Intelligence and Environmental Complexity*

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Abstract: I begin by introducing the distinction between intelligence and the *g* factor and by assessing the recent change in the epistemological status of theories critical of *g*. After explaining the usefulness of defining intelligence as both the ability to learn quickly and thoroughly, and the capacity to deal with environmental complexity, I offer five key observations about why *g* matters for everybody everywhere, followed by five key observations about why *g* matters for geography and environmental studies. In the conclusion, I will argue it is wise to embed the study of intelligence within the critical project in geography.

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> *"The lies that support social institutions and beliefs are not resisted, but fomented by the representatives of society, who insist on and collaborate in the lies, punishing those who refuse to protect the ideal by lying"* James March[1]

I. Introduction: intelligence and the g factor

The distinction between the *g* factor and that which is usually called 'intelligence' is crucial for understanding the psychology of individual differences. If intelligence is a property of a person's brain (a

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[1] James March, "Ibsen, Ideals, and the Subornation of Lies", *Organization Studies* 28 no. 8 (2007): 1280.

universal construct), the *g* factor is a latent variable reflecting one's relative rank among one's peers (an individual difference construct).[1] Both intelligence and the *g* factor are, like all concepts used by humans, socially constructed, i.e. they are fictions used to some purpose. However, unlike fairy tales, they are constrained fictions[2], i.e. fictions that have emerged over more than one century of empirical investigation of actual facts. As this paper will illustrate, the reason for maintaining these fictions in our conceptual toolbox is pragmatic: a great deal about social reality can be explained, predicted, and understood through their lens. By Milton Friedman's standard ("A hypothesis is important if it explains much by little"[3]), *g* theory is one of the most important theories available to social scientists today. By the epistemological standards of both explanationism[4] and Bayesianism, *g* theory accounts for a whole century of empirical evidence much better than any of its rivals. One of the most important findings in intelligence research is the so called positive manifold:[5] if somebody takes a series of widely diverse cognitive tests, the scores of the tests tend to be positively correlated, despite their difference in content and format.[6] The *g* factor captures this

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[1] Arthur Jensen, "Psychometric *g*: Definition and substantiation", in *The general factor of intelligence: How general is it?*, ed. Robert J. Sternberg and Elena Grigorenko (New York: Lawrence Erlbaum, 2002), 39–53; D. Borsboom, and Conan. V. Dolan, "Why *g* Is Not an Adaptation: A Comment on Kanazawa", *Psychological Review*, 113 no. 2 (2006): 433–437.

[2] Mario Bunge, *Chasing Reality: Strife over Realism* (Toronto: University of Toronto Press, 2006).

[3] Milton Friedman, "The Methodology of Positive Economics", in *Essays in Positive Economics* (Chicago: Chicago University Press, 1953), 14.

[4] P. Lipton, *Inference to the best explanation*, 2nd edition (London: Routledge, 2004).

[5] Psychometric literature uses this term to refer to the intercorrelation between a series of variables. In turn, this intercorrelation reflects *g*: the latent variable driving all the intercorrelated variables. See David. J. Bartholomew, *Measuring Intelligence: Facts and Fallacies* (Cambridge: Cambridge University Press, 2004), 35–67. The *g* factor is likely to be but one manifestation of a broader fitness factor, which is the hidden third variable that explains the recently discovered seemingly bizarre positive correlation between *g* and semen quality. See Rosalind Arden et al., "Intelligence and Semen Quality Are Positively Correlated", *Intelligence* 37 (2009).

[6] Douglas K. Detterman, "Spearman's g: Past, Present, and Future", in *Human Ability: Genetic and Environmental Influences*, ed. R. A. Peel and M. Zeki, (London: Galton Institute, 2005).

property of all cognitive tests[1] to share a significant part of their variance. To put it simply, a pupil who earns straight As in geography will tend to be at least average if not above average, in all school subjects; conversely, a student whose average grade in geography is D- will tend to have poor grades across the board of the disciplines studied. In other words, the *g* factor is a latent between-subjects dimension that measures an individual's comparative standing in intellectual ability and, as such, its predictive validity is unmatched by any other psychological variable.[2]

In the last two decades, the field of intelligence research has been divided over the extent of the significance of the *g* factor.[3] This

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[1] One's score in an IQ test is an excellent indication of one's *g*, but IQ scores are also contaminated with variables beyond *g*, depending on the type of tests taken. Thus, if one takes an IQ test based on verbal subtests, one's IQ score will be moderately influenced by one's verbal ability, over and above *g*. However, *g* can be estimated not only from IQ tests, but also from any school test with cognitive demands (e.g. SAT and GRE in the USA, A levels in the UK) and from tests of elementary brain processes such as reaction time and inspection time (L. Sheppard and P. Vernon "Intelligence and Speed of Information-Processing: A Review of 50 Years of Research", *Personality and Individual Differences* 44 no. 3 (2008): 535–551). Thus, there are *culture-free* ways to measure the *g* level of diverse populations and these new ways render obsolete the older criticism that the measurement of intelligence is valid only within Western culture.

[2] IQ is slightly better than social class at predicting income, years of education, and job status: T. Strenze, "Intelligence and Socioeconomic Success: A Meta-Analytic Review of Longitudinal Research", *Intelligence* 35 no. 5 (2007): 401–426. IQ is not a mere reflection of parental social class: the correlation between the two is in the .25-.35 range, which means that more than 87.75% of the variance in IQ cannot be explained by social class. Notice for illustration the .25 and .29 correlations recently observed in large representative UK samples by Catherine R. Gale et al., "Intelligence in Childhood and Risk of Psychological Distress in Adulthood: The 1958 National Child Development Survey and the 1970 British Cohort Study", *Intelligence* 37 (2009). Finally, the ability of IQ-like tests to predict school achievement is not explained by their correlation with social class. This means that IQ tests and related SAT-like tests are not tools used by the rich to favour the rich. As Jensen put it in his writings, IQ tests help the poor but bright children escape the entrapment of their parents' social class; they "see though the veneer" of class. For a recent evidence-based discussion see Paul R. Sackett, et al., "Does Socioeconomic Status Explain the Relationship between Admissions Tests and Post-Secondary Academic Performance?", *Psychological Bulletin* 135 no. 1 (2009): 1–22.

[3] Nathan Brody, "To *g* or Not to *g* – That Is the Question", in *Handbook of Understanding and Measuring Intelligence*, eds. O. Wilhelm, and R. Engle, (London: Sage, 2005), 489–502.

division resulted partly because of an often-cited, but scientifically flawed critique of *g* by Harvard palaeontologist Stephen Jay Gould,[1] and partly because researchers within the field proposed alternative theories of intelligence that appealed to the general public through their egalitarian and optimistic overtones. However, the status within the field of these egalitarian[2] theories has been thoroughly undermined in the last five years, as better psychometric research on *g* is increasingly backed up by advances in neuroimaging, neurobiology, cognitive neuroscience, behavioural genetics and molecular genetics.

Thus, Robert Sternberg's theory of triarchic intelligence[3] – which, in essence, tries to argue that everyday intelligence and creative intelligence are of a different nature from scholastic intelligence – has been meticulously eviscerated in recent analyses.[4] The results of these analyses converge in their conclusion that triarchic intelligence has little or no predictive ability over and above the *g* factor: everyday intelligence, creative intelligence, and scholastic intelligence are all expressions of the underlying *g*.

Similarly, Howard Gardner's theory of multiple intelligences[5] – which argues that there are eight or nine intelligences, including musical intelligence and bodily-kinaesthetic intelligence – has been severely

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[1] See the following comments on his work: Arthur R. Jensen, "The Debunking of Scientific Fossils and Straw Persons. Review of Stephen Jay Gould The Mismeasure of Man (New York: W. W. Norton, 1981)", *Contemporary Education Review* 1 (1982): 121–135; J. P. Rushton, "Race, Intelligence, and the Brain: The Errors and Omissions of the Revised Edition of S. J. Gould's the Mismeasure of Man", *Personality and Individual Differences* 23 (1996): 169–180.

[2] The egalitarian move consists of replacing the *painful hierarchical differences* imposed by IQ (smart > average > dumb) with the *joyful flat differences* (different-but-equal) of the type "I have high musical intelligence, you have high spatial intelligence, but we are equal".

[3] Robert J. Sternberg, *Beyond IQ: A Triarchic Theory of Intelligence* (Cambridge: Cambridge University Press, 1985).

