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Nigel Barber

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Nigel Barber

Abstract

According to the uncertainty hypothesis, religion helps people cope psychologically with dangerous or unpredictable situations. Conversely, with greater control over the external environment due to economic development and technological advances, religious belief is predicted to decline (the existential security hypothesis). The author predicts that religious belief would decline in economically developed countries where there is greater existential security, including income security (income equality and redistribution via welfare states) and improved health. These predictions are tested in regression analyses of 137 countries that partialled out the effects of Communism and Islamic religion both of which affect the incidence of reported nonbelief. Findings show that disbelief in God increased with economic development (measured by lower agricultural employment and third-level enrollment). Findings further show that disbelief also increased with income security (low Gini coefficient, high personal taxation tapping the welfare state) and with health security (low pathogen prevalence). Results show that religious belief declines as existential security increases, consistent with the uncertainty hypothesis.

Keywords

disbelief in God, uncertainty hypothesis, religion as an adaptation, economic development, existential security, pathogen load, welfare state, Gini coefficient

Corresponding Author:

Nigel Barber, 4229 Silver Ct, Birmingham, AL 35213
Email: barnigel@gmail.com

A reasonable case can be made that religion is a pan human adaptation (Sanderson, 2008). This case begins with the observation that some form of supernatural belief is evidently found in all human societies, though some hunter gatherers may not be highly religious (Marlowe, 2002). It is bolstered by evidence that religion provides fitness benefits (improved health, increased reproductive success). Religiously active people in modern societies have more children (Blume, 2009; Frejka & Westoff, 2006; Kaufmann, 2010; Sanderson, 2008) according to copious evidence. The possibility that religious involvement improves health and life expectancy is consistent with a great deal of evidence but remains controversial (Barber, 2004; Hummer, Rogers, Nam, & Ellison, 1999; Koenig, McCullough, & Larson, 2001; Sloan & Bagarella, 2002). The health advantages of religion may occur because supernatural beliefs and related rituals help people to deal with uncertainty and anxiety (see below). This article tested the hypothesis that religion helps people deal with painful and unpredictable events in their lives through analysis of cross-national data on nonbelief in God.

If religion is primarily an adaptation to psychological uncertainty (the uncertainty hypothesis), then religious belief would be expected to decline in modern societies that enjoy greater existential security due to increased ability to prevail over the hostile forces of nature (e.g., predators, hunger, inclement weather, diseases). This article tested the prediction that countries in which there is greater material security (including affluence, better health, and social security) would have a higher incidence of nonbelief in God. I prefer the terms “disbelief” or “nonbelief in God” rather than atheism because far fewer people describe themselves as atheists and say they do not believe in God (Zuckerman, 2007).

Religion has costs as well as benefits, of course. Religion may be an evolved social contract whereby the ritual and other costs of religious membership (Edgerton, 1992; Irons, 2001; Sosis, 2004) are more than balanced by the benefits of reduced psychological uncertainty and by improved somatic health and increased reproductive success. Much of the benefits may be mediated by assuaging the psychological distress from painful and unpredictable events. The argument that religious beliefs and practices constitute a form of emotion-focused coping is well supported by empirical evidence.

High blood pressure is a reliable symptom of prolonged psychological stress. We know that religious rituals and prayer reduce blood pressure, an effect that is indistinguishable from that of secular meditation (Benson et al., 2006; Paul-Labrador et al., 2006). People who attend church regularly experience a reduced incidence of depression. Reduced depression suggests improved stress management given that prolonged and severe psychological

stress may cause depression (McCullough & Larson, 1999). Interestingly, this relationship is reversed among the elite of Harvard graduates: For them religiosity predicts *vulnerability* to depression, suggesting that elites may have less need of religion due to superior social support and that individuals especially vulnerable to depression resort to religious practice in that sub-population (Vaillant, Templeton, Ardel, & Meyer, 2008). Perhaps elites are less religious because they are more secure and the same principle might extend to country comparisons.

Why Are Affluent Countries Becoming Less Religious?

If religion provides advantages in terms of health and reproductive success, then evolutionary theory can account for its presence in most or all societies throughout the world. On the other hand, the decline of religious belief in recent history (Paul, 2009; Zuckerman, 2007, 2008) poses a challenge. Anthropologists have wrestled with this issue for over a century. Fraser (1922) proposed that with the development of science, many natural phenomena previously interpreted in supernatural terms become understandable in terms of natural forces that are predictable and potentially controllable. Fraser offered the opinion that such scientific views are most appealing to bright and educated people, a view that is empirically supported by strong correlations between IQ scores and disbelief in God both across individuals and across countries (Lynn, Harvey, & Nyborg, 2009).

