What is the ultimate cause of socio-economic inequalities in health? An explanation in terms of evolutionary psychology

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INTRODUCTION

The statistical association between poverty and ill health or premature death is well known, having been recorded over many years and in many societies. Numerous studies have confirmed that higher socio-economic position (SEP), measured in terms such as social class, occupational class, income, wealth or educational attainment, is reliably associated with a longer life and lower mortality rates. The relationship is positive, progressive and fine-grained; and does not have a threshold or plateau but applies across all economic strata from the lowest through to the highest[1–6].

The association between SEP and health is usually described in terms of poverty causing disease and sickness. However, I have argued that the relationship can more fruitfully be considered one in which added increments of SEP are correlated with added increments of health. The is a *salutogenic* explanation of the causes of health, rather than a pathogenic explanation of the causes of disease[6,7].

Previous attempts at explaining the correlation between SEP and health have made only implicit, non-specific and probably untestable assumptions about causal mechanisms[1,5,8,9]. I will suggest that evolved universal human psychological processes are the common cause both of economic stratification and the correlation between resources and health.

This approach represents an application of the new multidisciplinary endeavour sometimes called Darwinian medicine[10], and its extension from the well-known effects of evolution on physical adaptations to the recently developed field of 'evolutionary psychology', which brings together concepts from cognitive psychology with insights derived from modern evolutionary theory[11].

THE ENVIRONMENT OF EVOLUTIONARY ADAPTEDNESS (EEA)

Natural selection is inevitably retrospective: complex adaptations can only arise gradually in response to selection pressures acting over many thousands of generations[12]. Therefore, human psychological architecture arose in order to solve problems of survival and reproduction in the *environment of evolutionary adaptedness* (EEA)[11]. Humans have been 'designed' for a historical situation, not for contemporary society, and it is this mismatch which leads, ultimately, to health inequalities.

The EEA for humans was that of nomadic hunter–gatherer 'bands' of about 25 people in 'tribes' of about 500. This social environment appears to have spanned the Pleistocene era from about 2.5 million years ago until the invention of agriculture about 12 000 years ago[13–16]. Since that time, there have not been sufficient generations of humans to enable the evolution of complex and specific adaptations—furthermore, the rate of cultural change has been too rapid over recent centuries (and decades) to provide stable selection pressures.

The social environment during the EEA differed from contemporary societies in several important respects. In particular, the ancestral society was not *economically* stratified and lacked the stable and cross-generational economic differentials between 'classes' which are universal in post-agricultural cultures[14–20]. Palaeolithic society during the Pleistocene era was, to a high degree, egalitarian with an approximate equality of access to resources for men of the same age (the situation for women was somewhat different, but will not be considered further here[18,21–23]). This egalitarian pattern of economic organization appears to hold for all cultures which have an economy based upon *immediate returns*, where food and other resources are rapidly consumed and there is no surplus for accumulation.

All known human societies are, however, stratified in terms of *status*[24]. Such a pecking order seems to be a part of our primate inheritance of dominance hierarchies. The implication is that *social* stratification is primary and part of the EEA, while *economic* stratification (in terms of resources) is secondary; emerging only in 'delayed return' economies which generate a surplus of resources (those societies based either upon agricultural methods of food production or having access to concentrated, highly productive resources for gathering)[14,21,22].

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RESOURCE SURPLUS LEADS TO ECONOMIC STRATIFICATION

The capacity of humans to live in society requires explanation in terms of specialized psychological adaptations, or 'cognitive modules'[11,25,26]. These are the discrete and content-specific information-processing algorithms which have evolved in response to selection pressures encountered in the EEA. This view of human psychology has its roots in Chomsky's description of the innate mechanisms for acquiring and using language: other examples of modules include those specific for visual inputs such as colour, edge perception and depth perception[25,27,28].

Barkow postulates[11] that economic stratification is a consequence of psychological adaptations (modules) which originally evolved to enable social living in an egalitarian context. He outlines three possible causal cognitive mechanisms which are consistent with the principles of natural selection, human psychology and the development of recognizable human societies. Barkow's three adaptations ('Barkow's triad') are nepotism, the capacity for reciprocal social exchange and the disposition to seek higher social rank.

