Global warming: implications for human brain evolution

Climate change is an inherent and complex phenomenon of our planet. Changes in global temperatures can occur directionally in the case of gradual increases or decreases in temperature, and also in terms of greater or lesser variation or oscillation in temperature. These oscillations can happen over long periods of time, or on a much shorter seasonal time scale, which is amplified by displacement to the north or south of the equator. The implications of such changes are profound and far-reaching, as captured by the relationship between global warming and declines in biodiversity. Humans too are vulnerable in the face of climate change, not only affected by environmental perturbations but responsible for some of these effects, despite the veil of protection that society pretends to offer. So, what features of climate change have the greatest impact on our existence? Our human evolutionary past may provide some clues, which could inform our response to contemporary threats of global warming.

We sought to determine whether trends in global warming or cooling versus variation in temperature extremes was more closely related to a defining feature of our evolution – an increase in brain size and the development of more sophisticated cognitive functions. Using an archival sample of 109 fossilized hominid crania over the past 2 million years, which encompasses the period of maximal brain expansion, we discovered that large-scale temperature variation over 100,000 year intervals, derived from sea surface temperature data and oxygen isotope records, was the most highly significant climate factor related to increases in brain size ($r = 0.725$, p less than .01), explaining 52% of the variance in cranial capacity (a proxy for brain size). Cooling also had a significant effect. As the global mean temperature decreased, there was a significant increase in cranial capacity in the same sample ($r = -0.661$, p less than .01), accounting for 43% of the observed increase in the brain size. Finally, we discovered that 22% of the observed variation in cranial capacity could be accounted for by the location of where the crania were found (i.e., the distance of the fossilized crania from the equator). Thus as seasonal variation in temperature due to distance from the equator increased, there was a corresponding increase in brain size.

Contemporary data supports this trend. Based on a current sample of over 20,000 people from many different ethnic backgrounds, an estimated 2.5 cm^3 increase in brain size was observed for every degree of latitude displacement from the equator. It has also been found that for every degree of latitude displacement to the north or south of the equator, performance on IQ tests increases by an approximately one-half a point. Thus latitudinal displacements of 40 to 50 degrees translate into 20 to 25 point increases in average IQ scores. Together, these findings suggest that as global warming worsens, driven by our growing reliance on fossil fuels, we may be unwittingly reversing some of the conditions associated with the period in which the major expansion of the human brain occurred.

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