Supernatural belief may be one way of attempting to control the uncertainty of our lives (Zuckerman, 2007). This perspective, known as the uncertainty hypothesis, was introduced by anthropologist Bronislaw Malinowski (1954). Malinowski noted that Trobriand Island fishermen engaged in elaborate superstitious behavior when they worked in dangerous ocean conditions but not when they fished in calm and shallow water. The uncertainty hypothesis proposes that the more people attribute outcomes to uncontrollable forces (luck, chance) the more likely they are to use superstition. Superstitious behavior is thus an attempt to control highly uncertain outcomes through supernatural intervention. Note that though theologians frequently distinguish between religion and superstition, perhaps characterizing superstition as a lack of faith in God, I assume that there is no natural science basis to such distinctions and that both appeal to supernatural agents as a means of coping with uncertainty.

The uncertainty hypothesis enjoys some empirical support, specifically in connection with the origin of superstitious behavior in sports. Gmelch (1974)

found that different positions in baseball evoke varying levels of superstitious behavior: When players fielded they were less superstitious than when batting or pitching, and this difference was attributed to the fact that fielding errors are rare whereas even good batters miss the ball more often than they hit it. Recently Burger and Lynn (2005) supported the uncertainty hypothesis by finding that major league baseball players engaged in more superstitious behavior the more that they believed the outcome was determined by luck. Interestingly, men and women become more religious when they view pictures of attractive same-sex mating competitors, another possible case of uncertain outcomes (Li, Cohen, Weeden, & Kenrick, 2010).

The uncertainty hypothesis can be applied to comparisons between entire societies as well as between individuals. Thus, American baseball players are more superstitious than their Japanese counterparts because they attribute success more to chance than effort (Burger & Lynn, 2005). Although religion is more than a supernatural belief system, having ritual, ethical, and other dimensions (Vaas, 2009), the supernatural aspect of religious belief was hypothesized to respond to societal (or ecological) uncertainty in much the same way that superstition responds to individual-level uncertainty. This approach to societal adaptation is known as evolutionary social science, and Barber (2008) concluded that an adaptationist approach to societies requires us to employ such methodological individualism.

If religion helps people to cope with uncertainty, then more secure modern environments having greater existential security would engender less religious belief. This argument combines the uncertainty hypothesis with an existential security hypothesis. Religious disbelief might thus increase in economically developed countries as the quality of life improves in terms of increased life expectancy, health, food security, income security, and so forth. Norris and Inglehart (2004) supported this existential security hypothesis in their cross-national study of religious values in 80 countries where the importance of God and religion were greater in less secure nations. They did not analyze belief in God as was done in the present study. If the level of religiosity is low in forager societies (Lehmann, 2010), this might be interpreted as contradicting the uncertainty hypothesis, but one would need reliable information about actual quality of life in terms of food security, nutrition, health, stress levels, and so forth. Tudge (1998) argued that the quality of life declined with the introduction of agriculture judging from archaeological evidence on height, bone deformities, and so forth. Ember and Ember (1992) also found that foragers experience fewer natural disasters that cause food shortages.

Religious disbelief is higher in the social democracies of Europe than elsewhere, suggesting that the economic security provided by a well-developed

welfare state erodes religious belief (Paul, 2005, 2009; Zuckerman, 2007, 2008). Rees (2009) found empirical support for the security hypothesis in a cross-national analysis of frequency of prayer in 55 countries. This study found that prayer was less frequent in countries with greater material security, including gross domestic product, and more equitable distribution of income in a multivariate analysis. Unfortunately, this study did not control for Moslem religion or history of Communist government (see below). In bivariate correlations, prayer frequency was negatively related to life expectancy, peace, and control of corruption and positively related to infant mortality, homicide, and HIV prevalence, but many of these effects are possibly explainable in terms of varying levels of economic development. My cross-national study examines the connection between nonbelief in God and reduced existential uncertainty (or increased security) and uses a larger sample of countries (137) than previous studies.