Nepotism

Nepotism is the tendency of people to favour their own offspring and relatives. The tendency of selective pressure to favour nepotism has been described by Hamilton (in terms of inclusive fitness[29]) and Dawkins (in terms of selfish genes[30]). Nepotism seems to be a universal feature of human societies, even when nepotism goes against explicit social moves. As humans cannot reliably recognize individuals who share their genes, nepotism seems to work by means of psychological adaptations based upon the recognition of social familiars (particularly those familiar during childhood and other critical periods), and the development of distinctive emotions towards long-term acquaintances[11].

Social exchange—the ability to form coalitions

Human societies are characterized by a multitude of reciprocal arrangements between unrelated individuals whereby services and resources are traded to mutual advantage. Social exchange is adaptive in human society, in that cooperation, reciprocal sharing, and division of labour offer massive efficiency advantages in such matters as winning resources, surviving shortages, attack and defence. Trivers has described how selection pressures could favour the psychological adaptations necessary for social exchange[31].

In order that social exchange may be a sustainable strategy, it requires that favours must be mutual. Cosmides and Tooby have suggested a number of content-specific mechanisms for reasoning specifically about human relationships—such as a tendency to look for 'cheating' in social exchange situations[32]. Furthermore, Frank has suggested a strategic role for human *emotions* in maximizing long-term success at the expense of short-term 'rational' self-interest[33]. It is likely that the capacity to form unconditional emotional commitments is essential to the development and sustenance of flexible cooperation. A sense of justice may, for instance, serve a deterrent role in underwriting reciprocal exchanges, because individuals who perceive that they have been treated unfairly may respond by adopting extreme sanctions—even when to do so is at great cost to themselves.

Seeking high social rank

There is a mass of evidence which suggests that a striving for high relative standing (in such forms as self-esteem, self-respect, rank, prestige, reputation, etc.) is a background assumption to most of the literature of social and behavioural human sciences[24]. The importance of social rank is that in the EEA reproductive success would, on average, have been correlated with status (presumably by sexual selection mechanisms favouring high-ranking males[34–36]). Natural selection would mean that males who strove for, and achieved, high status would, on average, leave more descendants than would most males of lower status.

The status-seeking instinct is, I suggest, the ultimate cause of the association between SEP and health; but the causation is indirect and arises because health is a consequence of access to resources. Evidence from the archaeological study of human remains suggests a lack of health stratification where resources are equally distributed, in immediate-return hunter gatherer societies. In an (economically) equal society there is no *necessary* association between status and health or life expectancy. By contrast, there are substantial differences in age at death, stature and evidence of pathology between the rich and poor of agricultural societies[17].

Stratification of health according to status was something that emerged in its present form alongside economic stratification, and after the historical development of agriculture (or other types of delayed-return and storage economies). In such societies, individuals or groups with higher status also have differentially greater access to resources, and more resources seem always to lead to better health. For this to happen, we must assume that there are psychological processes which, first, translate status into resources and, secondly, translate resources into health.

Barkow's triad of psychological mechanisms (or something like them) can explain how status differentials are translated into economic stratification whenever an economy

generates a surplus of resources[11]. Extra resources accruing to those who successfully attained high status would be differentially transmitted to relatives by the action of nepotism. Descendants of high status individuals would tend to build coalitions with one another, because social exchange based on reciprocity would most benefit those with most to exchange, and mutual assistance would be greatest among those of roughly equal resources. Differences in access to resources would therefore tend to be sustained and transmitted between generations, and stable stratification would be the consequence.

'COUNTERDOMINANCE' MECHANISMS

It has been suggested that an egalitarian society would have brought fitness advantages in the EEA. For instance, sharing of food acts as an insurance policy to ensure a steady supply of meat which is only intermittently available due to the unpredictable success of hunting.[37] However, whatever its advantages to the group, the sustainability of an egalitarian system is vulnerable to invasion by selfish individuals pursuing dominance, and this would lead to economic stratification unless Barkow's triad of mechanisms were opposed by other instincts.

The advantages of social living for those of higher status are obvious, but the cooperation of individuals of lower status must also be elicited[33]. If low status individuals perceive their situations as 'unfair' then they may adopt sanctions. For instance, they may withdraw cooperation, mobilize adverse public opinion or employ violence[14,21–23].

