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The evolution of general intelligence

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ABSTRACT

Among Richard Lynn's numerous significant contributions to science is his cold winters theory of the evolution of general intelligence. The cold winters of Eurasia presented novel adaptive problems for our ancestors to solve, such as obtaining food by hunting large animals and keeping warm by building clothing, shelter and fire, and they functioned as strong selection pressures for higher intelligence. Empirical analyses support both Lynn's cold winters theory and my evolutionary novelty theory of the evolution of general intelligence. Mean annual temperature and the degree of evolutionary novelty in the environment independently predict the average intelligence of the population. Both theories can also account for the observed race difference in intelligence.

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How did human intelligence evolve? Why did humans attain such high levels of general intelligence? And why are there notable differences in average intelligence in different populations and races in different geographical locations?

The evolution of general intelligence is one of numerous areas in which Richard Lynn has made significant scientific contributions. In particular, along with Rushton (1995), Lynn has formulated and advanced the *temperature theory* (or *cold winters theory*)[1] of the evolution of general intelligence.

1. Cold winters theory

Lynn (1991) builds on Jerison's (1973) notion of *encephalization* throughout the evolution of life in the last 225 million years, and applies it specifically to the evolution of general intelligence among humans in the last 200,000 years. Jerison argues that, whenever a species migrates to a new ecological niche, novel adaptive problems confront the species and function as a selective force for greater intelligence. Those individuals of the species in the new ecological niche who cannot solve the novel adaptive problems die, and those who can, with their greater intelligence, live to reproduce more offspring who carry the genes for larger brains and greater intelligence. As species continue to migrate to new ecological niches and confront novel adaptive problems, the size of their brain relative to their body (encephalization quotient = EQ), and thus intelligence, increase in the course of evolution. The average living mammals are defined to have EQ of 1.0. On this scale, average living fish and reptiles have EQ of .05, average living birds have EQ = 1.0, gorillas EQ = 2.0, orangutans EQ = 2.4, chimpanzees EQ = 2.6, and *Homo sapiens* EQ = 7.5.

Jerison's (1973) original theory was strictly for explaining different degrees of encephalization *between* species, but Lynn (1991) has applied it to the evolution of general intelligence *within* a species. Lynn argues that, as human ancestors migrated out of the tropical and subtropical climates of sub-Saharan African savanna, and spread to the rest of the world, they encountered new adaptive problems in the new ecological niches of the temperate, subarctic, and arctic climates of Eurasia. The novel adaptive problems that human ancestors encountered out of Africa fall into two categories: obtaining food, and keeping warm.

1.1. Obtaining food

Our ancestors in Africa mostly subsisted on plant food, not hunted animals. Contemporary hunter–gatherers obtain a vast majority of their daily calories from gathered plant food. For example, the Gadio people in New Guinea obtain 96% of their calories from plants and only 4% from meat (Dornstreich, 1973). In the tropic and subtropic climate of Africa, plant food is abundant, and food procurement is therefore not difficult at all. Lee (1968) notes that women of the !Kung bushman tribe gather plant foods 1 day in three, and their men go on hunting expeditions for 1 week in three. The adaptive problem of obtaining food in the evolutionary environment of the sub-Saharan Africa does not therefore present a strong selection pressure for higher intelligence.

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[1] Neither Lynn nor Rushton gave an explicit name to their theory. In my 2008 article (Kanazawa, 2008), I called it *temperature theory*. However, in his contribution to this volume, Rushton (in press) calls it *cold winters theory*. I happen to like Rushton's name better than my own, so I will stick to *cold winters theory* throughout this paper.

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All of this changed when our ancestors left their ancestral home of Africa and migrated to Eurasia about 80,000 years ago (Oppenheimer, 2003). In the temperate, subarctic, and arctic climate of Eurasia, plant foods were seasonal and available only during the summer and the fall. Our ancestors who had migrated to Eurasia thus became increasingly dependent on hunting animals for food. Lee (1968) shows that, among the contemporary hunter–gatherers, there is a positive association between latitude and their reliance on animal meat for food; the higher the latitude (and thus the colder the climate), the greater the proportion of animal meat in their diet. Lynn (1991) also notes that hunting in the grasslands of Eurasia is more difficult than hunting in the woodlands of Africa because the former does not provide cover for the hunters. The prey animals can spot approaching hunters in the grasslands from miles away, whereas hunters can hide in the trees and other natural covers in the woodlands. Thus chimpanzees in Africa are known to hunt successfully (Goodall, 1986).

Effective hunting thus presents a whole host of new adaptive problems for our ancestors in Eurasia to solve, including the coordination of different hunters for a single goal and the manufacture and use of hunting weapons. These problems were largely unencountered by their counterparts left behind in sub-Saharan Africa. These novel adaptive problems exerted strong selection pressures for higher intelligence.