Specific Predictions

I predicted that atheism would increase with economic development as people acquired a better capacity to withstand the hostile forces of nature through improved scientific knowledge, technological development, greater affluence, food security, and increased rule of law including the stronger centralized government characteristic of developed countries. Development was assessed in terms of the proportion of the labor force employed in agriculture (a negative index given that developed nations have fewer agricultural workers). It was also predicted that nonbelief would increase with the proportion of the population enrolled in third-level education both because this is an index of economic development and because it is a vector for natural science ideas that may challenge religious claims.

As people acquired greater economic security, I predicted that disbelief in God would increase (Norris & Inglehart, 2004). Economic insecurity is exacerbated by unequal distribution of income (Gini coefficient) because more of the resources are concentrated in the hands of an economic elite creating poverty and deprivation at the bottom of the social hierarchy. Conversely, societies having a welfare state aim to help the poor by redistribution of resources. The welfare state requires heavier personal taxation and was measured indirectly in terms of taxation as a proportion of GDP.

Disbelief in God was also predicted to increase as health security rose. Health security was assessed in terms of the load of infectious diseases and pathogens.

Method

Sample

The sample of countries consisted of the 137 states for which Zuckerman (2007) presented data on incidence of atheism (compiled in Lynn et al., 2009). Mean gross domestic product (GDP) at producer price parity (PPP) was US\$10,855 for 2005 (95% confidence interval [CI] = US\$8,940-US\$12,770; Population Reference Bureau, 2006) compared to US\$9,500 for the world average, indicating that the countries were representative of the world's level of economic development.

Dependent Variable

The dependent variable was the proportion of the population reporting that they did not believe in God, in surveys conducted during the period close to 2004 and after (Zuckerman, 2007). The data are derived from multiple sources using somewhat different methodologies and asking slightly different questions (e.g., "Do you believe in God?" "Do you believe that God exists?"), which introduces the possibility of error, including translation errors (see Zuckerman, 2007, for detailed description of sources). It can also be objected that questions concerning belief in God are perceived differently by respondents who subscribe to polytheistic religions (e.g. Buddhism, Shinto) compared to monotheistic believers.

The validity of the data is supported by the fact that disbelief in God was significantly higher in Communist (or former Communist) countries and significantly lower in Moslem countries, consistent with the diverse legal treatment of religious belief and disbelief in these countries (see below). Zuckerman's data were validated against International Social Survey (1994) data on nonbelief in God for 15 countries, $r(13) = .91$, $p < .001$ (with both variables appropriately natural-log-transformed). The reliability of the data is also supported by the fact that approximately three quarters of the variance was systematic (i.e., could be explained in regression models), which estimates error at .13 that is acceptable for research purposes.

Control Variables

In my OLS (ordinary least square) regression analyses, I controlled the effect of living in a Communist society that criminalized religious belief (Anderson, 1994), including both countries of the former Soviet Union and contemporary Marxist-Leninist states (China, Cuba, Laos, and Vietnam). Although restrictions

on religious practice have been reduced in formerly Communist countries, levels of religious belief remain very low so that it is reasonable to combine both types of Communist state. Islamic states that follow Sharia law criminalize atheism (or strictly apostasy from Islam). In these states, apostasy is a capital offense (even if rarely prosecuted as such). Due to the possible legal penalty for professing disbelief (Sookhdeo, 2009), I also controlled the effect of living in a country where Islam was the most common religion (Central Intelligence Agency [CIA], 2006). Between them, these control variables (which were not correlated with each other and only weakly related to the other predictor variables) accounted for 40% of the variance in religious disbelief. Of course, we cannot distinguish how much of this effect was caused by a person's private belief or disbelief and how much was determined by fear of retaliation for expressing views that were in conflict with the state and its laws or with majority opinions (whether Islamic or Communist).

Independent Variables

Economic development was measured in terms of the proportion of the labor force employed in agriculture (natural-log-transformed) with fewer agricultural workers indicating more development (CIA, 2006). This is a more direct measure of economic development than measures of economic production commonly used by economists, such as gross domestic product (GDP) per capita. GDP can be quite misleading in the case of oil-producing nations where national wealth is comparatively high but remains concentrated in the hands of a few individuals and does not measure either affluence or economic development as experienced in the lives of most of the population. The proportion of young people enrolled in third-level education (UNESCO, 2010, via Nationmaster) was also used as an additional measure of development that is particularly relevant to atheism because higher education can be considered a key vehicle for natural science approaches to nature that provide an alternative to religious interpretations and for skeptical thought more generally. Of course, third-level education is also emphasized in developed countries where a college degree is desirable for success in a competitive skills-based labor market.