In order to ensure stable cooperation in a hunter–gatherer band it is necessary that those of low status are compensated in some way for their social and reproductive disadvantages[33]. Redistribution of resources may serve this purpose of compensation as part of the strongly egalitarian ethos which is the hallmark of EEA-type societies. High status individuals will typically consent to such redistribution because this allows social stability and the benefits of social exchange without eliciting sanctions. These instincts which favour egalitarian social arrangements can be described as *counterdominant*[23].

The psychological forces which led to egalitarian economic arrangements in the EEA can therefore be conceptualized as a dynamic equilibrium. On the one hand, humans have instincts which tend to lead to a dominance hierarchy among males, of the kind seen in non-human primates and presumably present in the common ancestor of humans and apes[18,21–23]. On the other hand, counter-dominant instincts will work to level hierarchies and promote equal sharing.

Counterdominance can be seen as one aspect of a complex instinct of context-dependent status maximization. When high status is not achievable, there are fitness advantages for low-status individuals to combine and enforce equal resource distribution and a generally anti-hierarchical and egalitarian ethos with autonomy for all adult males. The result is that each individual embodies a complex set of competing motivations—some latent and some overt—the expression of which is heavily dependent on social context. The basic tendencies include both the drive to dominate and the drive to resist domination. Each individual experiences a combination of the desire to get enough resources coupled to the desire that no other band member gets more: the result is equal, but vigilant, sharing[23].

However, the balance between dominance and counter-dominance is dependent upon economic arrangements. Ancestral hunter–gatherer economies were probably characterized by a relative abundance of food which was consumed as required[38]. Status differentials relating to special types of prowess were not usually accompanied by inequalities in power and influence, due to the opposing effect of counterdominant processes. Under conditions of economic surplus and storage, differential accumulations of resources would presumably become sustainable due to the accompanying differentials in power, allowing high status individuals to retain their larger shares. This would lead to the establishment of a persistent dominance hierarchy and economic stratification through the operation of Barkow's triad.

HEALTH IS CONSTRAINED BY ACCESS TO RESOURCES

So far, the argument has gone some way towards explaining how resource stratification could arise through the operation of evolved psychological mechanisms. It remains to explain why humans are so reliably predisposed to use resources in a health promoting fashion. After all, humans might plausibly use each increment of increased access to resources in a hedonistic quest for short-term pleasure: a quest which would rapidly lead to disease and early death[7].

The attainment of health and life expectancy are limited by access to resources in all existing societies, even the most prosperous and developed of contemporary cultures. Although there must, presumably, be a level of resource abundance above which life expectancy does not increase (i.e. the maximum attainable lifespan for humans), none the less the relationship between SEP and health remains positive and progressive, and life expectancy currently continues to rise and mortality rates to fall, in the wealthiest countries, and among the wealthiest classes of these countries[6]. There are also finely-grained differentials in health resolvable both between and within social class when

SEP is defined in terms of small increments of income, occupational status or educational attainment[1,4,39,40–42].

Human psychology has been designed, by natural selection, to promote reproductive success—but *health* is one of the pre-requisites for such reproductive success. Health is, thus, a by-product of natural selection, in so far as reproduction can only occur when a certain minimum level of adult health has been reached. In consequence, humans have a rich inbuilt repertoire of health promoting or salutogenic mechanisms[6,7,43] selected for their capacity to maintain organismal integrity at least until the time of reproduction. These range from the most basic level of organization (such as the mechanisms for repair of errors in DNA transcription, inter-cellular control mechanisms, and the processes of organism-wide homeostasis such as the immune, endocrine and nervous systems) up to the vast range of cognitive processes extending from simple protective reflexes to content-specific social learning. Without this innate set of processes the endemic hazards associated with human life would render survival until reproductive age extremely unlikely[7,43].

THE NATURE OF SALUTOGENIC PSYCHOLOGICAL MECHANISMS

The major agenda for research into the foundations of socio-economic differentials in health should be to investigate the scope and nature of human salutogenic psychological mechanisms.

Many salutogenic psychological mechanisms are presumably of broad applicability, and will tend to promote health in a wide range of human environments. Other mechanisms, however, will tend to harm health when operating in a context distinct from that encountered in the EEA. Given that the association between SEP and health is secondary and derivative, it should be possible to use an evolutionarily-informed perspective to look for those situations where the association between health and resources would be expected to break down: those contexts where evolved psychology is maladaptive.

