Social Anthropology Essay

Structural features

Communication features

Discuss how environmental variation has impacted on the evolution of Homo sapiens?

Homo sapiens occupies almost every corner of the known world, from tropical rainforests to Arctic tundra, showing that humans can adapt to a diverse range of environments. Yet *Homo sapiens* has no sub-species, and as a species we show remarkably high genetic unity, especially compared with non-human primates (Wells & Stock 2007). This suggests that all humans have the ability to adapt to most environments, through technological, behavioural and physiological plasticity rather than genetic adaptation. First I will look at the traits that *Homo sapiens* has evolved in order to be able to adapt to diverse environments. I will then look at how humans can adapt to temperature, solar radiation and altitude, both in terms of temporary responses and acclimatisation, looking at biological and behavioural adaptations.

Standard Introduction (see Chapter 1, Getting started on your essay)

Use of personal pronoun 'I' in essays may be acceptable in some subjects. Check with your tutor.

This is a statement of purpose to guide the reader. This essay is not arguing a case so there is no need for a thesis statement. The title requires a demonstration of knowledge rather than arguing a particular position.

Homo sapiens has evolved physiological traits, including bipedalism and the ability to adapt physiology to environment during growth, to adapt to their environment. However, an important human trait is the ability to alter the environment, through niche construction and social learning.

Compared to the other great apes, humans have evolved a more r-selected reproductive strategy, with relatively short interbirth intervals and slow childhood growth. This gives mothers the ability to 'stack' offspring, provisioning more than one offspring at once and allowing rapid population growth in new habitats (Wells & Stock 2007). Human offspring also have the capacity to match physiology to ecological conditions during ontogenesis, and so can adapt to parental experience. A good example of this is immunological programming, where the mother passes on antibodies in her breastmilk, providing her offspring with some immunity to the diseases she has been exposed to in that habitat. Wells and Stock discuss how childhood dependence allows ample opportunity for social learning, which is better than either innate behaviour or trial and error learning as an individual can acquire appropriate information even if it can't acquire it from own experience, allowing adaptation to a new environment without physiological adaptation (2007).

One of the most important traits that have evolved with the hominin lineage is bipedalism. Bipedalism facilitates life in diverse environments as it is a more energetically efficient mode of transport and allows a greater home range, meaning that humans can travel further in search of suitable food **(Wells & Stock 2007).** Bipedalism allowed efficient hunting (Liebenberg 2006), allowing increased meat consumption. This is an example of niche construction, as meat composition varies less than that of plant matter between ecosystems. Niche construction is important as it allows humans to make their habitat more amenable; through technology diverse environments can be homogenised **(Wells & Stock 2007).**

It is important to include a wide range of sources and to avoid over-use of one or two. However, in this assignment, it may be acceptable to use this sources as it could be a core reader and instructed to be used.

It is likely that the radiation of australopithecine species into novel habitats altered the selective pressures acting on them and selected for the ability to adapt to environmental variation **(Wells & Stock 2007)**. This led to a variety of adaptations, which interact to allow humans to alter both their environment to suit their physiology, and to alter physiology during development so that it is more suited for the environment.

We have therefore seen how *Homo sapiens* can adapt both physiologically and behaviourally to environmental stresses. I will now look at three specific stresses, temperature, solar radiation and hypoxia, and how humans can adapt both temporarily through culture and biologically mechanisms, and how they can acclimatise through physiological flexibility during growth.

Writer indicates moving on to the second part of the purpose statement

Extremes of temperature can be lethal for humans; excessive cold leads to hypothermia while heat stress can cause heat stroke and exhaustion. On exposure to heat stress, vasodilation occurs and sweating begins to facilitate heat loss through evaporation. In acclimatised people, sweating starts at higher temperatures and is more efficient (Frisancho 1993).

When exposed to low temperatures, vasoconstriction occurs to divert blood flow away from the skin to slow heat loss (Frisancho 1993). An increase in heat production occurs through shivering of the skeletal muscles and hormonal action on adipose tissues, known as non-shivering thermogenesis. In people who are acclimatised to cold temperatures, shivering starts at lower temperatures and there is more reliance on heat production through non-shivering thermogenesis. **It is debatable** how much this difference in native and non-native responses is due to genes and how much to adjustment to cold stress during growth. A study of cases of frostbite during the Korean War revealed that African American soldiers raised in cold climates

'It is debatable' indicates some critical analysis and evaluation using alternative sources (See Chapter 10, Critical thinking and analysis)

still suffered more from frostbite than European Americans raised in warm climates, suggesting that cold defences are partly genetic (Beall & Steegman 2000).

Body size and stature may also be an adaptation to variation in temperature. Bergmann's rule states that populations in colder climates should be larger than those in warmer environments, while Allen's rule predicts that the former will have relatively smaller exposed portions of the body. This is to increase surface area to body mass ratio in warm climates and decrease it in cold ones, to respectively dissipate and conserve heat. This pattern is seen across the world, suggesting that body size is an adaptation to temperature (Katzmarzyk & Williams 1998). Paterson (1996) studied two troops of Japanese macaques which had been moved to America, one to Oregon and one to Texas. He found that the Oregon macaques were heavier and had longer bodies compared with the Texan monkeys, while the latter had longer hands with a greater surface area. This is in accordance with both Bergmann's and Allen's rule, and provides an example of how early hominins could have adapted to temperature variation.