Economic security was assessed in terms of a more equal distribution of income (low Gini coefficient, CIA, 2006): Unequal distribution of income means that those close to the bottom of the income hierarchy experience greater economic hardships and uncertainty. The welfare state plays an important role in providing a protective mechanism for the poor. Unfortunately, there is no good direct measure of how well developed the welfare state is in

a particular country, but welfare states are costly and their cost can be measured in terms of the level of personal taxation in a country expressed as a proportion of national production or GDP (Heritage Foundation, 2009). Health security was measured negatively in terms of the current threat posed by various common infectious diseases and parasites using Fincher and Thornhill's (2008) measure "pathogen prevalence." This assesses the severity of 22 parasites in seven groups (leishmaniasis, trypanosomes, malaria, schistosomes, the filariae, spirochetes, and leprosy) based on data from the online Global Infectious Diseases and Epidemiology Network (GIDEON).

Statistical Procedure

The possibility of bias due to positive spatial autocorrelation (where geographically closer countries resemble each other in religious nonbelief, thus threatening their statistical independence) was assessed for 15% of the countries. This was done by correlating differences in religious disbelief percentages with distances between capital cities for adjacent pairs of countries. The correlation was, $r(19) = -.17, p > .10$, with the negative coefficient disconfirming the possibility of geographic drift concerning disbelief in God.

Data were analyzed using OLS regression. Variance inflation factors (VIF) were calculated to check for multicollinearity error, but in each case the square root VIFs were less than 2.00 (Fox, 1991), indicating that this was not a problem for the analysis. Some of the variables (including the DV) were natural-log-transformed (ln) to control for heteroskedasticity, particularly the problem of greater variance in developed countries than in developing ones (Zuckerman, 2007).

Results

Average disbelief in God in surveys conducted around 2004 was $M = 10.06\% \pm 1.35$ SE (Zuckerman, 2007). Correlations among disbelief and the predictor variables are presented in Table 1 along with descriptive statistics (means, standard deviations) for the predictors. It can be seen that all of the predictors were at least moderately correlated with the DV. Significant positive predictors included Communism, tertiary enrollment, and high personal taxation. Significant negative predictors included Moslem religion, agricultural employment, Gini coefficient, and pathogen severity.

Regression analysis results are presented in Table 2. All of the predictors were significantly related to disbelief, and most effects were highly significant. Disbelief was lower in Moslem countries and higher in Communist

Table 1. Correlations Among Disbelief in /God and Predictors for 137 Nations

Predictor	1	2	3	4	5	6	7	8
1. Ln disbelief (%)	—							
2. Moslem	-.50*	—						
3. Communist	.45*	-.10	—					
4. Ln agricultural labor (%)	-.60*	.33*	-.00	—				
5. Third-level enrollment (%)	.71*	-.34*	.26*	-.69*	—			
6. Gini coefficient	-.52*	-.04	-.41*	.30*	-.48*	—		
7. Taxation (% gross domestic product)	.71*	-.46*	.23*	-.54*	.66*	-.41*	—	
8. Pathogen load	-.70*	.23*	-.42*	.60*	-.72*	.50*	-.57*	—
Mean	1.01	0.31	0.20	2.91	25.76	40.23	21.90	33.52
± SD	1.69	0.46	0.40	1.32	24.05	9.29	12.16	6.76

Note: Ln = natural-log-transformed.

* $p < .05$.

Table 2. Effects of Existential Security on Disbelief in God for 137 Nations

Predictor	Variance inflation factor	B	SE B	t
Moslem	1.23	-.92 (.25)	.16	5.75**
Communist	1.23	.86 (.20)	.18	4.78**
Ln agricultural labor (%)	1.44	-.24 (.19)	.056	4.29**
Third-level enrollment (%)	1.78	.0083 (.10)	.0036	2.31*
Gini coefficient	1.25	-.032 (.18)	.0079	4.05**
Taxation (% gross domestic product)	1.34	.030 (.22)	.0060	5.00**
Pathogen load	1.64	-.039 (.16)	.011	3.55**
Constant	3.54	.54	—	—
r^2		.75		
$F(6, 129)$		56.68***		

Note: Ln = natural-log-transformed. Standardized regression coefficients in parentheses.

* $p < .05$. *** $p < .001$.

