort to overcome the shortcomings of this 'social logic' mistakenly applied to the physical world and to increasingly complex societies. If so, as our domains of action are broadened, the consequences of cognitive and affective mechanisms evolved in an evolutionary past become more important.

A biosocial perspective does not doom us, however, to talk about our biological limitations. On the contrary, I have argued that human evolutionary history has been one of exploiting potentials. The rational methods discovered by human intelligence give us a prospect for improving our implementation of technology beginning with improving our understanding of ourselves.

NOTE

1. Writing might be the earliest non-controversial example of a mind-extensive technology. Of course, body-extensive technologies do limit mind-extensive technologies and somewhat shape ideational content. But the dominant function of mind-extensive technology is not to extend the muscular or sensory capabilities of the user; it is to extend cognitive events so that those events can be shared among individuals. I have been toying with the hypothesis - or at least a collection of observations and hunches - that the earliest co-occurrence of body- and mind-extensive technology revolves around rhythm. It seems that only a slight genetic shift might add rhythmic capabilities to the tone modulated signalling of primates. The tonal and pitch variations of baby talk include a rhythmic component, and infants are exposed to different rhythms through lullabies and children's songs. The closest we can reliably come to shared affect is through rhythm. Rhythm unites the fighting force or the working force in the fields. Rhythmic hand clapping expresses approval. The production of rhythm produces the feeling of shared membership in a group, one that can be extended beyond primary group to large-scale groups. Rhythm can be produced vocally, with body parts by clapping, or by striking objects. The invention of stone tools may have come about not by a brilliant insight, but accidentally, by striking two rocks together to produce rhythmic sound.