[4] Linda. S. Gottfredson, "Dissecting Practical Intelligence Theory: Its Claims and Evidence", *Intelligence*, 31 no. 4 (2003): 343–397; Nathan Brody, "Construct Validation of the Sternberg Triarchic Abilities Test (STAT): Comment and Reanalysis" *Intelligence*, 31 (2003): 319–329; M. A. McDaniel and Deborah L. Whetzel, "Situational Judgment Test Research: Informing the Debate on Practical Intelligence Theory", *Intelligence* 33 no. 5 (2005): 515–525.

[5] Howard Gardner, *Frames of Mind: The Theory of Multiple Intelligences* (New York: Basic Books, 1983).

attacked on both theoretical and empirical grounds.[1] Visser et al tested this theory empirically and found that Gardner's crucial claim that the eight intelligences are uncorrelated is false. Instead of independence, the researchers found a positive manifold among the subtests measuring the different intelligences, and hence were able to extract a robust *g* factor. To sum up, as time goes by, both the evidence for *g* theory and the evidence against alternative theories of intelligence pile up. This direction of scientific progress will – by necessity – force researchers and policy makers to obey the canons of Bayesian updating of beliefs and thus confront the enormous implications for social life entailed by *g* theory[2].

In what follows, I will explain why *g* is the missing piece in the puzzle of social science research in general and of geography in particular. I start by addressing the nature of human intelligence as it relates to the activity of learning and to the necessity of dealing with environmental complexity.[3] I subsequently answer the question 'why *g* matters for everybody everywhere?', then I elaborate on 'why *g* matters for geography?', and I finish the paper by considering why *g* matters for the success of the critical project in geography.

II. The nature of human intelligence

Intelligence has been defined in many ways by the experts in the field and each definition sheds light on one or several significant manifestations of this property of the brain. First of all, intelligence is the ability to learn thoroughly and quickly. Alfred Binet,[4] the author of the

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[1] Beth A. Visser, Michael C. Ashton, and Philip A. Vernon, "Beyond g: Putting Multiple Intelligences Theory to the Test" *Intelligence* 34 no. 5 (2006): 487–502; *Gardner under fire*, ed. Jeffrey Schaler, (Chicago: Open Court Publishing, 2006).

[2] Linda S. Gottfredson, "Social Consequences of Group Differences in Cognitive Ability", in *Introducau a psicologia das diferencas individuais*, eds. C. E. Flores-Mendoza and R. Colom (Porto Allegre, Brazil: ArtMed Publishers, 2006), 433–456.

[3] See also C. Gonzalez, R. P. Thomas and P. Vanyukov, "The Relationships between Cognitive Ability and Dynamic Decision Making", *Intelligence* 33 no. 2 (2005): 169–186. To understand some of the mechanisms involved see J. Duncan et al. "Goal Neglect and Spearman's g: Competing Parts of a Complex Task", *Journal of Experimental Psychology: General* 137 no. 1 (2008): 131–148.

[4] I do not have space here to review the complex history of intelligence research and especially Spearman's seminal work on factor analysis. An excellent account of this history is in Arthur R. Jensen, *The g factor: The science of mental ability*,

first test of intelligence (1905), was particularly concerned with this understanding. The French government at the time asked him to find a way to identify those pupils who do not profit from the standard education, either because they learn too slowly or because they learn too fast. More than one century of research has added robust data to support the view that the ability to learn varies widely among individuals. Arthur Jensen[1] observes that within any given school, the most intelligent student learns five to twenty times faster than the least intelligent. Usually by the third grade, the average student makes the crucial transition from learning to read to reading to learn, but those students with an IQ below 80 never quite manage to make it. Later on in the schooling system, researchers have found that an individual with an average IQ (100) has a 50-50% chance to be admitted for a university education, and a person with an IQ of 115 has a 50-50% chance to be admitted into graduate school.

An important question in the field revolves around the ceiling of learning: can individuals of low intelligence learn – if they have plenty of time and excellent teachers – difficult subject matters such as mathematics, theoretical physics, or metaphysics? To the extent that intelligence essentially measures a person's capacity to deal with abstract matters, the answer seems to be 'no'.[2] The issue of abstraction lies at the very heart of what intelligence measures. Consider a child who plays on her family lawn with three dogs of different breeds (Johnny, Danny, and Andy) and two cats of different breeds (Figaro and Coco). In metaphysical parlance, Johnny, Danny, Andy, Figaro, and Coco are particulars, i.e. items with a given identity, readily observable by anyone. If the child notices that Johnny, Danny, and Andy, despite their differences, share many things in common (e.g. barking), she can group them together in her mind under the label 'dog'. 'Dog' is a universal, i.e. a general term that subsumes all the particulars with a certain set of properties. Intelligence is the ability to extract universals from particulars. This presupposes the capacity to grasp the essential properties of a set of particulars, as well as the ability to detect what distinguishes closely related universals. When one writes the abstract for

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(Westport, CN: Praeger, 1998), chapters 1 & 2, and a shorter account in Bartholomew, *Measuring Intelligence...*, chapter 2.

[1] Ibid.

[2] Ibid.; Charles Murray, *Real Education. Four Simple Truths for Bringing America's Schools Back to Reality* (New York: Crown Forum, 2008).

one's article, one tries to extract the core findings of one's paper. In the same vein, to figure out that Johnny, Danny, and Andy can be grouped under the universal 'dog', one needs to be able to conceptually extract their core properties. The effects of intelligence differentials appear shockingly clear when one analyses the level of abstracting that individuals can tackle. The child in our story may have no difficulty in extracting the first level universals 'dog' and 'cat', but the fact that dogs and cats and herself can be grouped under the higher universal 'mammals' might elude her at that stage of early cognitive development. I have deliberately chosen an example of a child playing, to dismantle the wrong but pervasive assumption that IQ is relevant just for school learning. The ability to learn from play, from watching TV, from observing others, from life experience is exactly the same with the ability to learn within the school system.

The school system in any given society performs the obvious task of preparing the younger generations for socially useful roles. But there is more than meets the eye. From a *g* theory perspective, the school system is a long IQ test that sorts individuals and puts them in their place, i.e. a job commensurate with their level of intelligence. To understand why the school system is an IQ test,[1] we need to take a longitudinal view at the curriculum, from first grade to grade twelve, and from first year of college to the last year of one's law school, or medical school, or PhD programme. What is it that differentiates the contents to be learned in the earlier grades from those in the later grades?

As a first generalisation, the defining pattern that can be detected is a steady and robust increase in cognitive complexity. One of the most important ways of defining intelligence sees it as the ability to deal with complexity.[2] But what is it that makes complexity 'complex', more difficult than simplicity? There are several factors involved and complexity is the emergent property resulting from their interaction. One

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[1] See also Ian. J. Deary et al., "Intelligence and Educational Achievement", *Intelligence*, 35 no. 1 (2007): 13–21; Strenze "Intelligence and Socioeconomic…" and Murray, *Real Education…*

[2] Ashby's law of requisite variety expresses the fact that environmental complexity can be dealt with only to the extent that it is matched by the complexity of the brain. "Smart people" equals "more complex brains", which equals "better ability to cope with the complexities of our environment" (the title of the present paper points to this idea). See the excellent synthesis by E. Mercado, "Neural and Cognitive Plasticity: From Maps to Minds", *Psychological Bulletin* 134 no. 1 (2008): 109–137.

such factor is the sheer volume of the material to be dealt with. The amount of material taught in any given class tends to increase with each grade, and so does the amount required for passing one's exams.

A second factor is the level of abstractedness: in the first grade, the textbook is filled with empirical and common sense material such as photographs, depictions of scenes of life, animals, buildings, etc. The language used includes many monosyllabic and frequently deployed words: cat, bed, pen, pear, car, and so on and so forth. By the end of high school and at college all these early pleasurable beginnings are left behind and the students have to deal with highly abstract and anti-common sensical material: formulas for calculus, the structure of the atom, mathematical probability, philosophical debates about causality, freedom, and the possibility of truth, etc. There are far fewer pictures and they point to abstract diagrams rather than everyday objects of one's surrounding. Put differently, there is a shift of emphasis from trivial surface perceptual characteristics to significant but invisible deep underlying structures: the former can be seen with one's *eyes* (perception), the latter can be seen only with one's *mind eye* (conception). The language used in textbooks and by the faculty also changes. The words deployed are increasingly polysyllabic, increasingly rare, and denote concepts increasingly difficult to see (let alone visualize): photon, determinism, commodity, rationality, inexhaustible, accountability, epistemology, etc.

