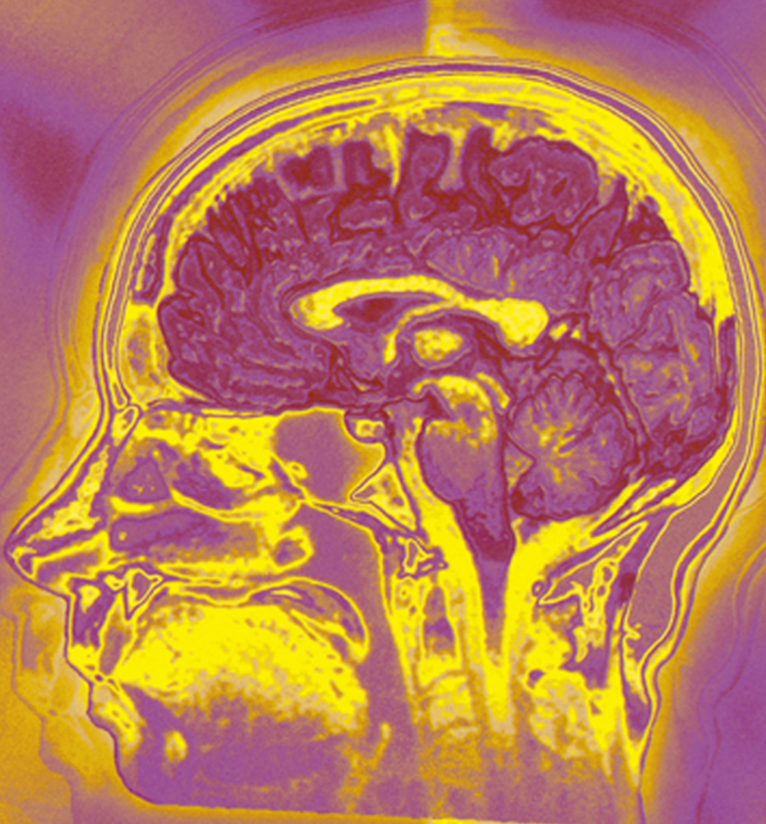
Evolutionary Psychology

A Critical Introduction



Christopher Badcock

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Preface

In order to make this book as easy to read and to understand as possible, I have tried to make the text as straightforward and transparent as I can. I have assumed little or no existing knowledge of the subject in my readers, and developed the text out of many years' experience of teaching courses on evolution, psychoanalysis and sociology to university students studying for social science degrees. However, I have attempted to cover some difficult new material, and so I hope that readers who are knowledgeable in the field will not find the book without interest or value.

I must emphasize that this book is not intended to be a general critique of evolution or psychology. Because most evolutionary psychologists take the fundamental assumptions of modern Darwinism and genetics for granted, I have not spent much time discussing the many controversial questions that these subjects properly raise outside of evolutionary psychology. To do so would take us far from my main subject and would have resulted in a far longer book. However, where a fundamental issue of evolutionary interpretation does have pertinence to evolutionary psychology, I have discussed the difficulties that are relevant to it. A good example is the whole question of adaptation, which is discussed in the first chapter. Although I have space to do no more than allude to the considerable criticism that adaptationism in general has aroused, I do discuss the difficulties involved in the approach for evolutionary psychology in some detail.

Similar remarks apply to psychology: I have not discussed the problems posed, for example, by the modular or cognitive approaches to the mind in general, but do discuss them in some detail where they are relevant to evolutionary psychology. In general, I have not raised critical issues simply for the sake of being critical of evolutionary psychology, controversial though it may be. Instead, I have broached them where they seemed in my judgement to be fundamental and significant for a proper understanding of the subject.

This book is described as a critical introduction not because it is critical of the fundamental claim that human psychology has evolved – so much is indisputable – but because much criticism is warranted in the application of that belief to particular aspects of psychology by evolutionary psychologists. As a writer who adopted the term *PsychoDarwinism* to distinguish his own view of evolved psychology from that of others (Badcock 1994), I can be counted on to share the overall aims and aspirations of evolutionary psychology, but to be very critical of some of the particular forms that it usually takes. This, I hope, has qualified me to be both sympathetic and objective in my approach.

