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Evolutionary Health Psychology

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Introduction

For the last decade and a half the discipline of Evolutionary Psychology (EP) has been developing with great success. The first collection of significant papers was published in 1992 (Barkow et al.) and recently a landmark handbook has been produced summing the progress so far, as well as setting an agenda for future study (Buss, 2005). Unlike other areas within Psychology, EP extends its interest to all behaviours, rightly seeing them as part of an evolved phenotype, and health has not escaped attention, most notably in a paper by Eaton et al. (2002) about evolutionary health promotion. In this essay I will outline Eaton et al.'s position and then go on to suggest ways of further extending their perspective, concluding with some comments about the impact of Evolutionary Health Psychology on social policy.

The Mismatch Hypothesis

Eaton et al. advocate what might be best termed the mismatch hypothesis. Our phenotype has emerged during a long evolutionary history; however, anatomically modern humans (*Homo sapiens sapiens*) have only been in existence for the past 100,000 years. This is too short a period for significant evolutionary change and this means that our adaptations were selected to solve ancient problems. Given that we live in a modern world, very unlike that even 10,000 years ago, there is the potential for mismatch between modern problems and our adapted solutions.

As an example, Eaton et al. discuss nutrition in the Palaeolithic, or Stone Age. The Palaeolithic is not representative of a unique environment from which modern humans emerged but Eaton et al. see analysis of this environment as instructive. They note that serum-cholesterol-raising fat was nowhere near as abundant in Palaeolithic diets as it is in those of modern Westerners; carbohydrate was mainly sourced from fruits and vegetables, whereas it is now more commonly sourced from "cereals, refined sugars and dairy products" (p.111); and sodium consumption was lower in the Palaeolithic while fibre and various micronutrients were more abundant compared with modern Western sources. It is noteworthy that modern Western lifestyles are far more sedentary than those of Palaeolithic hunter-gatherers, who would burn far more calories. Clearly, modern Western people are eating foods that they are designed to consume, but in different ratios than their forebears. Eaton et al. argue that this is a result of our evolved taste preferences. For example, "polyunsaturated fats and sodium are required nutrients, but on the (Stone Age) African savanna they were sometimes in short supply" (p.113); given this we are designed to seek out and eat as much of these food sources as possible when we encounter them. Unfortunately, with the onset of modern agriculture, we can acquire these foods daily. In short,

we are adapted for periods of starvation and as such our bodies are designed to lay down calories for the future. Natural selection would not work against the long-term health implications of such preferences because these preferences were designed to keep our ancestors alive long-enough to successfully reproduce. In the modern world there is no selection against them either, because cardiac and related problems still emerge post reproductive age. However, as longevity has increased in modern times more people are suffering from these ills (see below); any preventive scheme would do well to be aware of our evolved tastes and preferences, as well as our ancestral diets.

Evolutionary Psychology

The preferences that Eaton et al. refer to are the product of our evolved psychology. Eaton et al. have usefully alerted us to underlying psychological dispositions that govern behaviour, but EP can go further than this and characterise the nature of mechanisms responsible for such dispositions.

Psychological mechanisms take specific inputs and produce specific outputs, and in so doing perform a function. These functions have been selected for and constitute adaptations. This, of course, is a characteristic of all biological mechanisms. The relationship of an input to an output is that of a decision, or a conditional rule (Dickins, 2005). *If* input p, *then* output q $(p{\rightarrow}q)$. Natural selection builds organisms that are hierarchically organised sets of decision rules. The task of EP is to perform adaptationist analyses in order to discover the occurrence and nature of specific decision rules, and this has to be done in light of information about past and present ecologies.

Recent work on stress provides an excellent example of this aspect of EP. Two things immediately strike anyone researching stress. First, that stress is an unpleasant experience and, second, that it has long-term and detrimental health effects. On the surface this would seem to have no adaptive value for an organism, for it appears to be a costly situation with no benefits. However, given the regularity of such responses it would appear that stress is a part of our designed behavioural phenotype.