A third major factor is the embeddedness of relevant material in a mass of irrelevant data. In the first grade, the key ideas and key concepts in any given lesson are highlighted and the students are explicitly told that these highlights are the things that are important and that they should focus their learning efforts on them. As time goes by and the students arrive in high school, college, and then graduate school, they are increasingly expected to be able to detect on their own the relevant material. In a senior class in college, they might be given two hundred pages of scholarly material to read, with no highlights or summing up of key ideas whatsoever. It is their job to sift through the mass of data and to find the gems that are truly important. This ability to tell apart gems from junk data is the essence of intelligence and makes it easy to understand why the twenty first century (with phenomena like Google) will intensify the role of *g* in predicting school, career, and life success.

A fourth factor that amplifies complexity from one level of education to another is the increasing incompleteness of the explanations given in class and in textbooks. If the student learns in grade six what

genes are, by the end of the high school the teacher and the text will mention genes without bothering to explain again what they mean. It is assumed that the student did her job of learning in previous grades and that now she is mastering the concept. But students pass from one year to another with grades ranging from A+ (excellent mastery of the material), to D– (minimum requirements barely met). The less intelligent students, who do not fully assimilate the new material taught, pass to the next grade with an extra-baggage of poorly understood concepts and theories. Their lesser level of intelligence, combined with that extra-baggage ('historical' lesser intelligence) makes it double difficult for them to cope with the new contents, as they lack the conceptual tentacles needed to grab new material. As this phenomenon happens across disciplines and across areas of study, their cumulative effect makes studying at higher levels a true ordeal, as everything seems to conspire to be over the head of the student. Thus, those of lesser intelligence are pruned along the system, either by being invited to leave (e.g. failure to meet minimum requirements or rejection at one important exam), or by leaving of their own initiative.

Other factors that increase complexity are the presence of contradictory information (and college is all about comparing and contrasting competing theories at odds with one another), the suffusion of information with misleading cues (which distract the less perceptive and the less astute away from the truly important cues), the presence of vague material (open to multiple interpretations), the presence of distorted/deformed material (e.g. having to take notes in the class of a professor who speaks English with a very thick accent), and the amount of intrasystemic relational complexity (e.g. to understand Marxist political economy one needs both a solid grasp of economic realities and a deep understanding of how the three laws of dialectics operate in concert).

All these factors make education a question primarily of intelligence and only secondarily of self-esteem, motivation, and values.[1] As intelligence in any given population is normally distributed, with

[1] F. Gagné and F. St. Père, "When IQ Is Controlled, Does Motivation Still Predict Achievement?", *Intelligence*, 30 (2001): 71–100; B. Spinath et al., "Predicting School Achievement from General Cognitive Ability, Self-Perceived Ability, and Intrinsic Value", *Intelligence* 34 no. 4 (2006): 363–374. Richard Lynn and Satoshi Kanazawa, "How to Explain High Jewish Achievement: The Role of Intelligence and Values", *Personality and Individual Differences* 44 (2008): 801–808.

more people in the middle and fewer people towards either the lower or the higher ends of the probability distribution function, both highly retarded and highly gifted students are penalised by the system of mass education. Children with an IQ less than 50 are not able to enrol in the general education system and are permanently monitored in special schools for the retarded. Children with IQs between 50 and 75 are often allowed into the general system, but they are almost always pruned out by the end of elementary education.

There are then, four[1] important thresholds along the IQ continuum: IQ 50 (threshold for admission into the mass education system), IQ 75 (threshold for entering high school), IQ 100 (50-50% chance of admission to college), and IQ 115 (50-50% chance of admission to graduate school or of finishing college with high grades).
Whereas the above analysis of the nature of intelligence might have helped foresee why IQ matters for everybody everywhere, in the next paragraphs I will draw together those threads that most straightforwardly facilitate the honest evaluation of IQ's importance. I will structure my answer into five key observations.

III. Why does *g* matter for everybody everywhere?

1. The g factor is a matter of life and death

Consider four ways in which individuals can be gifted:[2] having a high IQ, singing well, drawing beautifully, and being a natural athlete. What distinguishes the gift of high intelligence from the other three is its social and personal impact. Human intelligence, in other words, is highly consequential for matters of life and death. This observation needs elaboration at two levels. The first refers to one's individual chances of living a long and healthy life and thus will stir the interest of medical geographers. The new field of cognitive epidemiology[3] has found that the amount of health knowledge one possesses is highly correlated (at .88)[4]

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[1] Jensen, *The g factor…*

[2] 'Gifted' is used here as a broad term that includes not only the 'highly intelligent', but also those people highly talented in non-intellectual areas (e.g. athletic ability, singing, etc). This use implies that not all gifted individuals are by necessity highly intelligent.

[3] Ian J. Deary, "Why Do Intelligent People Live Longer?", *Nature*, 456 (2008): 175–176; Ian J. Deary et al., "More Intelligent, More Dependable Children Live Longer: A 55-year Longitudinal Study of a Representative Sample of the Scottish Nation", *Psychological Science*, 19 (2008): 874–880.

[4] Brody, "To *g* or Not to *g*…".

with one's IQ. Health knowledge, in turn, helps one's health by its translation in healthy living practices and in the ability to detect early on the signs of potentially serious diseases. Health knowledge aside, IQ manifests its impact on life and death through its role in the ability to prevent accidents. To understand this effect, one has to grasp a particularly important way of understanding the nature of intelligence. Intelligence is the ability to go beyond what is present, to see in the future, to anticipate what is around the corner; it is the mind's eye. Low intelligence hinders the capacity to see through consequences and to anticipate threats to one's bodily integrity. To make things worse, the ability to react fast is one of the components of intelligence.[1] Those individuals with a low IQ tend to be slow both in intellectual matters and in steering the wheel in the right direction when confronted with the risk of an accident on the highway.[2] Health knowledge, the ability to see around the corner, and the ability to react quickly are just three examples of many other *g*-loaded dimensions that explain how IQ governs people's chances to live a long and healthy life. But when I said that the *g* factor is a matter of life and death, I was also thinking of a second level of analysis, concerned this time not with individuals, but with the collective properties of a given social group. The likelihoods that a person will not end up in jail, that she will not die in her apartment because of an earthquake, and that she will survive despite a very severe stroke depend, respectively, on the quality of the work of the lawyer, the architect, and the physician. What these three jobs have in common is their very high levels of cognitive complexity. By contrast with a tomato peeler, a janitor, or a shoe-shiner, the productivity and the quality of the performance in these three cognitively complex jobs *critically* depends on the level of intelligence of its practioners. We do know now[3] that all

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[1] Sheppard and Vernon, "Intelligence and Speed…"; See also B. Rypma and Vivek Prabhakaran, "When Less Is More and When More Is More: The Mediating Roles of Capacity and Speed in Brain-Behavior Efficiency", *Intelligence* 37 (2009).

[2] Linda S. Gottfredson, "Innovation, Fatal Accidents, and the Evolution of General Intelligence", in *Integrating the mind*, ed. M. J. Roberts (Hove, UK: Psychology Press, 2007).

[3] Linda S. Gottfredson, "Why g Matters: The Complexity of Everyday Life", *Intelligence*, 24 no. 1 (1997): 79–132; N. R. Kuncel, S. A. Hezlett and D. S. Ones, "Academic Performance, Career Potential, Creativity, and Job Performance: Can One Construct Explain Them All?", *Journal of Personality and Social Psychology*, 86 no. 1 (2004): 148–161.

jobs, regardless of their cognitive demands, benefit from a higher level of intelligence, but the extent of this dependency varies immensely. Productivity and work quality are correlated with IQ at .2 for jobs of low cognitive complexity, at .4- .6 for jobs of intermediate cognitive complexity (and 63% of jobs in the American economy belong in this category[1]), and at .8 for jobs of high cognitive complexity. Put simply, 64% of the variance in performance among lawyers, architects, and physicians (and university teachers, CEOs, engineers, and pharmacists) is explained by IQ alone. The difficulty of becoming a lawyer, architect, or physician reflects society's interest in creating a thorough screening of potential candidates. Society's selection systems (exams, qualifications, hiring rules) operate to ensure that only those with a high enough IQ are allowed into these jobs of high responsibility.