Essentially, there are two ways to write a book like this. One is to make it as complete a survey as possible of the entire literature of the subject. This provides coverage, but often at the cost of comprehension, because so much material has to be summarized so succinctly, and because contradictions, discrepancies and disagreements in the literature tend to be glossed over in the need to ensure equal representation to all points of view. By and large, this has not been my aim in this book. Instead, I have adopted the alternative method of trying to focus on key concepts, findings and arguments, and have attempted to lay a secure conceptual foundation from which readers can venture out into the literature on their own, confident that they grasp its fundamentals. To this extent, I hope that it will be as useful to readers outside evolutionary psychology who wish simply to be informed about its scope and claims as it will to those who are already well acquainted with the field.

To date, most publications in evolutionary psychology have either been technical papers published in journals and edited books, or popular accounts, aimed at the general reader. This book is somewhere between the two, being intended for readers who may have little or no existing knowledge of the field, but also being a critical review of published material. To this extent, you could see it as both an introduction to evolutionary psychology, and a commentary on some of the existing literature. It attempts to get at the fundamental facts and theories of evolutionary psychology much more than the popular accounts do, but also to take a wider, more critical view of the field than is normally possible in a scientific paper. To this extent, I hope that it will fill an important gap in the literature of the subject, and that it will both equip and encourage readers to explore it further for themselves. Suggestions for further reading are given at the end of each chapter to help in this respect, and there is a full reference list of cited material at the end of the book.

Wherever possible, I avoid jargon and difficult language, but do try to carefully explain and define those technical terms that must be introduced. Definitions are also given in the glossary of technical terms at the end of the book. Boxes contain text that is additional or peripheral to the chapter in which it is embedded. Some of these feature examples of points made in the main text. Others add additional information or technical details. Some contain alternative material, or non-essential but still relevant additions to the central argument. Where the content of a box is relevant to the issue being discussed, it is indicated. The intention of having boxes is to keep the central argument of each chapter as simple and direct as possible, but not to rule out other relevant, illustrative or alternative material that may help with understanding it. Some boxes are relevant to more than one discussion, and where this is so, the reader's attention is drawn to them on each occasion.

Christopher Badcock

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1

Selection and Adaptation

As far as we know, human beings are the only organisms in the universe who have evolved to the point where they are able to enquire about their own evolutionary origins. Today the claim that our bodies are the product of evolution is nothing like as widely contested as it once was. However, the proposition that not merely our anatomy and physiology but our psychology too might also have evolved is much more controversial. This is the subject matter of evolutionary psychology, and it is the aim of this book to introduce and explain the principles of the field to those with little or no existing knowledge of it.

The concept of evolution

Today the word *evolution* is strongly associated in people's minds with **Charles Darwin** (1809–1882) and his theory of natural selection. Yet Darwin himself only used the word once in the first edition of his *Origin of Species* (and only then at the very end, where the last word of the book is 'evolved'). In Darwin's day, 'to evolve' meant to unfold, roll out or unfurl (Pagel 1998). Darwin himself used the term 'transmutation' or the phrase 'descent with modification' rather than 'evolution' to suggest a slow, gradual change of one thing into another. Understood in the sense of continuous change, you could see evolution as contrasting with *revolution*, which means sudden, discontinuous change.

However, it was **Herbert Spencer** (1820–1903) who was mainly responsible for introducing the term 'evolution' to the English-speaking world. According to Spencer,

> Evolution . . . is a change from a less coherent form to a more coherent form. . . . Alike during the evolution of the Solar System, of a planet, of an organism, of a nation, there is progressive aggregation. . . . From the lowest living forms upwards, the degree of development is marked by the degree in which the several parts constitute a co-operative assemblage . . . there are not several kinds of Evolution having certain traits in common, but one Evolution going on everywhere after the same manner. (Spencer 1884)

The antithesis of evolution for Spencer was not revolution, but dissolution. As this quotation shows, Spencer interpreted evolution as a cosmic process of incremental aggregation and integration into increasingly more complex wholes that embraced the entire universe, organic and inorganic, human and social. The culmination of this process at the social level was human society, with the largest, most integrated and complex societies representing its supreme expression. However, science was also a product of the evolutionary imperative to combine knowledge into larger and more integrated units, and here Spencer's own work was evidently intended as the culmination of the trend: a general philosophy based on the most general principle of all – Evolution.