(or former Soviet) countries, and between them these variables accounted for 40% of the variance (according to a separate analysis not shown). Disbelief increased with economic security as reflected in more equal distribution of

income and higher taxation rates. Disbelief also rose with economic development as assessed by both low levels of agricultural labor and high levels of third-level enrolment. The effect for third-level enrolment was weaker than all of the other effects, and this reflects a higher level of shared variance with other factors (specifically agricultural workers and pathogen load, Table 1). The VIF was also higher for third-level enrolment than for the other predictors, though well below the 2.00 cutoff indicative of multicollinearity problems (Fox, 1991). Finally, the pathogen load, which was the second weakest predictor according to the regression analysis and still a highly significant negative predictor of disbelief, indicates that religious belief is stronger in countries suffering from a heavy pathogen load. As one might expect, pathogen load was negatively correlated with economic development (Table 1) so that the regression effect was smaller than the simple correlation due to shared variance with other predictors.

Discussion

Results confirm the uncertainty hypothesis in the sense that all of its specific predictions were strongly supported. Disbelief in God increased with economic development (i.e., declining agricultural labor force) as people acquired greater existential security. This was consistent with the findings of Norris and Inglehart (2004) for the importance of God and religion and those of Rees (2009) for the frequency of prayer. Nonbelief also increased with the proportion of the population enrolled in third-level education, though this effect was comparatively weaker in the regression analysis compared to the large simple correlation (Table 1). Economic development and higher levels of education are likely reflective of greater existential security via many different mechanisms from better infrastructure and improved food supply to better development of centralized government, reduced birth rates (Barber, 2010a) and improved public health. Results are also consistent with Lynn et al.'s (2009) finding that national IQ is positively correlated with disbelief in God.¹ (High IQ is itself arguably an adaptation to economic development,² Barber, 2010b).

Cutting across a particular country's level of economic development, I predicted that greater economic security in terms of distribution (and redistribution) of income would be associated with higher levels of disbelief in God. Consistent with this prediction, disbelief was higher in countries having more equal distribution of income (low Gini coefficients). Moreover, countries with higher levels of personal taxation, (measuring welfare state development) had higher disbelief, and this effect was the strongest one for any of

the independent variables in the regression analysis (but somewhat weaker than the effect for the control variable Moslem country, see Table 2).

The final prediction was that nonbelief would increase with health security. Consistent with the prediction, countries with a heavier pathogen load had lower levels of disbelief in God, even with controls for economic development. Note that Fincher and Thornhill (2008) found that the *number of religions in a country* was positively correlated with pathogen severity, but this was a different research question, and their methodology makes it difficult to exclude economic development as a possible third variable on the assumption that economic development promotes religious homogeneity as well as public health and thus eliminating or reducing many pathogens.

Taken together, the results show that the incidence of religious disbelief in a country (Zuckerman, 2007) is very strongly predicted by economic development, by favorable health conditions and by a more equal distribution of income as well as a well-developed welfare state (insofar as this is measured by high levels of personal taxation relative to GDP). Of course, high taxation rates also enable governments to provide many other public services, including better infrastructure, greater rule of law, public education, and better public health programs.

Predictions from the uncertainty hypothesis were supported by the data. This conclusion supports the argument that one evolutionary function of religion is to help people cope with uncertainty in their lives whether it is inability to control the physical ecology (where technological development has a key impact), economic uncertainty associated with low incomes, a weak social welfare system, or epidemic diseases that shorten life expectancy.

The results are correlational, of course, and do not establish that loss of religious belief can be attributed to economic development, health security, economic security, and so forth. Although the results are consistent with the causal conclusion, alternative interpretations cannot be ruled out; however, it is difficult to imagine what these alternatives might be, for example, in terms of reverse causation or third variables. As to the reverse causation question, disbelief in God cannot cause economic development, from a logical perspective, because, according to other research works, it comes after development (Norris & Inglehart, 2004; Zuckerman, 2007), but causes must precede effects. It is also difficult to identify a convincing third variable that produces both economic development and disbelief, though scientific education might seem plausible as Fraser (1922) suggested. Yet third-level education accounted for only a small proportion of the effect of economic development on disbelief in God (4% of variance explained, according to a separate analysis not shown here). This implies that higher education cannot be a major third

variable here, and this variable seems a reasonable proxy for scientific education. Similarly, it might be argued that a well-developed welfare state reduces the social functions of religion as a source of education, health care, and charitable donations. Yet the welfare state, as assessed by taxation levels, also accounted for a small proportion of the effect of economic development on disbelief in God (6% of variance explained, according to a separate analysis not shown here).