It is the fact that IQ is so consequential in determining what we cherish the most (being alive and being healthy) that separates it from other comparatively trivial talents (music, painting, athleticism). To put things in a historical perspective, we are where we are in terms of scientific and technological progress because of the work of invention and innovation of high IQ individuals and teams. It is true that creativity and intelligence are not fully coextensive categories, but it is equally true that they overlap significantly and that truly socially useful creativity in the scientific domain requires a high level of intelligence.[2]

2. The g factor makes a difference across the board of human activities

Intelligence, however, is different from musical talent, painting ability, or athletic prowess not only with regard to its role in issues of life, death, and the collective future. A second factor that explains the fundamental importance of intelligence arises from the pervasiveness of

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[1] F. Schmidt, "The Role of General Cognitive Ability and Job Performance: Why There Cannot Be a Debate", *Human Performance* 15 no. 1–2 (2002): 187–210.

[2] For an accessible discussion see Dean Simonton, *Genius 101* (New York: Springer Publishing, 2009). For primary sources see F. Preckel, H. Holling and M. Wiese, "Intelligence and Creativity in Gifted and Non-Gifted Students: An Investigation of Threshold Theory", *Personality and Individual Differences*, 40 (2006): 159–170; G. Park, David Lubinski and Camilla P. Benbow, "Ability Differences among People Who Have Commensurate Degrees Matter for Scientific Creativity", *Psychological Science* 19 (2008): 957–961; Paul J. Silvia, "Another Look at Creativity and Intelligence: Exploring Higher-Order Models and Probable Confounds", *Personality and Individual Differences*, 44 no. 4 (2008): 1012–1021.

its effects across the board of social activities. Sociologists Linda Gottfredson and David Gordon have pioneered the study of the apparently trivial effects of *g* and have converged in their finding that life itself is an intelligence test.[1] To understand life as an intelligence test, one needs to understand the Spearman-Brown formula that underwrites the logic of psychometrics. To simplify this, we can say for the present purposes that each question on an intelligence test contains two sets of components: the large component is highly specific information; the small component is *g* itself. It is the aggregation of questions that allows for the extraction of *g*. To give an example, the questions 'Who wrote *Gone with the wind*?', 'What is the capital of Chad?', and 'In what year did the US become independent?' measure specific knowledge of literature, geography, and history, but the specifics of each answer cancel each other out and what emerges when a test's answers are summed up is the *g* factor itself. Each particular question is a poor indicator of *g*, but the sum of the questions becomes an excellent indicator of *g*. The myriad daily events we go through are the equivalent of the specific questions discussed above. We can think of trivial acts such as reading the instructions on how to use a newly bought tool, calculating the amount of carpet needed for one's living room, finding a website with reliable advice, planning the activities for the forthcoming week, convincing one's partner to give up smoking,[2] preparing a special meal, and grasping the meaning of the latest news on CNN. None of them seems to be a straightforward and robust measure of intelligence, but together they do allow for intelligence to make a significant difference in one's quality of life.

Other things being equal (e.g. level of motivation), an intelligent person can achieve one's daily goals in a shorter period of time, and with

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[1] Gottfredson, "Why g Matters…", Gottfredson, "Innovation, Fatal Accidents…"; Robert A. Gordon, "Everyday Life as an Intelligence Test: Effects of Intelligence and Intelligence Context", *Intelligence* 24 (1997): 203–320.

[2] M. J. Schulte, M. J. Ree and T. R. Caretta ["Emotional Intelligence: Not Much More than g and Personality", *Personality and Individual Differences* 37 (2004): 1059–1068) found a .45 correlation between emotional intelligence and IQ. A recent breakthrough contribution that begins to explain the mechanisms behind this positive correlation is Brandon J. Schmeichel, Rachael N. Volokhov and Heath A. Demaree, "Working Memory Capacity and the Self-Regulation of Emotional Expression and Experience", *Journal of Personality and Social Psychology*, 95 no. 6 (2008): 1526–1540. For a discussion of the positive correlation between IQ and emotional well-being see also Gale et al., "Intelligence in Childhood and Risk…".

fewer resources. This daily advantage steadily cumulates into overall life success, at least as measured by the criteria of contemporary social science (level of education, income, job status, freedom from illness).

*3. The g factor means that **high** intelligence is a scarce resource*

All human beings are endowed with some intelligence, but their *g* levels are a function of the statistical properties of the normal distribution curve. Most people are average in intelligence (2/3 are within one standard deviation from the group's average and 95% within two standard deviations). The individual who stands at the right end of the probability distribution function for IQ tends to learn more thoroughly and 5 to 20 times faster than the individual at the left end of the distribution.[1] In any given job, the top 1% most productive employees work 3.29 to 10 times faster and better than the bottom 1% of the least productive employees.[2] Considering the population of the UK, Canada, or USA, only the top 5% of individuals in these countries have an IQ above 125. If this figure is seen in light of the fact that the average IQ of physicians and PhDs is about 125,[3] one starts to understand that from the perspective of any given capitalist company or that of any given profession, the major ingredient in the recipe for successful performance is the attraction and retention of the most intelligent individuals. This beginning of understanding can then be deepened by grasping the fact that a tiny difference in talent between two competing companies' top performers is likely to determine the divergent fate of those companies in an economic world increasingly ruled by winner-take-all markets.[4]

4. The g factor eludes human attempts to increase it through education

Researchers of human intelligence have frequently made the distinction[5] between fluid intelligence and crystallized intelligence. The first type is the biological engine that determines how fast and how

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[1] Jensen, *The g factor…*

[2] Schmidt, "The Role of General Cognitive…"

[3] Gottfredson, "Why g Matters…"; Schmidt, "The Role of General Cognitive…"

[4] R. H. Frank and P. J. Cook, *The Winner-Take-All Society* (New York: Free Press, 1995).

[5] An open question in the field is establishing in what contexts *g* and fluid intelligence can be used interchangeably, but it is clear that conceptually they are distinct constructs. For a brief but pointed explanation see K. Kovacs, K. C. Plaisted and Nicholas J. Mackintosh, "Difficulties Differentiating Dissociations", *Behavioral and Brain Sciences* 29 no. 2 (2006): 138–139.

quickly we learn and manipulate information, and is under tight genetic control.[1] Fluid intelligence reaches its peak at around age 16 and starts declining in one's 20ies.[2] It is the weapon that helps humans deal with novelty[3] of any kind: learning new things, making sense of novel contexts and situations, etc. Many attempts have been made in the second half of the last century to boost it through intensive pre-school or school education, but the apparent gain in IQ obtained by children immediately after training disappears in the next few years. In 2005, four intelligence experts writing in four different contexts about this depressing finding, converged in their conclusions: 'Shared environmental influences are important in early childhood but reduce to zero by adolescence';[4] 'Jensen's 1969 conclusion about the failure of socioeducational interventions to raise low IQ substantially and permanently still stands';[5] 'As far as anyone knows, *g* itself cannot be coached',[6] and finally Detterman:[7]

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[1] Ian J. Deary, F. Spinath and Timothy C. Bates, "Genes and Intelligence", *European Journal of Human Genetics*, 14 (2006): 690–700; N. P. Friedman et al., "Individual Differences in Executive Functions Are Almost Entirely Genetic in Origin", *Journal of Experimental Psychology: General,* 137 no. 2 (2008): 201–225; Robert Plomin, Y. Kovas and C. M. A. Haworth, "Generalist Genes: Genetic Links between Brain, Mind, and Education", *Mind, Brain, and Education,* 1 no. 1 (2007): 11–19; P. Shaw, "Intelligence and the Developing Human Brain", *BioEssays* 29 no. 10 (2007): 962–73; Simonton, *Genius 101.*

[2] Timothy A. Salthouse, "When Does Age-Related Cognitive Decline Begin?", *Neurobiology of Aging* 30 (2009).

[3] A more nuanced statement would define fluid intelligence as "a broad individual difference dimension contributing to diverse types of controlled or effortful processing" [Timothy. A. Salthouse, J. E. Pink and E. M. Tucker-Drob, "Contextual Analysis of Fluid Intelligence", *Intelligence*, 36 (2008): 464]. Novelty requires going beyond default functioning (System 1), i.e. it requires effortful, controlled processing of information (System 2).

[4] S. A. Petrill, "Behavioral Genetics and Intelligence", in *Handbook of understanding and measuring intelligence*, eds. O. Wilhelm and R. Engle (London: Sage, 2005), 166.

[5] Linda S. Gottfredson, "What If the Hereditarian Hypothesis Is True?", *Psychology, Public Policy, and Law* 11 (2005): 313.