Darwin took a different view

Despite the widespread assumption that evolution is inevitably progressive, Darwin himself confessed in a letter to a correspondent that 'After long reflection, I cannot avoid the conviction that no innate tendency to development exists.' In *The Origin of Species* he added, 'The inhabitants of each successive period in the world's history have beaten their predecessors in the race for life, and are, insofar, higher in the scale of nature; and this may account for the vague, yet ill-defined sentiment, felt by many palaeontologists, that organization on the whole has progressed' (cited by S. J. Gould 1990: 257–8).

To see what Darwin meant, suppose that you were standing on the stage of a theatre. Outside there is a large crowd of people wanting to get in to see some spectacle. Seats are allocated on a one-price, first-come, first-served basis, and the doors are opened. What will happen? Obviously, the first to get seats will want them at the front of the stalls, normally the most expensive in a theatre. Once these are filled, boxes and the centre and back stalls will begin to fill, as will the front rows of the dress circle. When stalls, boxes and dress circle are filled, higher circles will be filled, until eventually only the 'gods' – the highest seats, most distant from the stage – will remain. But are the gods the best seats, and would anyone with a free choice of any seat choose such a seat? Of course not. The gods only got filled because the rest of the theatre was full already.

This suggests an arresting parallel with evolution. The first-comers of organic evolution to the Earth found a completely open environment and filled the easiest and most accessible parts first – the equivalent of the stalls in my theatre analogy. These were the first, very simple unicellular organisms, descendants of which – bacteria – are still found in vast numbers everywhere on Earth. Later comers had to do a little more to survive, so they evolved separate nuclei in their cells, or became multi-cellular – the equivalent of those filling the circles in the theatre analogy. Eventually all these environments were filled and it was more likely than before that large, complex, 'higher' organisms would find new ways of exploiting what remained – often by preying on organisms 'lower' down the scale. Eventually, and very late in evolution in relation to the beginning, human beings, the 'highest' of all organisms, appeared – the 'gods' in my theatre simile.

The point of this analogy is that no one standing on the stage and watching such a theatre fill would make the mistake of thinking that higher seats were necessarily 'better' than lower ones. On the contrary, the evidence of their eyes would suggest the opposite: that it was the lower seats in the theatre, those nearer the stage, that were filled first, and the higher ones – including ultimately the gods – were only filled after all the lower ones were taken.

An objective view of organic evolution on Earth would take a similar view. Life evolved into increasingly complex and elaborated forms only because simpler and more fundamental ones had evolved first and had already colonized most of the available environments for such organisms, leaving newcomers to find new, 'more advanced' and usually more complicated ways of existing. There is no reason to presume that there is some universal law of progressive evolution apart from this as envisaged by Spencer – or at least, no reason to think so if the mechanism that drives evolution is the one discovered by Darwin.

Natural selection

Darwin's contribution to our understanding of evolution lay in his discovery of *natural selection* as a mechanism that could explain much evolutionary change. The inspiration for Darwin came in part from his interest in and astonishing knowledge of what by contrast we could call *artificial selection*. This term describes the human interference in animal and plant breeding that has resulted in the many domesticated species that we see around us today. Although all modern dogs are believed to be descended from a few wolf ancestors, they have been selectively bred by humans to be as different as a chihuahua or a Great Dane, a corgi or a greyhound. In each case, successive selection by human breeders for dogs with larger or smaller size, longer or shorter legs, has resulted in these and the many other different types of dog that exist today.

Darwin's great insight was to see that purely natural factors could have a similar result. For example, greyhounds have been bred to run fast and win races, giving them their characteristic long legs, deep chests, slender build and small heads. However, it is easy to see that natural factors could have selected for speed in a similar way, for instance in species of predators who engage in single-handed chases of fast-moving prey. Here the best example is the cheetah, which is even faster than the greyhound (and can reach speeds of 50 miles per hour for short periods). But just like the artificially selected greyhound, cheetahs too have very long legs, a light build, big lungs, and heads which are small in relation to the body. It is easy to see that success in catching prey may have selected these features in cheetahs in much the same way that success at winning races made breeders select them in greyhounds.