1.2. Keeping warm

The temperate, subarctic, and arctic climates of Eurasia presented another set of problems for our ancestors: keeping warm during cold winters. These problems necessitated our ancestors in Eurasia to manufacture shelter and clothing to keep warm during cold winters. Effective clothing and shelter were all but unnecessary to survive in the tropic and subtropic climates of sub-Saharan Africa.

The cold temperatures of Eurasia also presented our ancestors with the problem of *building* fire and keeping it burning. Lynn (1991) notes that it must have been easier to acquire fire in Africa than in Eurasia. In Africa, there would have been spontaneous brush fires, from which our ancestors could take ignited branches, carry them back to camp, and get a domestic fire started. In Eurasia, there would have been few (if any) spontaneous brush fires, so our ancestors would have had to make fire by friction of two pieces of wood or percussion of flint stones. Those who could not figure out how to start and build a fire presumably died out in the cold winters of Eurasia, thus selecting for higher intelligence.

Lynn's (1991) and Rushton's (1995) cold winters theory therefore avers that cold winter temperature of Eurasia, which presented our ancestors with novel adaptive problems of obtaining food and keeping warm, among others, selected for greater intelligence. Their theory can explain how general intelligence evolved in the course of human evolution and why Europeans and East Asians have higher average intelligence than Africans.

2. Evolutionary novelty theory

I have approached the problem of the evolution of general intelligence from my perspective as an evolutionary psychologist, and offered a slightly different explanation for it. The concept of general intelligence poses a problem for evolutionary psychology (Chiappe & MacDonald, 2005; Cosmides & Tooby, 2002; Miller, 2000a). Evolutionary psychologists contend that the human brain consists of domain-specific evolved psychological mechanisms, which evolved to solve specific adaptive problems of survival and reproduction in narrow specific domains. If the contents of the human brain are domain-specific, how can evolutionary psychology explain general intelligence, which is seemingly domain-general?

In contrast to views expressed by Chiappe and MacDonald (2005), Cosmides and Tooby (2002), and Miller (2000b), I (Kanazawa, 2004) propose that what is now known as general intelligence may have originally evolved as a domain-specific adaptation to deal with evolutionarily novel, nonrecurrent problems. The human brain consists of a large number of domain-specific evolved psychological mechanisms to solve recurrent adaptive problems. In this sense, our ancestors did not really have to *think* in order to solve such recurrent adaptive problems. Evolution has already done all the thinking, so to speak, and equipped the human brain with the appropriate psychological mechanisms, which engender preferences, desires, cognitions, and emotions, and motivate adaptive behavior in the context of the ancestral environment. For example, our ancestors never had to think what was good to eat. All they had to do was to eat and keep eating what tasted good to them (sweet and fatty foods that contained high calories), and they lived long and remained healthy.

Even in the extreme continuity and constancy of the ancestral environment, however, there were likely occasional problems that were evolutionarily novel and nonrecurrent, which required our ancestors to think and reason in order to solve. These novel adaptive problems likely *included, but were not limited to*, the problems of obtaining food and keeping warm in the northern latitudes of Eurasia that are underscored by Lynn's (1991) and Rushton's (1995) cold winters theory.

To the extent that these evolutionarily novel, nonrecurrent problems happened frequently enough in the ancestral environment (a different problem each time) and had serious enough consequences for survival and reproduction, then any genetic mutation that allowed its carriers to think and reason would have been selected for, and what we now call "general intelligence" could have evolved as a domain-specific adaptation for the (originally narrow) domain of evolutionarily novel, nonrecurrent problems, which did not exist in the ancestral environment and therefore for which there are no dedicated modules in the form of domain-specific evolved psychological mechanisms.

From this perspective, general intelligence may have become universally more important in modern life (Gottfredson, 1997; Herrnstein & Murray, 1994; Jensen, 1998) only because our current environment is almost entirely evolutionarily novel. My theory suggests, and available empirical data confirm, that more intelligent individuals are better than less intelligent individuals at solving problems *only if* they are evolutionarily novel. More intelligent individuals are *not better* than less intelligent individuals at solving evolutionarily familiar problems, such as those in the domains of mating, parenting, interpersonal relationships, and wayfinding (Kanazawa, 2004, 2007), *unless* the solution involves evolutionarily novel entities. For example, more intelligent individuals are no better than less intelligent individuals in finding and keeping mates, but they may be better at using computer dating services.

3. Empirically adjudicating between the cold winters theory and the evolutionary novelty theory

A couple of recent studies (Ash & Gallup, 2007; Bailey & Geary, 2009), employing varied methods, have demonstrated that the average intelligence of a population appears to be a strong function of both average temperature and evolutionary novelty. However, given that cold winter temperature (the key explanatory factor in the cold winters theory) is part of the evolutionary novelty emphasized in my evolutionary novelty theory, and given that latitudes simultaneously increases both the coldness of the winter temperature and evolutionary novelty of the environment, it is difficult to adjudicate between these theories. It would require statistically controlling for both explanatory factors simultaneously in predicting the average intelligence of populations.