[6] Charles Murray, "The Inequality Taboo", *Commentary* 120 no. 2 (2005): 13. See also Murray, *Real Education…*

[7] Douglas Detterman, "Spearman's g: Past, Present, and Future", in *Human Ability: Genetic and Environmental Influences,* ed. R. A. Peel and M. Zeki, (London: Galton Institute, 2005), 17–18; emphasis in original.

"The evidence is overwhelming that *g* is heritable, stable, and difficult to change. *No one has been able to identify environmental variables that affect g or to change g through systematic intervention*… For better or worse, that is the way the truth is revealing itself."

Even more recently, and helped by advanced statistical methods, Watkins et al[1] tried to re-assess the relation between school achievement and fluid intelligence, but were forced to conclude that the arrow of causation goes only in one direction: from IQ to school achievement and not the other way around.[2] If fluid intelligence is not malleable, crystallized intelligence is to some extent.[3] The latter term denotes the sum total of the knowledge and skills accumulated by an individual through formal and informal learning. It can be seen as the fruit of the application of fluid intelligence to the acts of living and learning. This latter metaphor makes sense in a longitudinal perspective: crystallized intelligence reaches its peak sometime in one's fifties and declines thereafter because of the steeper slope of brain degeneration that characterises old age.[4] Taken together, the facts that (a) few people are born with relatively high levels of intelligence and that (b) fluid intelligence cannot be robustly[5] increased through training make human intelligence an extremely sought-after natural resource.

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[1] M. W. Watkins, P. Lei and G. L. Canivez, "Psychometric Intelligence and Achievement: A Cross-Lagged Panel Analysis", *Intelligence* 35 no. 1 (2007): 59–68.

[2] See also the following studies that triangulate Watkins et al, in cultural contexts ranging from India to the US: S. A. Brouwers, R. C. Mishra, and F. J. R. Van de Vijver, "Schooling and Everyday Cognitive Development among Kharwar Children in India: A natural Experiment", *International Journal of Behavioral Development*, 30 (2006): 559–567; H. N. Nie and S. Golde, "Does Education Really Make You Smarter?" *Miller-McCune* May 19 (2008), available at http://www.miller-mccune.com/article/349; H. N. Nie, S. Golde and D. M. Butler, Education and Verbal Ability over Time: Evidence from Three Multi-Time Sources (2007), Working Paper available at http://www.stanford.edu/group/siqss/cgi-bin/downloads/Education_SIQSS.pdf.

[3] Keith E. Stanovich, *The Psychology of Rational Thought: What Intelligence Tests Miss* (New Haven: Yale University Press, 2009).

[4] A. R. Jensen, *Clocking the Mind: Mental Chronometry and Individual Differences* (Amsterdam: Elsevier Science, 2006); Salthouse "When Does Age-Related…".

[5] The media are replete with citations of research that shows that IQ can be boosted. What is not said is that either the boost was massive, but short-lived

5. As time goes by, the impact of g on social and economic life grows stronger

The history of humanity is a history largely governed by the unfolding of scientific and technological progress and hence by an increase in the cognitive complexity of the school, of life and of the workplace. This spiralling complexity has exercised a continuing selection pressure for ever higher levels of intelligence. Gottfredson[1] proposes the mechanism of double jeopardy as essential for understanding the specifics of this silent Darwinian selection. Double jeopardy means that whenever a new invention or innovation is introduced, the intelligent individuals: (a) know how to use it better than the less intelligent, a fact which slightly increases their chances in the evolutionary struggle to spread their genes, and (b) know better how to avoid being harmed by the new tool, a fact which increases their comparative chances of surviving fatal accidents. The less intelligent are thus in a double jeopardy with each new invention that is being added to the repertoire of living. If this process is magnified across spaces and times, the selection pressure for high intelligence becomes magnified as well. It is precisely this magnifying effect that characterises capitalist competition and its newest expression in the form of the relentless neoliberal globalisation of 'the knowledge economy'. The opening of national markets and the sustained flow of human interaction via the Internet remove former barriers to the global hunt for high levels of intelligence and sharply increase the discrepancy between the wealth of the smart and the wealth of the not-so-smart. The forces of globalisation combined with technological advances create an increasing number of winner-take-all markets, and hence an increasing number of contexts in which intelligence makes all the difference. The pervasive neoliberal[2]

(return to baseline), or else it was long-lived, but trivial. As of 2009, there is no evidence for IQ boosts that are both massive and long-lived (Murray, *Real Education*…). Even if artificially increasing IQ may become a reality in the future, this does not mean that IQ differences between individuals will be erased. One of the main roots of social inequality is likely to persist for the foreseeable future.

[1] Gottfredson, "Innovation, Fatal Accidents…".

[2] All geographers who study neoliberalism systematically fail to observe that neoliberalism magnifies the individual and collective impact of *g*. An elegant refutation of neoliberal ideology would consist of the following inference: since neoliberalism magnifies the impact of *g*, and *g* is the result of unfair advantage at the genetic lottery, it follows that neoliberalism is the maximisation of genetic unfairness, and hence, on the basis of a Rawlsian theory of justice, should be

attack on welfare capitalism has undermined the safety nets through which societies used to take care of those unlucky in the genetic lottery:[1] progressive levels of taxation, anti-monopoly laws, payment according to experience and not according to performance, security of employment, guaranteed minimum wages, support for the unemployed, etc.

It sounds sensible to infer that if a given variable is so fundamental to life, it must, somehow, express itself onto geographies and be an expression of those geographies. But a non-geography scholar might refute this inference as mere disciplinary wishful thinking derived from the narcissist premise that everything that is important must have something to do with geography. When the weapon of reasoning is in dispute, the ultimate resort for assessing the truthfulness of hypotheses remains scientific evidence. Therefore, in the next paragraphs I turn to the various strands of scientific evidence from the multidisciplinary area of intelligence research to make it unmistakably clear that intelligence has a geography[2] and that we ought to take it seriously.

IV. Why g matters for geography?

1. The g factor is a scalar phenomenon

Arthur Jensen argues[3] that the study of human intelligence requires a concerted effort to analyse both the vertical and the horizontal dimensions of the *g* nexus. The vertical dimension constitutes the backbone of the stringent refutation of older arguments that intelligence is simply an oppressive social construction and refers to the various scales of analysis at the level of brain geographies.[4] Thus, one can study global features of the brain such as brain size and its .3-.4 correlation with intelligence,[5] or the differential developmental trajectory of the

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discarded. Intelligence research can thus work for the progressive politics of critical geographers.

[1] See also Dragos Simandan, "An Evolutionary Geography of Environmental and Social Justice", *Studia Ambientum* I no. 1–2 (2007): 90–107.

[2] For an elegant use of spatial autocorrelation methodology to investigate the geographical properties of IQ differences see the pioneering work of G. A. Gelade "The Geography of IQ", *Intelligence*, 36 no. 6 (2008): 495–501.

[3] Jensen, *The g factor*…, Jensen, "Psychometric *g*…", Jensen, *Clocking the Mind…*

[4] Richard. Haier, "Neuro-Intelligence, Neuro-Metrics and the Next Phase of Brain Imaging Studies", *Intelligence* 37 (2009).

[5] M. A. McDaniel, "Big-Brained People Are Smarter: A Meta-Analysis of the Relationship between in Vivo Brain Volume and Intelligence", *Intelligence* 33 (2005): 337–346; G. F. Miller and L. Penke, "The Evolution of Human

neocortex,[1] and then descend at more detailed levels, to study the particular areas that are activated during intelligence tasks with differential *g* loadings,[2] or to capture the variation in the quality of neural oscillations that is responsible for the *g* factor.[3] Ultimately, the vertical dimension reaches the molecular level of analysis, where *g* can be researched by looking at gene expression and the peculiarities of the DNA.[4]

The horizontal dimension of the *g* nexus refers to the study of the impact of *g* outside the individual and is therefore more intuitively linked with the geographers' traditional concern for scale.[5] As one moves up from one scalar level to the next, one needs to articulate *g*'s spatial phenomenology with complexity theory, by increasing consideration of properties such as emergence.[6] The first scalar level is the microcosm of the individual (the study of how the infant matures into an adult by reacting to environments with different demands on intelligence, electing environments with different demands on intelligence, and evoking[7] environments with different demands on intelligence), then follow the

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Intelligence and the Coefficient of Additive Genetic Variance in Human Brain Size", *Intelligence*, 35 no. 2 (2007): 97–114; M. van Leeuwen et al., "A Genetic Analysis of Brain Volumes and IQ in Children", *Intelligence* 37 (2009).