Artificial selection relies on the fact that traits like longer legs or bigger lungs may in large part be heritable, so that breeding from winners is likely to produce new winning greyhounds in the future. Similarly with natural selection: if long legs and the other features that make for speed in cheetahs were heritable, those cheetahs that possessed them the most would tend, not merely to be the best fed, but also to be those who would be most likely to hand them on to the greatest number of progeny, thanks to the contribution that food can make to reproductive success. Given long enough, natural selection for speed in the chase could produce results in a cat closely comparable to those which human breeders have achieved in a dog. Furthermore, the same principle could apply to any other heritable feature: natural selection could have exactly the same kinds of results that artificial selection is known to have had.

An important consideration – and one that was decisive for Darwin – was the realization that most species normally produce vastly more offspring than can ever survive, given the natural resources they need. Most plants, for example, produce large numbers of seeds, and many animals that lay eggs do so by the hundred, thousand or million. Clearly, rapid population growth is not just something of which human beings in the modern world are capable. Most species produce potential offspring in staggering numbers, and could in principle expand exponentially (in other words, two original parents could have four offspring, who could produce eight grandchildren, sixteen great-grandchildren, and so on). For Darwin, this meant that there was a constant and unremitting struggle for survival among the members of a species, both with each other and with other species that might compete for the same resources. Any natural factor that affected the survival and reproductive success of individuals in this struggle would effectively be playing a selective role – at least if it operated for long enough to affect the evolution of the species.

Another important assumption of the theory is that normally individuals in a species will vary slightly in many heritable traits. This variation is necessary to provide the differences that natural selection – just like artificial selection – might exploit. Common observation convinced Darwin that this was in fact the case and that in any population of plants or animals, such tendencies to variation always exist. He also found that new variations will sometimes appear that did not exist before, and today we would call these *mutations* (Darwin would have called them 'sports'). According to modern evolutionary theory, a mutation is a random, heritable variation in a population that arises spontaneously. Clearly, such mutations will add to the stock of variation in a species and provide further raw material on which selective forces can act.

Nevertheless, it is important to realize that evolution by natural selection doesn't claim that organisms are simply products of chance. On the contrary, its central concept is that they are the result of cumulative natural selection, which by definition is discriminating, and selects particular features that promote an organism's survival and/or reproductive success. Chance doesn't do any more than generate the variations and mutations from which natural selection selects. To this extent, it is quite true that Darwin's theory begins with chance factors, but the whole point of natural selection is that what is selected is not random, even though it may be selected from a random set. What is selected is selected because ultimately it confers better than average reproductive success on its possessors, and anything that departs from the average in a systematic way is by definition non-random.[1]

Most of the time, natural selection prevents evolution

A common error is to imagine that natural selection and evolution are synonymous, and that evolutionary change is continuously driven by natural selection to produce new forms. This is not necessarily true. To see why, consider the issue of mutation a little further.

Mutation can have three effects on an organism: it can improve its survival and/or reproductive success; it can damage its survival and/or reproductive success; or it can leave either or both unaffected. Because most living organisms are very complex, any random change – or mutation – in a given part or aspect of the organism is much more likely to damage it than it is to leave it unchanged, and it is even less likely to improve it. Imagine taking a watch to pieces, arbitrarily changing one part, then putting it back together again. You wouldn't be surprised if it worked less well – or not at all – afterwards. The same would happen with any complex, integrated whole; and living organisms are much more complex than watches.

This means that the vast majority of mutations will probably damage living organisms, rather than improve them. Because such mutations don't promote survival and reproductive success, natural selection will tend to eliminate them. Nevertheless, such mutations *are* evolutionary changes, and they occur constantly. Only very occasionally and exceptionally will a mutation promote the survival and/or reproductive success of an organism in which it finds itself, and only then will natural selection take a hand and perhaps preserve it.[2]

Survival of the fittest

'Survival of the fittest' was a phrase coined by Spencer to describe natural selection, and it is still widely used today, particularly in popular writing about evolution. As with Spencer's other term, 'evolution', Darwin himself was reluctant to adopt it, and with hindsight, it is easy to see why.