In my 2008 article (Kanazawa, 2008), I attempt to adjudicate between the cold winters theory and the evolutionary novelty theory of the evolution of general intelligence. For this purpose, I use another one of Richard Lynn's significant scientific contributions – the national IQ data (Lynn & Meisenberg, 2010; Lynn & Vanhanen, 2002, 2006). I use annual mean temperature as a measure of the coldness of the winter, and latitude, longitude and distance from the ancestral environment as proxies for evolutionary novelty of the environment. While these are far from perfect indicators of evolutionary novelty, which is the extent to which the environment differs from the evolutionary environment in sub-Saharan Africa, they do capture important aspects of it. For example, fauna and flora must physically travel from one location to another in order to migrate to a new environment (as our ancestors did). Thus the farther away two locations are, the less likely it is that the fauna and flora of the two locations share many species in common.

It is difficult to pinpoint the exact location of the ancestral environment, mostly because it was not just one place. So I use three alternative locations in sub-Saharan Africa, three vertices of the inverse triangle that is the African continent: the coordinate (0N, 0E), where the equator and the prime meridian intersects, which happens to be in the Atlantic Ocean just off the coast of Nigeria; the coordinate (30S, 30E), which is the southeast corner of South Africa; and the coordinate (10N, 40E), which is in the middle of Ethiopia. The latter two locations represent as far east and south one can go from the coordinate (0N, 0E) and still remain on the African continent.

As it turns out, however, all of my substantive conclusions are robust with respect to the chosen location of the ancestral environment. No matter which location one chooses as the site of the ancestral environment, both mean annual temperature and evolutionary novelty (measured by latitude, longitude, and distance) are significantly correlated with and independently predict the average intelligence of the population. Mean temperature has a significant and large effect on average intelligence net of evolutionary novelty, and evolutionary novelty has a significant and large effect on average intelligence net of mean temperature. Even though mean annual temperature and latitude are significantly correlated with each other, they both independently predict the average intelligence. Even when the mean temperature is statistically controlled, both the longitude and the distance from sub-Saharan Africa independently predict the mean intelligence of the population.

Mean temperature and evolutionary novelty together account for half to two-thirds of the variance in national IQ. The results appear to suggest that both Lynn's (1991) and Rushton's (1995) cold winters theory and my evolutionary novelty theory (Kanazawa, 2004) are both partially correct and explain the evolution of general intelligence among humans.

4. Implications for race differences in behavior

Richard Lynn's another significant contribution to science is in the area of race differences in intelligence (Lynn, 2006, 2008). Both his and Rushton's cold winters theory and my evolutionary novelty theory can explain the systematic differences in general intelligence between the races.

Because the mean winter temperature of the temperate, subarctic, and arctic Eurasia are systematically and significantly lower than that in the tropic and subtropic Africa, the cold winters theory would predict that mean intelligence to be higher in Eurasia than in Africa, which is indeed the case (Lynn & Meisenberg, 2010; Lynn & Vanhanen, 2002, 2006). Because the ancestral environment for humans was in sub-Saharan Africa, locales outside of sub-Saharan Africa are by definition more evolutionarily novel than those in sub-Saharan Africa. My evolutionary novelty theory would therefore predict that the mean intelligence of the population outside of Africa to be higher than that inside. And, indeed, as I note above, even when the mean temperature is controlled, the farther away the population is from sub-Saharan Africa, the higher their mean intelligence.

In this context, it is instructive to note that *the geographical differences in national IQs are not entirely explainable by the difference between the races.* Largely black nations outside of sub-Saharan Africa, mostly in the Caribbean and the South Pacific, have significantly higher national IQs than those in sub-Saharan Africa (63.8 vs. 80.5; $t(68) = 10.12$, $p < .001$). The difference is therefore at least partly geographic, not entirely racial. Because the Caribbean and the South Pacific represent an evolutionarily novel environment, this is perfectly consistent with my evolutionary novelty theory of the evolution of general intelligence.

5. Conclusion

In his long and brilliant career, Richard Lynn has made significant scientific contributions to many areas of intelligence research and differential psychology. Among them are the evolution of general intelligence (Lynn, 1991), the compilation of highly reliable and valid data on national IQ (Lynn & Meisenberg, 2010; Lynn & Vanhanen, 2002, 2006), and the race differences in intelligence (Lynn, 2006, 2008). This brief note has shown how the three areas of Lynn's contribution converge. His national IQ data allow for the empirical test of and provide support for his cold winters theory of the evolution of general intelligence (as well as my evolutionary novelty theory), which explains the race differences in average intelligence. However, more empirical research is necessary to test and adjudicate between his cold winters theory and my evolutionary novelty theory of the evolution of general intelligence among humans. In particular, any data that show that the average intelligence of a population is uncorrelated with its geographical location would cast doubt on both the cold winters theory and evolutionary novelty theory of the evolution of general intelligence.

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