[1] Shaw, "Intelligence and the Developing…"; S. Karama et al., "Positive Association between Cortical Thickness and Cognitive Ability in a Representative US Sample of Healthy 6 to 18 Year-Olds", *Intelligence* 37 (2009).

[2] Ullen et al., "Intelligence and Variability in a Simple Timing Task Share Neural Substrates in the Prefrontal White Matter", *The Journal of Neuroscience*, April 16, 28 no. 16 (2008): 4238–4243; Richard Haier et al., "Gray Matter and Intelligence Factors: Is There a Neuro-g?", *Intelligence* 37 (2009); Colom et al., "Gray Matter Correlates of Fluid, Crystallized, and Spatial Intelligence: Testing the P-FIT model", *Intelligence* 37 (2009).

[3] Jensen, *Clocking the Mind…*

[4] J. Manning, "The Androgen Receptor Gene: A Major Modifier of Speed of Neuronal Transmission and Intelligence?", *Medical Hypotheses*, 68 no. 4 (2007): 802–804; Shaw, "Intelligence and the Developing…".

[5] Nathan Sayre, "Scale", in *A Companion to Environmental Geography* (Oxford: Blackwell, 2009).

[6] Thus, the *g* factor can emerge as an entity at the psychometric level, without being unitary at the genetic – molecular level. See C. Shikishima et al., "Is g an Entity? A Japanese Twin Study Using Syllogisms and Intelligence Tests", *Intelligence* 37 (2009).

[7] Geographers who draw on non-representational theory, as well as specialists in children's geographies would be particularly suited to study these micro-level geographies of genes-environment interactions.

levels of elemental sociality (e.g. the dynamics of intelligence in the family, the group of neighbours, the group of close friends and the group of co-workers), then the level of the small community (village/neighbourhood), then the level of the region and the level of the nation-state, and finally the global level. At the present moment, the field of intelligence research is marred by the asymmetry between the significant amount of research taking place on the vertical dimension of the *g* nexus, and the relative paucity of good quality work on the horizontal dimension.[1] Geographers should profit from this epistemic asymmetry and literally invade this field of study.[2]

2. The g factor is all about space

There is a tremendous amount of excellent work on theorising spatiality in geography,[3] but regardless of the myriad alternatives proposed for understanding space, it becomes readily apparent that the study of the *g* factor is all about space, even if one operates with traditional ways of defining spatiality. Thus, the recent work by Lynn and Vanhanen[4] based on the aggregation of culture-reduced IQ tests, has

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[1] Thanks to Ron Johnston for pointing out that my analysis of the school system in section II of this paper is itself an example of the study of the horizontal dimension of the *g* nexus.

[2] Because it reminds them that people are not and cannot be equal in IQ, geographers (most of whom are politically to the Left) have negative or even vitriolic reactions to this topic. The irony is that the very people they dislike for being smart, mean, and rich (the privileged) are more Leftist/liberal than the people they sympathise with. The less intelligent tend to be not only poorer than the bright, but also less tolerant than them, and more conservative, religious, anti-feminist, and racist. Recent references are: L. Stankov, "Conservatism and Cognitive Ability", *Intelligence* 37 (2009); Ian J. Deary, G. D. Batty and Catherine R. Gale, "Bright Children Become Enlightened Adults", *Psychological Science*, 19 (2008), 1–6; Richard Lynn, J. Harvey and Helmuth Nyborg, "Average Intelligence Predicts Atheism Rates across 137 Nations", *Intelligence* 37 no. 1 (2009): 11–15.

[3] Bob Jessop, Nick Brenner and Michael Jones, "Theorizing Sociospatial Relations", *Environment and Planning D: Society and Space* 26 no. 3 (2008) 389–401; Gill Valentine, Sarah Holloway, Nicholas Clifford, eds., *Key concepts in geography*, 2nd edition (London: Sage, 2009).

[4] Richard Lynn and Taatu Vanhanen, *IQ and global inequality* (Augusta, GA: Washington Summit Books, 2006); See also the many related references cited in Dragos Simandan 'Theoretical Note on the Explanatory Failure of Paul Romer's (1990) "Endogenous Technological Change"', *Theoretical Developments in*

uncovered marked geographical variations in intelligence at the global level, between and within continents. Taking the UK's average IQ as the standard (IQ 100), the aforementioned authors have calculated the national IQ for 192 nations and found that the lowest national IQ is 59 and the highest is 108. Whilst these findings will certainly raise the attention of economic geographers[1] and development geographers, other subdisciplines will have to reconsider their theories as well. Political geographers will need to provide an explanation for the .57 correlation between national IQ and level of democratisation[2], specialists in the geography of health and population geographers will have to explain the .77 correlation between national IQ and life expectancy,[3] and geographers who research the expansion of the European Union will have to consider the fact that within Europe alone the national IQ ranges from 89 to 102. In turn, this required update and reconfiguration of geographical discourses might also lead to a new golden age for quantitative geographers in the years to come.

Having said this, we can now move on to observe that the global level of analysis appears important for the study of intelligence in two respects. Firstly, from a historical perspective, the out-of Africa theory of migration[4] has been used to invoke the role of the cold winters in

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Contemporary Economics (Timişoara: Mirton Publishing House, 2008), 243–259, available online at http://www.brocku.ca/geography/faculty/d_simandan/

[1] See Simandan, 'Theoretical Note…' for a discussion of IQ and economic growth. See also G. A. Gelade, "IQ, Cultural Values, and the Technological Achievement of Nations" *Intelligence* 36 no. 6 (2008): 711–718; H. Rindermann, "Relevance of Education and Intelligence at the National Level for the Economic Welfare of People", *Intelligence* 36 no. 2 (2008): 127–142.

[2] See also both H. Rindermann, "Relevance of Education and Intelligence for the Political Development of Nations: Democracy, Rule of Law and Political Liberty", *Intelligence* 36 no. 4 (2008): 306–322; and Ian J. Deary, G. D. Batty and C. R. Gale, "Childhood Intelligence Predicts Voter Turnout, Voting Preferences, and Political Involvement in Adulthood: the 1970 British Cohort Study", *Intelligence*, 36 (2008): 548–555.

[3] See also Satoshi Kanazawa, "IQ and the Health of States", *Biodemography and Social Biology* 54 (2008): 200–213.

[4] S. Ramachandran et al., "Support from the Relationship of Genetic and Geographic Distance in Human Populations for a Serial Founder Effect Originating in Africa", *Proceedings of the National Academy of Sciences USA* 102 (2005): 15942–15947; Gregory Cochran and Henry Harpending, *The 10,000 Year Explosion: How Civilization Accelerated Human Evolution* (New York: Basic Books, 2009).

Eurasia in accelerating the selective pressure for intelligence.[1] Whilst this use of the out-of-Africa theory remains controversial and raises major ethical issues,[2] geographers' expertise on the sins of environmental determinism could definitely contribute to sharpening the quality of the arguments surrounding it. Secondly, from a present-day perspective, the sharp global differences in intelligence could be integrated by economic geographers into a much needed post-Marxist geographical political economy of human resources within globalised Google-capitalism.[3] The scarcity of highly intelligent minds and their crucial importance for capitalist businesses, as well as the new technological and political changes in the global village will generate a quite different kind of brain drains and brain wars[4] than those we have been used to in the past decades. Mapping their new configurations seems to me a quintessentially geographical job.

Below the global level, the dynamics of intelligence remain highly spatial and explain, to an extent, cumulative processes of regional growth and change. Thus, at the level of nation-states, older work by researchers such as Doreen Massey or Richard Florida needs to be complemented with studies of the regional differences in average intelligence. Is the historical logic of capitalism generating labour

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[1] J. P. Rushton and Arthur R. Jensen, "Thirty Years of Research on Black-White Differences in Cognitive Ability", *Psychology, Public Policy, & Law* 11 (2005): 235–294; R. Lynn, *Race Differences in Intelligence: An Evolutionary Analysis* (Augusta, Georgia: Washington Summit Books, 2006); Satoshi Kanazawa, "Temperature and Evolutionary Novelty as Forces behind the Evolution of General Intelligence", *Intelligence* 36 (2008): 99–108.