Survival is only a means to reproductive success The first reason to be cautious about 'survival of the fittest' is that survival is not necessarily the key issue in evolution by natural selection. Although I linked survival and reproductive success together in my comments above about natural selection, a moment's thought reveals that they are not quite the same. As far as evolution understood as gradual change in a species is concerned, survival is only a means to the more important end of reproduction. This is because it is the number of descendants an organism has that determines its contribution to the evolution of the species. How long and how well an organism survives may often critically affect its ultimate reproductive success, but it is reproductive success and only reproductive success that ultimately matters where evolution is concerned.

Survival can cost reproductive success Another reason why survival may only be a means to the end of reproductive success is that survival and reproductive success may imply trade-offs against each other: that is, more or better survival – less reproductive success, and vice versa. Because resources devoted to survival are often the same ones exploited for reproductive success (such as food), there usually is such a trade-off, so that an organism has the 'choice' of devoting those resources either to survival (say, laying down fat) or to reproduction (say, laying eggs). Clearly, an organism that was selected to divert all its resources to survival would lose out in the evolutionary competition with those that instead were selected to divert some or all of them to reproduction. Indeed, as box 1.1, 'Testosterone and fitness' points out, this is effectively what happens in human males, and explains their reduced life expectancy as compared to females.

The box on testosterone also illustrates another difficulty with 'survival of the fittest'. This is the tendency to interpret 'fitness' in terms of personal health and vigour. As the box explains, the very thing that promotes men's sporting success – testosterone – also significantly reduces their life expectancy and increases their vulnerability to death and disease from many causes. Once again, this is because personal health and vigour is a means to the end of reproductive success, rather than being an end in itself.

Because of such difficulties with the meaning of 'fitness', it is often modified in scientific literature with adjectives like 'Darwinian', 'true', 'heritable', 'genetic' and so on. As long as those using the term 'fitness' fully understand its meaning, no harm is done, but throughout this book I propose to avoid it wherever possible and substitute other terms, such as 'reproductive success', in part to escape the unfortunate associations brought to Spencer's slogan by Social Darwinism.

Errors about the meaning of 'fitness' underlie the worst excesses of some other nineteenth- and twentieth-century views of evolution. For instance, Spencer's concept of 'survival of the fittest' was applied to social inequality, suggesting that the powerful, wealthy and able-bodied members of society were products of a social equivalent of natural selection which determined that the 'fittest' should succeed and the less fit should fail. It was an inevitable consequence, according to this view, that those who were poor, ill, or disadvantaged in any way were not among the elect of evolution and were neither fit nor fitted to share the privileges enjoyed by those who had beaten them in the struggle for survival. Indeed, some argued that merely to support or to succour such evolutionary failures was perverse and worked against the grand plan of evolution: it would weaken the race and

Box 1.1

Testosterone and fitness

Men die more readily than women at all ages from all causes which can affect both sexes – an effect which is seen from conception to death and can only be reversed by castration. In early adulthood men are approximately 400% more likely to die from accidents, wounds and stress than are women, and remain at least 100% more prone to death from these causes up to age 75. Where violent death is concerned, a man is 20 times more likely to be murdered by another man than is a woman by another woman.

However, marked differential life expectancy can also be found between male and female members of celibate, non-violent and abstemious religious orders, and a similar finding is also reflected in heart disease, the leading cause of death for both sexes in the United States, where women again have only 30% the mortality of men between the ages of 35 and 54. Nevertheless, castrated tom-cats live longer than their intact male counterparts, and so do human castrates. Detailed comparisons standardized for age, intelligence and category of mental deficiency among castrated and intact inmates of a mental institution in Kansas demonstrated that the median age at death of intact men was 55.7 years, as compared to 69.3 years for castrates, and that the earlier the castration was performed, the more life expectancy increased. These data suggest that it is being male and being subject to the effects of male sex hormones – principally testosterone – that actually shorten male life-spans.

Such observations can't be explained as the consequence of social causes, because the greatest rate of male wastage occurs before birth, and in some societies male mortality is lowest when male and female sex roles are most differentiated in early adulthood. However, testosterone levels in males are ten times what they are in females, don't overlap significantly in their range, and are detectably different between the sexes from birth.