However, it has been suggested that smaller body size in the tropics is the result of poor nutrition in these areas, rather than an adaptation to temperature (Beall & Steegman 2000). Katzmarzyk & Williams (1998) conducted a study looking at the available data for body size across the world since 1953, in order to re-evaluate whether body size does vary with temperature. They found that while the pattern can still be seen, with smaller body size in the tropics, the correlations are lower now than in 1953, and there has been a significant increase in body mass, particularly in warmer climates. This may reflect the westernisation of lifestyle in these areas, which has resulted in improved nutrition and healthcare, suggesting that smaller body size is not solely an adaptation to heat stress, but is the result of undernutrition.

As well as biological and physiological defences, humans also have behavioural adaptations to extremes of temperature. Shelter, fire and clothing, as well as an efficient foraging strategy, help to reduce the impact of cold stress. Shelter is also important under hot conditions, as is scheduling activities outside the hottest times of the day. In these ways, humans can lessen the effects of temperature without having to have physiological adaptations (Beall & Steegman 2000).

Another environmental stress that humans face is that of ultraviolet radiation (UVR), which can cause sunburn and

increases the risk of skin cancer, as well as degrading folate, which is necessary to produce DNA. The biological defence against high levels of UVR is increased melanin content of the skin, as melanin absorbs UVR, preventing it damaging skin structures. This can be a temporary response to increased UVR exposure, resulting in tanning of the skin. However, populations living in high UVR areas are acclimatised to solar radiation through having genetically more darkly pigmented skin. The disadvantage of increased skin melanin content is that it inhibits the synthesis of vitamin D, which is required to absorb calcium from the gut. Therefore, populations in more northern latitudes have evolved lighter skin to avoid vitamin D deficiency (Jablonski 2006).

Humans also have behavioural adaptations to avoid UVR damage, which in some cases have reduced the need for physiological adaptation. For example, people in South America have lighter skin than people at equivalent latitudes in the Old World, as by the time humans migrated to this area of the world they had cultural adaptations, such as shelter and clothing, to protect them from UVR. Dietary adaptations, in the form of increased consumption of fatty fish, have also reduced the need to evolve lighter skin, as vitamin D can be obtained from diet instead of being synthesised through UVR exposure; this is why the Inuit have darker skin than others at high altitudes (Jablonski 2006).

The final environmental stress I am going to look at is hypoxia resulting from high altitude. When sea-level natives ascend to high altitudes, their heart rate, rate and depth of breathing and haemoglobin concentration all increase in order to increase the amount of oxygen in the blood. Partial acclimatisation can occur, whereby the initially high heart rate decreases, and haemoglobin concentration is increased through increased production of red blood cells rather than a decrease in plasma volume (Beall & Steegman 2000). However, even after months at high altitude, sea-level natives still do not achieve a similar work capacity to that attained at sea-level. It appears that full acclimatisation relies on growing up at high altitude, as high-altitude natives have an increased lung volume and rely less on hyperventilation; they can attain a similar work capacity as at sea-level (Frisancho 1993).

Writer indicates moving on to the final part of the purpose statement to guide the reader

It remains unclear whether acclimatisation to high altitude is genetic or is achieved through physiological adaptation during growth. A study comparing children of European origin living at high and low altitudes in Bolivia, who should show the general

human capacity to adapt to high altitude, revealed that those raised at high altitude did have increased lung volume. However the difference between the two populations was not of the same magnitude as that between native Bolivians and the migrant lowlanders, suggesting genetic factors are at work (Beall & Steegman 2000).

In conclusion, *Homo sapiens* as a species is well adapted to living in diverse environments. Although some populations do show special adaptations for their own environment, such as increased lung volume at high altitude or small body size in the tropics, these may arise out of physiological flexibility during ontogenesis rather than genetic factors. By far the most significant adaptation that humans have for environmental variation is culture; behavioural adaptations, passed on through social learning, mean that humans can homogenise diverse habitats and survive without the need for genetic adaptation.

Standard Essay Conclusion (see Chapter 1, Getting started on your essay)

Word count: 1,637

References

APA Referencing system (see Chapter 8, Referencing with accuracy)

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Frisancho, R. (1993) *Human Adaptation and Accommodation* (University of Michigan Press)

Jablonski, N. (2006) *Skin: A Natural History.* (University of California Press)

Katzmarzyk, P. T. & Williams, L. R. (1998) Climatic influences on human body size and proportions: ecological adaptations and secular trends. *American Journal of Physical Anthropology*, **106**: 483–503

Liebenberg, L. (2006) Persistence hunting by modern hunter-gatherers. *Current Anthropology*, **47:** 1017–1025

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Wells, J. & Stock, J. (2007) The Biology of the Colonizing Ape. *Yearbook of Physical Anthropology*, **50**: 191–222

Diana and Tom's Comments

The writer has produced an in-depth and well-researched description and analysis of the topic. All parts of the essay are relevant to the question and issues have been explored and addressed in detail. The structure is clear and easy to follow, and the language and style is appropriately formal. The essay could be improved by including more evaluative comments which would further re-assert the writer's own voice.