[2] Anthony W. Edwards, "Human Genetic Diversity: Lewontin's Fallacy", *Bioessays* 25 no. 8 (2003): 798–801; Jonathan Haidt, "Faster Evolution Means More Ethnic Differences. The Edge Annual Question" *Edge*, January 1 (2009); Gottfredson, "What If the Hereditarian…".

[3] Thomas R. Friedman, *The world is flat. A Brief History of the Twenty-first Century*, 2nd edition (Farrar: Straus and Giroux, 2006).

[4] By brain wars I refer to the *g*-loaded games of strategy that underpin both capitalist competition and political conflicts. Economic geographers and political geographers need to confront the fact that *g* might be the key resource that explains the fate of these games. The starting point for this undertaking resides in the fact that intelligence has also been defined as: (a) the ability to solve problems, (b) the ability to make predictions, and (c) the ability to avoid making mistakes (Gottfredson, "Innovation, Fatal Accidents…"). All these three alternative definitions are mere flavours of the comprehensive defining of intelligence as the ability to deal with environmental complexity.

migration, which in turn explains these regional differences, or does that logic merely respond to pre-existing regional differences in intelligence? Two recent examples will give a glimpse of the fascinating and troubling issues awaiting geographical research at this level of analysis. The first is Kanazawa's research on the US.[1] His finding that IQ alone explains a quarter of the variance of gross state product within the United States replicates at a regional and national scale Lynn and Vanhanen's finding of a correlation of .60 between national IQ and gross national product per capita at the global scale. The second example is from the UK. Lynn and Longley[2] found that, although the average IQ in the UK is 100, the Scottish score is below average (97), the South-East of England above average (figure not given), and the Jews living in the UK score significantly above average (110). The latter group is over-represented among UK's Nobel prize-winners by a factor of 8.0 and among the fellows of the Royal Society by a factor of 7.6. The many British geographers who study spatial inequalities in the UK will have to change their theories in order to explain these data.

3. The g factor is at the very heart of place formations

Behavioural geneticists have provided a fine-grained analysis of how one's genetic makeup unfolds in space to create place. In geography, the emphasis in the study of place has been on the ways in which space creates the individual.[3] At the intersection of behavioural genetics and geography we can now foresee a more mature account of place, characterised by the simultaneous investigation of how one's brain geographies[4] create one's external geographies and of how one's external

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[1] Satoshi Kanazawa, "IQ and the Wealth of States", *Intelligence* 34 (2006): 593–600.

[2] Richard Lynn and D. Longley, "On the High Intelligence and Cognitive Achievements of Jews in Britain", *Intelligence* 34 no. 6 (2006): 541–547. See also Lynn and Kanazawa, "How to Explain…" and Cochran and Harpending *The 10,000 Year…*

[3] Jonathan Murdoch, *Post-Structuralist Geography: A Guide to Relational Space* (London: Sage, 2006).

[4] Neuroscientists frequently speak of the geography of the brain, given its high degree of differentiation with integration. The method of structural magnetic resonance imaging, responsible for major advances in neuroscience, is about mapping the brain and inferring the functional relations between its highly differentiated regions. One of the thorny findings in this field is that the two sexes have different brain geographies. Another is that males are overrepresented among the highest IQ scorers, a finding with possible implications for claims of

geographies create one's brain geographies. There are three specific interactions[1] that govern the production of humans and places: passive (as a child grows up, she is the victim or beneficiary of certain environmental constraints, such as the cultural and economic conditions of her family and of her neighbourhood), elective (the child has a degree of choice about how to play and how to spend her time – a highly intelligent child might start reading books at age four, a less intelligent child might be more drawn to playing with dolls), and evocative (the parents of an intelligent child might spend more time educating the child or buying books for her; whereas the parents of a less intelligent child might not persist in feeding their child with 'culture' if the child does not seem interested at all in intellectual matters).

As the individual grows up, so does the genetic determination of one's place, because the flow of time makes the cumulative effects of *g* more and more manifest. In social systems with vertical social mobility, an adult finds herself in a social and geographical setting resulting from how far her intelligence has allowed her to travel up the social hierarchy. Thus, a very intelligent child might start her life in a place marked and marred by delinquency, poverty, and disintegration (e.g. a slum in Calcutta or Cairo), but through success in the school system, she can manage to shift places and end up living in a prosperous gated community in Los Angeles or New York. The saying 'Birds of a feather, flock together' is quite true of intelligence as well. Married couples and one's person's group of friends have IQs correlated at about .40.[2] The explanation for this assortative mating resides in the fact that communication across the different segments of the IQ's normal distribution is awkward:[3] whilst a difference of up to 10 IQ points

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gender discrimination, e.g. the Lawrence Summers affair. See Wendy Johnson, A. Carothers and Ian J. Deary, "Sex Differences in Variability in General Intelligence: A New Look at the Old Question", *Perspectives on Psychological Science* 3 no. 6 (2008): 518–531.

[1] Petrill, "Behavioral Genetics...".

[2] See the references cited in J. P. Rushton, "Inclusive Fitness in Human Relationships", *Biological Journal of the Linnaean Society* 96 (2009): 8–12.

[3] And see E. A. Day et al., "Ability Based Pairing Strategies in the Team-Based Training of a Complex Skill: Does the Cognitive Ability of Your Training Partner Matter?", *Intelligence*, 33 (2005): 39–65; as well as the discussion in Dragos Simandan, "A Geographical Theory of Exceptional Human Performance: Economic and Policy Implications from the Standpoint of Consequentialist Ethics", *Romanian Journal of Business Ethics* (2008): 19–45, available online at http://www.brocku.ca/geography/faculty/d_simandan/

between two persons is hardly perceivable, beyond 10 IQ points the gap in speed of thought and in sophistication of verbal expression, as well as the difference in the cognitive complexity of the foci of interests cannot be overlooked. The geographical implication of this state of affairs can be traced down to the level of place: places themselves have different g-loadings.[1] To give an example, the people who read and have conversations in a Starbucks Coffee Shop located inside a bookstore in Manhattan co-create a highly g-loaded place. The people who inhabit a jail for common delinquency[2] co-create a low g-loaded place. One's level of intelligence drives one to places that match that level, which further ensures that one remains at that level. As Thrift has put it,[3] 'places are passings that haunt us…and we haunt them'.

4. The g factor embodies some of the secrets of how society interacts with nature

The study of society-nature relations is at the very heart of both geography and intelligence research. It is unnecessary to review here how geographers have approached this core focus of their discipline,[4] although the fact that the scale of analysis has moved down to the level of embodied interactions and incorporations[5] is worth remembering. Indeed, the aforementioned analysis of passive, elective, and evocative genes-environments interactions suggests that intelligence research and geography would mutually benefit from the study of how individuals perform through place and places perform through individuals. But geographers, or at the very least those geographers who see themselves

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[1] Urban geographers need to incorporate in their analyses of urban life the reality of wide differences of IQ between neighbourhoods. Gordon ("Everyday Life as…", 225) gives the example of New York, with average neighbourhood IQ ranging from 74 to 118.

[2] Social geographers studying the geography of crime will have to change their theories to account for the finding that 'Delinquents average about ten IQ points lower than their nondelinquent siblings reared by the same parent(s) in the same social-class environment' (Jensen, *The g factor*…, 571).

[3] Nigel Thrift, "Steps to an Ecology of Place", in *Human Geography Today*, eds. J. Allen and Doreen Massey (London: Polity Press, 1999), 311.

[4] F. Ginn and David Demeritt, "Nature", in Sarah Holloway et al., *Key Concepts in Geography*, 2nd edition (London: Sage, 2009).

[5] Owain Jones, *After Nature: Entangled Worlds*: *A Companion to Environmental Geography* (Oxford: Blackwell, 2009).

as 'critical',[1] need to engage intelligence researchers on a different front as well. I have in mind the deep ethical conundrums associated with those theories that explain differences in the average IQ of ethnical groups as a result of specific adaptations to radically different physical environments. There is now academic research travelling freely in both prestigious refereed journals[2] and the Internet which emphasises the direct correlation between cranial capacity and distance from the Equator and the inverse correlation between IQ and amount of skin pigmentation. If in the past accusations of poor research design and flawed methodology could be invoked to refute such claims,[3] this strategy becomes increasingly unconvincing because of the new, very precise tools available from neuroscience,[4] psychometrics,[5] behavioural genetics,[6] and physical anthropology.[7] A new type of engagement is necessary and geographers might have some of the required theoretical resources.