One known effect of testosterone is to raise the resting metabolic rate of males by approximately 5% as compared to females. Effectively, this means that the male biochemical 'engine' is running about one-twentieth faster all the time than is that of a woman, perhaps explaining why it wears out sooner. Again, a major factor in enhanced male vulnerability to death, disease and injury is the greater aggressiveness and readiness to take risks characteristic of males – and this, too, seems to be an effect of testosterone. Finally, testosterone depresses the immune system, and thereby increases vulnerability to disease.

If castrated males survive better than sexually intact ones, as they are indeed known to do, and if evolution does in fact select the fittest in the sense of personal survival, why has natural selection not selected males without testes? Put in plain terms such as these the answer is obvious. Males without testes would do somewhat better in terms of individual survival and resistance to all causes of death at all ages, but they would leave no descendants who could enjoy those advantages! From this we can draw the correct conclusion, insufficiently appreciated until astonishingly recently: selection selects ultimately for reproductive success, not necessarily or primarily for personal survival. If it does select for the latter – and, of course, it certainly does so to a large extent in practice – the only reason that it does is that personal survival, health, longevity or whatever are necessary factors in promoting an individual's ultimate reproductive success, rather than being factors selected in themselves irrespective of reproductive success.

dilute the 'fitness' of society as a whole. Here was 'survival of the fittest' perfecting, not merely individuals, but entire civilizations!

These views seem to be the inevitable consequence of errors about what natural selection actually selects and an outcome of the belief that evolution is primarily concerned with increments to individual health and welfare, rather than anything else. But if we take the correct view that true, Darwinian fitness is only another term for reproductive success, there is no way in which we could make these mistakes. In other words, Darwinian fitness implies a purely *quantitative* measure – differential reproductive success; it does not necessarily imply any other kind of necessary qualitative improvement, superiority or enhancement of an organism's individual attributes.[3]

Three assumptions about adaptations

Natural selection produces *adaptations*: that is, traits which serve to promote an organism's survival and reproductive success. As such, adaptations have a parallel in the traits selected in artificial selection, for example, long legs and speed in greyhounds. These characteristics of greyhounds are adaptations in the sense of being modifications of traits that can be found in all dogs. Every dog has legs, and all dogs can run, but in greyhounds the legs and other features have been adapted for speed, resulting in the characteristic, lean, long-legged look of the greyhound. However, we have already seen that natural factors could have selected for speed in a similar way and have indeed produced very similar adaptations in cheetahs.

Three assumptions are commonly made about adaptations, and it is important to understand these from the start, because failure to do so often leads to misunderstanding of evolutionary explanations and much unnecessary argument.

1 Adaptive on average Because natural selection works on large numbers of organisms, the basis of selection is inherently statistical, rather than exact. This means that the effects of adaptations also need to be seen in a statistical, averaged-out context, and as applying to populations and typical cases, rather than to every individual and any particular case.

Any adaptation is not necessarily always and invariably adaptive in all circumstances. Wings in birds may be adaptive for flight, but they can be severe encumbrances on the ground or in water. Large tails promote an individual peacock's reproductive success, but peahens fly much better without them! An adaptive behaviour like freezing into stillness when a predator appears may save the life of an animal, but won't necessarily do so every time. On the contrary, there would have to be cases where an individual who froze but still got eaten might have escaped if it had tried to do so. However, the assumption is that freezing evolved as an adaptation to attack by predators because it worked more often than not, not because it necessarily worked every time.

2 Adaptive all other things being equal There may be other factors that intrude to limit or negate the effect of an adaptation, and these need to be separated out from the effects of the adaptation itself. For example, it is clearly adaptive for parents to feed their offspring because such offspring are their reproductive success, and as we have already seen, reproductive success is the only currency accepted by natural selection. However, some birds who lay two eggs normally only feed the first to hatch, and ignore the second, who usually starves to death, or is killed (and sometimes eaten) by its elder sibling. How can that be adaptive? And why isn't an obviously adaptive behaviour – feeding the chick – directed towards both offspring?