During stressful situations the adrenal hormone cortisol is released. Cortisol increases the amount of available glucose in the body, and glucose provides readily usable energy. When the stressful situation is over, cortisol production reduces: this has the hallmarks of a simple on/off switch. In this case, where q is the production of cortisol, an evolutionary theorist would begin to ask questions about when the production of q would produce an adapted advantage, and this would generate hypotheses about the nature of p.

Shively (2000) developed a hypothesis about p, in this instance. Social primates live in groups with distinctive hierarchical organisation. High-ranking individuals tend to gain in terms of access to food and reproductive resources, and this clearly impacts positively upon them in terms of getting their genes into the next generation and beyond. Low-ranking individuals are not so lucky when it comes to resource acquisition, and are dominated by those who outrank them. Shively hypothesised that low-status primates would be more likely to suffer stress for they would have to avoid antagonistic interactions with high-status individuals and engage in more protracted and round-about methods of resource acquisition. Such behaviours are energy expensive, for the animals need to be constantly 'on their toes'. Cues of relative social standing would therefore fulfil the role of p.

Shively worked with cynomolgus monkeys in order to uncover the detail of this $p{\rightarrow}q$ relationship and the potential cortisol-related costs.

Shively first created a group of experimental animals that had been manipulated into a standard social hierarchy of the sort found in the wild. All of the monkeys were fed a high-fat diet, which is associated with long-term cardiac problems, and they had their serum cortisol and plaque levels measured. Those monkeys who were of lowest social status, and therefore in the more stressful situation, had the highest counts on both measures, relative to the high status individuals. Next, Shively took the high status individuals and put them into a new social group which she again manipulated, but this time they held the lowest status. The diet was held constant and serum cortisol and plaque levels were again measured. These monkeys now had the highest levels on both measures relative to the high status monkeys in their new group. Shively also noted that low status monkeys, in both groups, exhibited traits associated with behavioural depression and anxiety.

Shively's elegant work shows the detail of this particular decision rule architecture, but it also demonstrates the mechanism underlying the long-term costs of cortisol metabolism. Long-term cortisol elevation has health consequences, such as increased risk of type II diabetes and coronary heart disease. However, in evolutionary terms these long-term costs are offset by short-term gains. By the time the consequences of elevated cortisol affect an organism it is likely to have reproduced and be nearing the end of its life, possibly having entered senescence. Such future-discounting, as economists refer to it, makes perfect sense in light of evolutionary analyses.

The lessons to draw from Shively's work on stress are clear. She was able to develop a testable hypothesis about the function of stress, and in so doing she was able to go beyond intuitions about what stress is and present a precise description of its function. Evolutionary theory has enabled her to elucidate design and explain behaviour. What is more, she has shown how negative phenomena, such as stress, can still be adaptations.

Teenage Pregnancy

Over the last three terms the UK government has been concerned about rates of teenage pregnancy, which are the highest in Europe. This is seen as a social problem, but one that also has associated sexual health risks. In the *Government's Response to the First Annual Report of the Independent Advisory Group on Teenage Pregnancy* (2002) they outlined a number of key strategies that had been implemented. These included the establishment of the Teenage Pregnancy Unit and a number of educational initiatives "focusing on the themes of choices and taking control and responsibility around relationships and sexual behaviour" (p. 3). The government also implemented sex and health education programmes and a variety of services to effectively counsel teenage children. The *Response* notes some reduction in the overall numbers of teenage pregnancies since they began their projects, as well as an improvement in the numbers of teenage mothers in work or education, but the UK still has the highest rates within Europe. What is more, this problem is distributed differently across demographic groups, such that girls from poorer backgrounds are ten times more likely to become teenage mothers than those who are wealthier.

The broadly educational thrust of the government's policy rests on a standard assumption about psychology; that humans are rational choosers. So, the government assumes that if teenagers are presented with the facts about the effects of early parenthood in terms of long-term costs, and are then presented with information about how to manage their fertility through contraception, they will be able to weigh everything up and come to the decision to delay reproduction until they have more resources, and prove to be better net contributors to the national economy. Clearly, some teenagers will not know about contraception, or where to get it, and this information will be of use to them, thereby reducing the problem a little; but, one of the clear messages coming from EP is that humans are anything but rational choosers (Evans and Cruse, 2004). Instead, our reasoning and deciding processes are functionally specific conditional rule architectures, like everything else that natural selection has designed. This means that specific inputs will lead to specific outputs, and when it comes to reproductive decision making we are designed to optimise some key trade-offs; notably, current versus likely future resources (Wells, 2003).