Examples already suggested have included the appetite for salt, fat and sugar and the pleasurable effects of drugs of abuse[10,20,44,45]. Also, at a social level, empirical research might begin by examining the relationship between status-seeking and health on the basis that the drive to enhance social standing has the potential (where it is strong) to damage health. The most obvious situation occurs among young men, who are the segment of the population most likely to participate in risky behaviour such as fighting and trials of strength and courage although these may pose immediate dangers to health. Young men are at an age where sexual activity would have begun in the EEA, and where status in the peer group would have been of over-riding importance in securing a mate—low status males would, on average, leave fewer descendants[34].

However, salutogenic psychological mechanisms are universal among normal humans, and it is the nature of their interaction with resources that produces health differentials. Only tentative guesses are at present possible as to the nature of these putative mechanisms. I suspect that the capacity for 'long-termism'—a status-dependent ability to defer current satisfaction and invest resources to produce greater gains in the future—may be crucial to the generation of health inequalities[7]. Some work has been done on differentials in long-termist attitudes comparing smokers and non-smokers[6]: this approach could be sharpened and focused in the light of an evolutionary perspective.

CONCLUSION

The nature of stratification for ancestral human culture was quite different from that seen in contemporary societies (Figure 1). Humans were designed for an immediate return hunter–gatherer system that was economically equal but exhibited differentials in status and, as a result, reproductive success—life expectancy was not necessarily correlated with status. Yet we now live in delayed return systems of production, which are economically stratified, have substantial inequalities in health: but where status-based differentials in reproductive success have, in many cases, disappeared or even reversed[34–36]. Such is the paradox. Evolutionary psychology thereby throws some light on one

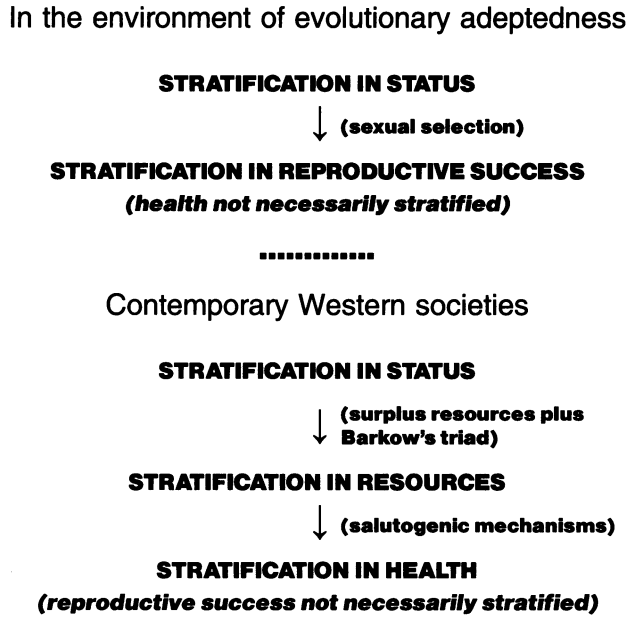

Figure 1 **Causal pathways for an evolutionary theory of health differentials**

of the root causes of endemic tension and discontent in modern human society[19].

As a proposed ultimate cause of health differentials, the evolutionary explanation leaves open the question of *proximate* causes of health and disease—such as the major causes of mortality by predation, pathogen, degenerative disease, accident or homicide. Proximate causes will differ substantially between different societies[7,47] even though the patterning of health by SEP is universal. It would be valuable to identify the principal health promoting psychological mechanisms in a given context and their relation to proximate causes in contemporary culture, because such knowledge may have considerable relevance for health policy.

The analysis of health inequalities in terms of evolutionary psychology raises as many questions as it answers. However, it gives clear guidance as to the nature of these questions and the approach necessary to answer them. Efforts should be directed at understanding and studying the nature of relevant psychological processes and their relationship to status and to resources (Figure 1). Cognitive psychology and evolutionary theory provide the framework. If the field of Darwinian medicine is in its infancy, the application of evolutionary psychology has hardly yet been born... It is virgin territory for doctors, but this exciting new perspective offers—I believe—an enormous potential for attaining fresh insights into the nature and determinants of human health.

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