The answer is that other things are not equal for the second chick because it is the second, rather than the first. Birds who lay two eggs like this often normally only fledge one chick per season. But that in itself makes it critical to have a chick to fledge. The second chick is a back-up who would be fed if the first failed to hatch, or to thrive when it did. Hatching order makes all the difference, and means that feeding the first chick to hatch is indeed adaptive. But feeding the second too is usually not adaptive, simply because the parents would normally not be able to find enough food to feed both chicks, and trying to do so would probably mean that neither fledged (Mock and Parker 1997).[4]

3 Adaptive in the conditions in which the adaptation originally evolved Obviously, human beings did not evolve originally in a modern, urban environment, and with the benefit of the things you would find there, such as technology, modern communications, plentiful food and sophisticated health-care. This means that our adaptations may have to be seen in an earlier evolved context, rather than in that of a modern society.

A good example might be our liking for sweet, salty or fatty foods. Such foods were scarce in our primal environment, and so natural selection arranged our preferences for them so that we would consume as much of them as we could when we got the opportunity. Dietary fibre, on the other hand, was impossible to avoid in primal conditions, and so no particular liking for it was necessary. Today the situation is quite different, and excessive and prolonged consumption of sweet, salty or fatty foods and insufficient consumption of dietary fibre can be severely maladaptive (Strassmann and Dunbar 1999). But that is simply because our tastes are adapted for the past, not for the present.

The EEA

This third point about adaptations is particularly pertinent to evolutionary psychology because some writers see it as distinctive of the field. They take the view that evolutionary psychology represents an advance over earlier evolutionary thinking as applied to human beings because it makes a central issue of the fact that we are not necessarily adapted to a modern, industrial way of life, but to an earlier, more traditional one. Some call this the *environment of evolutionary adaptedness*, or EEA for short (see box 1.2, 'The human environment of evolutionary adaptedness').

According to evolutionary psychologists, human beings have lived in small hunter-gatherer groups for over 99 per cent of the million-odd years our species has existed. Some think that 'This hunting and gathering way of life is the only stable, persistent adaptation humans have ever achieved,' and go on to claim that 'insufficient time has elapsed since the invention of agriculture 10,000 years ago for significant change to have occurred in human gene pools' (Symons 1979: 35). Other evolutionary psychologists castigate those who take current benefits of an adaptation into account when explaining it for not being 'adaptationists in the strict Darwinian sense' because only past conditions can explain present adaptations (Tooby and Cosmides 1997: 293).

Box 1.2

The human environment of evolutionary adaptedness

The term 'environment of evolutionary adaptedness', or EEA for short, was first introduced by the psychoanalyst, **John Bowlby** (1907–1990), and today has become a central tenet of evolutionary psychology.

Bowlby points out that no organism is so flexible that it is adapted to any and all environments. On the contrary, organisms are adapted to particular conditions that constitute their EEA. He adds that although it is usually safe to assume that the habitat occupied by a species today is the same, or very similar to, its EEA, this is not so in the case of human beings because today humans live in many more, very different, and often more quickly changing environments than they did in the past. This leads to the conclusion that the human EEA is represented, not by the present environments of human beings, but by the period of approximately 2 million years preceding the emergence of the diversified habitats seen today. He concludes that '*the only criterion by which to consider the natural adaptedness of any particular part of present-day man's behavioural equipment is the degree to which and the way in which it might contribute to population survival in man's primeval environment.*' (Bowlby 1982: 59, emphasis in the original).

Although there is understandable controversy about the details of the human EEA, most students of the subject would accept the following general characteristics as broadly likely:

- hunter-gatherer and/or scavenging subsistence;
- nomadic or semi-nomadic pattern of movement;
- low population density;
- relatively small, kin-based groups;
- stone-age technology at best;
- relatively high infant mortality and low life expectancy by modern standards;
- generally much greater vulnerability to the natural environment;
- fewer lifestyle options than in later societies.

In many respects the most sensible way to characterize the human EEA for the purposes of evolutionary psychology might be in negative terms: in other words, to realize that humans are not necessarily adapted for life in modern industrial societies, with high population densities, fixed places of residence, complex social groupings, bureaucracy, transportation, mass media, medicine, technology, plentiful food and minimal exposure to natural selection (at least as it would have operated in the EEA). This also meets the objection that there may never have been one EEA, or one continuous EEA, but rather multiple ones. Here the point would be that most modern human environments are simply not the same as the primal conditions in which our species first evolved.