In summary, results of this cross-national analysis help to explain the distribution of disbelief around the globe accounting for three quarters of the variance. The results point to several areas for future research. One key issue is that the contemporary decline of belief in God is understandable as an adaptive response to increasing existential security. It is unclear whether there is a loss of interest in the supernatural or whether interest in the supernatural is merely diverted away from religion to other forms of expression, such as science fiction, television soap operas, and so forth. It would also be interesting to learn whether the social advantages of religious participation are replaced by secular pursuits, such as sports, as Wann et al. (Wann, Melznick, Russell, & Pease, 2001, pp.198-200) suggest. Another fertile topic might be to discover whether the stress management role of religion is replaced by increased use of antianxiety medications, recreational drugs, and secular practices such as exercise and psychotherapy.

The results help make sense of the fact that atheism is growing more rapidly than any particular religion (Zuckerman, 2007), though highly religious countries have higher birth rates so that the number of religious believers on the planet is higher now than at any time in history (Norris & Inglehart, 2004, p. 5). Even so, as poorer nations become more developed, religious belief will likely undergo progressive decline because an increasing proportion of the world's population will feel secure in respect to food supply, public safety, income, health, and the other conditions associated with economic development that give people a better sense of control over their lives and decrease the level of desire or perceived need for supernatural redress of existential insecurity.

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Notes

1. Kanazawa (2009) argued that religiosity is a function of IQ rather than economic development in connection with his regression analysis for 52 countries. Kanazawa's analysis did not control for health, economic security, or Moslem religion. The variables that he did include (IQ, ln GDP, school life expectancy, Communism, sub-Saharan Africa) are strongly correlated with each other, as he admitted, though the relevant correlation coefficients were not reported and there were no regression diagnostics to check for multicollinearity, such as computing VIFs; merely natural-log-transforming GDP did not begin to address the problem and could have even made it worse. My exploratory work found that an analysis such as Kanazawa's, even for my larger sample, would incur multicollinearity problems. Multicollinearity can be characterized as a problem of insufficient information in the sense that the statistical procedure has no means of determining which of the collinear factors should be used in a predictive equation (Allison, 1998; Fox, 1991). In some cases, the result is determined simply by which factor is entered into the regression equation first so that the other factors are rendered insignificant as they add little or nothing in terms of additional variance explained. For these reasons, negative findings in an analysis corrupted by multicollinearity are meaningless. Thus, when Kanazawa (2009) claimed to have ruled out economic development as a factor in declining religiosity, he not only contradicted a great deal of empirical research to the contrary (Norris & Inglehart, 2004; Paul, 2009; Zuckerman, 2008) but also claimed to have accomplished the statistical impossibility of deciding between highly correlated factors in a regression analysis (Allison, 1998; Fox, 1991).
2. A reviewer of this article took exception to my characterization of the relationship between economic development and intelligence, specifically the argument that IQ scores increase as part of an adaptive response to economic development, a perspective that is laid out in detail elsewhere, providing a parsimonious integration of much data (Barber, 2010b). The reviewer claimed that Lynn and Vanhanen (2002) had very clearly demonstrated that economic development is a consequence of average intelligence. Yet these are correlational data and cannot be used to establish a causal relationship. Lynn and Vanhanen are merely arguing that IQ causes economic development. Their perspective cannot accommodate the fact that Ireland was briefly one of the wealthiest countries of Europe or that African economies are currently growing faster than the United States despite relatively lower IQ scores in each case. Moreover, evidence shows that the kind of high parental investment, improved nutrition, and increased years of education known to boost IQ scores lag economic development rather than preceding it (Barber, 2004, 2005, 2010b; Ceci, 1991; Martorell, 1998), whereas causes must precede effects.

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Bio

Nigel Barber hails from Ireland. He received his PhD in biopsychology from Hunter College, CUNY, and taught psychology at Bemidji State University and Birmingham Southern College. A prolific cross-national researcher, he accounts for societal differences in sexual and reproductive behavior using an innovative approach, known as evolutionary social science. Books published by him include *Why Parents Matter*, *The Science of Romance*, *Kindness in a Cruel World*, and *The Myth of Culture: Why We Need a Genuine Natural Science of Societies*. The author blogs at *Psychology Today* (<http://blogs.psychologytoday.com/blog/the-human-beast>) and the *Huffington Post*, (<http://www.huffingtonpost.com/nigel-barber/>)