A look at the data on teenage pregnancy reveals some key patterns that are of interest to an evolutionary theorist. Lee *et al*. (2004) analysed data collected from a large cohort across the UK. They were interested not only in teenage pregnancies (which were defined as pre-18 conceptions), but also pre-18 abortions. The introduction of abortion data is crucial, for it gives a greater insight into the fertility decisions made by girls and young women than that afforded by simply recording conceptions. Conceptions can be accidental; decisions to keep babies are not. As with the UK government, Lee *et al*. noted a disparity in terms of socioeconomic status; low socioeconomic status girls had the highest proportion of pre-18 conceptions and the lowest proportion of pre-18 abortions relative to high socioeconomic status girls. In short, poorer girls were getting pregnant more frequently and deciding to keep the baby more often[1]. Lee et al. also reported that girls from deprived areas were more likely to suffer "abortion negativity" from parents and others in older generations; this was in contrast to the groups in wealthier areas.

When summarising their findings Lee *et al*. commented that:

> Outcomes of conception are related to the degree of social disadvantage or social advantage and the perceptions of future lives that emerge as a result:
> - continuing a pregnancy is more likely to be the outcome where life in the present seems in some way insecure and where it seems motherhood may 'change your life' in a positive way
> - those who are certain that future life will develop through education and employment tend to opt for abortion (p.24)

In this quotation Lee *et al*. are neatly expressing an instance of future discounting that is in accord with the predicted trade-off between current and likely future resources. Females have a limited reproductive lifespan that

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[1] It is worth noting that Ventura *et al*. (2001) published a survey of teenage births in the USA from 1940 to 2000. In recent years, up to 2000, Hispanic and black populations have had the highest rates of teenage pregnancy, with Hispanic populations having an increase in 2000 to 94.4 per 1000, which was the highest rate for any population group within the USA. In general there has been a reduction in teenage pregnancy in the latter part of the twentieth century, although the highest rates have been consistently recorded in the southern states, where Hispanic populations are largest. One thing to note about Hispanic populations is their relatively low socioeconomic status within the USA; Hispanic poverty has exceeded that of black poverty, and is only surpassed by American Indian populations (Changing America: Indicators of Economic Well-Being by Race and Hispanic Origin, Council of Economic Advisors, 1998; http://www.access.gpo.gov/eop/ca/pdfs/ca.pdf).

ends before senescence, and has decreasing likelihood of success as the menopause draws near. Having children is a resource-heavy activity both in terms of maternally and extrinsically derived nutrients, as well as other aspects of child care. If future opportunities to acquire more resources look likely then delaying reproduction until later in adult life will allow mothers to produce offspring under optimal conditions. However, if such a future is unlikely, motherhood when still young and vigorous is an optimal strategy. The decision to abort is most prevalent among high socioeconomic status girls because their future is more likely to include further or higher education, good employment prospects, and partnership with equally well-educated and employed males. Low socioeconomic status girls do not have these options.

What Lee *et al*. have described is the operation of a set of psychological decision rules that help to optimise fertility decisions, in light of relative social standing as measured by socioeconomic status. These rules might not be entirely conscious, particularly around conception (as Lee *et al*.'s data suggests) but the following decisions about abortion are. What is more, the girls who keep their babies stress how important the support of their own parents is. Given that low socioeconomic status parents do not make for old grandparents (see below) this is another key factor in the fertility decision process[2].

The socioeconomic disparity outlined above is, as said, a relative wealth difference, which in effect is about relative social standing. As we have already seen with Shively's monkeys, relative social standing is a crucial factor in primate life that can cause significant stress. Given this, one would further predict a relationship between relative wealth, relative early pregnancy and social stress. Wilson and Daly (1997) investigated this in the Chicago boroughs and demonstrated that in low socioeconomic groups teenage birth rate was higher and life expectancy was lower compared with that in wealthier boroughs. What is more, male early mortality and homicide rates were much higher in the poorer boroughs.