However, as the evolutionary anthropologist William Irons has argued in a recent paper, the current reproductive consequences of an adaptation sometimes are a guide to what occurred in the past. Indeed, he points out that 'Saying that human beings were . . . hunter-gatherers for one or two million years creates a false picture of stasis during this period.' In his view, 'the statement that 10,000 years is not enough time for evolutionary change is hard to defend.' Irons adds that in the generational equivalent of just a tenth of that (30 generations, rather than 300–400), laboratory mice have been bred 'to obtain non-overlapping distributions of behavioral traits'. He also notes that there is strong evidence that certain human physiological adaptations, such as sickle-cell anaemia, have evolved in much more recent times (Irons 1998).

According to other critics of evolutionary psychology, you might just as well argue that Stone Age hunter-gatherers were maladapted to their way of life because for millions of years prior to that their ancestors were vegetarians. They add that a growing body of evidence suggests that evolved reproductive striving continues to translate into reproductive success in traditional, kin-based societies that have not undergone the demographic transition to smaller family sizes of the past century (Strassmann and Dunbar 1999). Indeed, if reproductive success is taken as the ultimate proof of successful adaptation, modern human populations have far outperformed our hunter-gatherer predecessors, despite being allegedly 'maladapted' for modern ways of life: 'Today we number approximately six billion. That would seem to be proof enough of our being adapted to current conditions' (Lopreato and Crippen 1999: 131).

Adaptations need not be relevant only to the EEA

Clearly, the present consequences for reproductive success of an adaptation do not necessarily tell us anything about how and why it originally evolved – but neither should it be assumed that they tell us nothing. Many psychological adaptations may still work in circumstances very similar to those in which they originally evolved simply because the major environmental factor shaping their evolution was the presence of other people who had evolved in a similar way. Despite dramatic changes in subsistence and population density, there may still remain much in the human, psychological environment that is essentially the same as it ever was. If so, modern conditions may be relevant to adaptive evolution, and present-day adaptive pay-offs could sometimes be a good guide to the origins of the adaptation concerned.

An example might be risk-taking. Numerous studies in many different contexts consistently and reliably indicate a marked difference between the sexes where taking risks is concerned. With one exception, women are much less likely to indulge in behaviour that risks life and limb by comparison to men. Indeed, a recent study showed that the predicted differences in risk-taking behaviour could still be found in kibbutzniks after three generations of socialization aimed at eliminating sex-role differences. Only in one respect were women ready to take greater risks than men, and that was in defence of their own children. With this one exception, men remained the prime risk-takers (Lampert and Yassour 1992).

Such findings readily fit evolutionary expectations because, as we shall see in more detail in a later chapter, a man's reproductive success normally varies much more than a woman's. Because a woman's ultimate reproductive success is determined by the number of pregnancies she can manage in one lifetime, and because her physical well-being is critical to successfully completing a pregnancy and raising her offspring, taking risks with her life or reproductive future is not normally rewarded by natural selection. However, a man has much more to gain from risky behaviour because his only obligatory contribution to a future offspring is a single sperm, and this even an injured or disabled man may well be able to provide. Furthermore, because men produce such sperms by the million each day, the only limit on a man's reproductive success is the number of women he can inseminate. If taking risks with life and limb can increase that number significantly for a man – for example by competing with other men for mates – then risk-taking will be selected in males in a way it is unlikely to be in females, who never need more than a single male per pregnancy as far as insemination is concerned (see below, pp. 152–5).

Despite the great differences between our modern and primal ways of life, there need be no essential difference where a readiness to take risks is concerned because all that is different is the circumstances that surround the risk, not the risk-taking itself. Driving fast, sky-diving, or betting large sums of money may not have been risky behaviours in which our primal ancestors could indulge, but there would probably have been just as many – if not more – risky alternatives that they encountered in their hunter-gatherer way of life. Given that risk-taking as such appears to be a naturally selected sex-specific difference, there is no reason to think that its expression today is in any way essentially different from what it was in the past: something that could (with the exception of defending children) benefit males more than females.