Relatively high levels of violence and homicide often accompany teenage pregnancy (Pickett et al., 2005) and are another example of what Wilson and Daly refer to as *steep* future discounting. It would appear that males with low social status and few resources to trade with resort to violent competition in order to secure status and resources within their own group. Such aggressive behaviour is associated with cortisol functioning as well as other adrenal hormones released in times of stress. As with all primates, status cashes out as reproductive success, such that males who win violent competition are more likely to impregnate the young girls in their community. Indeed, much aggressive competition surrounds issues of sexual access.

The behavioural future discounting summarised by Lee *et al*. only brushes the surface of a complex situation. There are some other crucial facts that an evolutionary perspective brings to bear on teenage fertility decisions: low socioeconomic status girls reach menarche and begin sexual experimentation earlier than high socioeconomic status girls; poorer people live shorter, less healthy lives compared with those from wealthier groups; and people from low socioeconomic groups are smaller and finish growing earlier than those from high socioeconomic groups. These facts suggest that socioeconomic strata represent specific ecologies and, that in response to their ecology, less well-off girls are making the *physiological* decision to divert energy from growing

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[2] In some non-Western populations a significant predictor of reduction in infant mortality is the presence of grandparents (Sear et al, 2002). These populations are economically stressed and might represent a more extreme form of the same strategy that this paper is outlining for some poor Western teenage girls. In the USA, general adolescent developmental outcomes for children of single mothers do seem to be improved by the presence of grandparents (Deleire and Kalil, 2002).

into fertility and fecundity. Indeed, Wells (2003) has argued that the nutritional inputs received *in utero* by a foetus act as a predictive variable for future nutrition. If it is poor, nutrients are diverted to building hearts, brains, livers and reproductive machinery which in turn leads to lower birth weight children, followed by rapid *post partum* weight gain, with long term health consequences, such as type II diabetes, and other negative developmental outcomes (Boardman et al., 2002). The physiological decision rules are switched to rapid response mode in order to deliver successful reproduction under harsh circumstances, and as with the cortisol story, the long-term ill effects are unlikely to be selected against.

This analysis of teenage pregnancy demonstrates a number of things. First, that psychological and physiological decision rules are part of an integrated system. This is not a form of genetic determinism. On the contrary, this theoretical perspective accounts for the reactivity of organisms to key environmental inputs. Both physiological and psychological mechanisms are in the business of calibrating the organism to the environment to better maximise its opportunities for reproduction. This means that if a teenage girl born into a low socioeconomic group finds that her situation improves, the prediction would be that her psychology would allow her to deal with this, and she would find her decisions and beliefs changing (cf. Saigal et al., 2006). However, there are crucial thresholds on the timings of all these things.

A second lesson to draw is that the educational initiatives of the UK government are bound to fail. In essence they are designed to instruct low socioeconomic status girls to behave more like their wealthier counterparts. Even if poorer girls desired to make these decisions, it is unlikely that they would lose their concern with resources, and hence their relatively low social status. As Pickett et al. (2005) note, "successful programs for preventing adolescent pregnancy and violence have often focused on personal development, attempting to undo the psychosocial costs of low status" (p. 1182).

Conclusions

This essay has aimed to provide a glimpse of the power of evolutionary theory and its applications. The interpretation of Lee *et al*.'s teenage pregnancy data was clearly a *post hoc* discussion of patterns emerging from their work. The purpose was illustrative – the evolutionary perspective makes clear sense of the data, and marries it to other information about physiological differences between populations. However, this *post hoc* discussion also leads to some predictions: low socioeconomic status females should reproduce earlier than high socioeconomic status females; teenage mothers should have more than one child and the inter birth interval between the first and second should not exceed the Western average (if anything it might be shorter); increasing wealth and access to opportunity should be the major predictor of the recent trend for late motherhood, and so called "voluntary childlessness", in some populations; in the USA, pro-choice campaigners should mostly come from the middle classes. All of these issues clearly impinge upon health and public policy, yet at the same time are best informed by a comprehensive theory of human nature that is thoroughly grounded in biology. Evolutionary Health Psychology holds the promise of helping to improve the lives of many people.

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