5. The g factor is a question of distance

Nystuen's landmark paper on fundamental concepts in spatial science[8] identified distance as essential to the business of geography. Whereas he had in mind the direct meaning of 'physical distance', more recently geographers have built much of their critical undertakings around the idea of 'social distance'.[9] Both meanings are needed to understand intelligence, but, equally important, the study of the *g* factor is critical for grasping the causal mechanism through which groups of

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[1] Nicholas Blomley, "The Spaces of Critical Geography", *Progress in Human Geography* 32 (2008): 285–293.

[2] E.g. Rushton and Jensen, "Thirty Years of Research…", and Donald I. Templer and H. Arikawa, "Temperature, Skin Colour, per Capita Income, and IQ: An International Perspective", *Intelligence* 34 no. 2, (2006): 121–139.

[3] E.g. the work of Steven Jay Gould, Richard Lewontin, and Steve Rose.

[4] Haier, "Neuro-Intelligence, Neuro-Metrics…".

[5] David Borsboom, *Measuring the mind: Conceptual issues in contemporary psychometrics* (Cambridge: Cambridge University Press, 2005).

[6] Petrill, "Behavioral Genetics...".

[7] Rushton and Jensen, "Thirty Years of Research…".

[8] J. Nystuen, "Identification of Some Fundamental Spatial Concepts", *Papers of the Michigan Academy of Sciences* 48 (1963): 373–384.

[9] J.-F. Staszak, "Other/Otherness", in *International Encyclopedia of Human Geography*, eds. Rob Kitchin and Nigel Thrift (Amsterdam: Elsevier, 2009).

people (including siblings[1] raised in the same family) become separated – physically and socially. How then, does intelligence create distance? In the beginning of this paper, I captured this process by explaining the dynamics of growing up through schooling, from grade one to graduate school. What school does to people can be traced down to giving them the opportunity to find out their strengths and weaknesses. A child who systematically receives Ds in mathematics, English, science, and history (negative reinforcement), might withdraw his libido[2] from these activities and thus escape the devastating effect of a long string of narcissic wounds. He will start to tell his colleagues that only nerds get good grades, that school is for sissies, that real men are good at playing football and so on and so forth. His low level of intelligence, operating via the grading system, and impacting his sense of self-esteem,[3] creates a distance between him and his genetically luckier colleagues even though he is still part of the same group of pupils. His disengagement from school (IQ correlates with school marks and years of education completed at .6-.7[4]) is balanced by his active pursuit of a new venue where he can be successful. He might become a very good football player and fulfil his social needs for respect, significance, and admiration through this alternative engagement.

What starts as mere social distance may soon become physical distance. After the end of compulsory education, the uneven micro-geography of the former classroom translates unto the uneven geographies of broader social life. Cognitive distance (probabilistically) becomes geographical distance. The high IQ child is more likely to attend a prestigious university, marry one of her new colleagues, make

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[1] Murray compared the average income of dull and bright siblings and found that those with IQ under 80 earn $23,600, whereas those with IQ above 120 earn $70,700. The positive correlation holds throughout the IQ range. Full details in Charles Murray, "IQ and Income Inequality in a Sample of Sibling Pairs from Advantaged Family Backgrounds", *American Economic Review* 92 no. 2 (2002): 339–343. It is worth remembering that due to the genetic phenomenon of regression to the mean, the average difference in IQ between siblings is quite large: 12 IQ points (which is 2/3 of the 17 points difference between random strangers (Jensen, *The g factor*…).

[2] Sigmund Freud, *An Outline of Psychoanalysis* (London: Hogarth Press, 1940/1979).

[3] J. W. Gardner, *Excellence: Can we be equal and excellent too?* (New York: W. W. Norton & Company, 1984) (revised edition).

[4] Gottfredson, "Social Consequences…"; Strenze, "Intelligence and Socioeconomic…"; Murray, *Real Education*…

friends in this highly selective environment, obtain a high status, highly paid job in a major American city, and afford to live in one of its gated communities. The low IQ child is more likely to soon find himself facing the vicissitudes of life and work in the lower half of social desirability. He will end up living among people of similar IQ, since the spatial aggregation of individuals operates under the probabilistic laws of the *g* nexus: from an economic perspective, his level of earned wealth will be partly governed by his level of intelligence (and it is useful to think of both one's *earned* wealth[1] and one's knowledge as different versions of crystallized intelligence); from a social perspective, his spouse and friends will be selected from similar locations along the normal IQ distribution function.

Intelligence-induced distance between siblings re-appears like a fractal at higher scales of analysis.[2] The *g* factor divides the geographical landscape economically and socially and thus introduces distance into the geographical logic of collective life. Societies have developed practices and institutions that try to undo this relentless segregation: the act of teaching, for example, is the deliberate simplification and organisation of the material to be learned, i.e. the deliberate attempt to reduce the *g* loading of the material. Trade unions, the principle of seniority, and anti-monopoly laws are other examples of practices and institutions designed to hide away the enormous differences in *g*-loaded performance among individuals and their divisive consequences.

But the two most important practices that keep silent the operation of *g* in the geographical landscape are the myth of luck (more exactly luck later in life; of course IQ itself is the result of genetic luck at the inception of life) and the myth of laziness. Pasteur is credited for having said that 'chance favours the prepared mind' and a close inspection of what seems to be mere luck unravels a situation of *highly*

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[1] Marxist geographers need to enlarge their explanation of the unfairness of exploitative relations under capitalism, by considering the fact that the capacity to exploit others requires intelligence. The rich do not become rich only through unfair familial inheritance of wealth, but also through unfair winning of higher intelligence at the genetic lottery (e.g. Warren Buffett, Bill Gates, and, more generally, self-made millionaires raised in modest families).

[2] It is worth remembering at this analytic juncture a crucial question raised by Thomas Sowell : "If you cannot achieve equality of performance among people born to the same parents and raised under the same roof, how realistic is it to expect to achieve it across broader and deeper social divisions?" Thomas. Sowell, *The quest for cosmic justice* (New York: Free Press, 1999), 63.

constrained stochasticity: if we take the metaphor 'life is a gamble, and humans merely players', we will understand that the *g* factor makes some players more skilled at the game of life. These high IQ players know how to force their luck, because that is what *g* is all about: the ability to see through social clutter, to separate the gems from the mud, to spot opportunities, to detect dangerous situations, etc. People may invoke bad luck to avoid facing the fact that they are not very successful at navigating the complexity of life. At the other end of the brilliant collective mythology that allows us to live with the unpopular *g* lies the myth of laziness[1]. One has failed to obtain good grades or a desired job because one has been lazy. Or, at the other end of the spectrum, one has obtained good grades and one's desired job because one has been just hard working. The fallacy[2] of this line of thinking can be seized by understanding a fundamental principle of psychology: human activities tend to contain their own motivation.[3] In other words, intelligence is not merely the ability to learn, it is the appetite for learning as well. Truly smart individuals crave intellectual activity, they devour knowledge, they spend all their time in endeavours that put their intelligence to work. To us they might seem to be working hard, but for them that activity is not

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[1] The fact that there are 'lazy' people who occupy jobs below their cognitive ability raises the opportunity for all people of low cognitive ability to tell to themselves and to others that they too have failed to get a better job because they have been lazy. It is to this latter opportunity that I refer as the myth of laziness: it is a way of saving face by explaining failure through laziness alone, thus bypassing the causal role of intelligence. 'I am smart, but lazy' is a very popular remark that signals the personal and social usefulness of this myth.

[2] Since a student's interests do not necessarily coincide with what is taught in school, it is possible to have low grades in school despite a high level of intelligence. But a careful analysis of the life of that highly intelligent student will reveal hobbies and interests that put her intelligence to use (e.g. chess, reading adventure novels, memorising soccer players, video games, writing poetry for her lover). Furthermore, the student can use her intelligence to detect the minimum level of effort required in order to pass her exams and then carefully invest in school-learning just that amount of effort. This life route explains why it is more likely to have intelligent people employed in jobs well below their cognitive potential, than to have people with low intelligence employed in jobs well above their cognitive potential. For cognitively complex jobs, high ambition must be matched by high intelligence.

[3] K. Karolyi and E. Winner, "Extreme Giftedness", in *Conceptions of giftedness*, eds. Robert Sternberg and J. E. Davidson, 2nd edition (New York: Cambridge University Press, 2005), 377–394.

work, it is play. Similarly, an individual with excellent athletic ability will crave to exercise her talent. She cannot not do it. She must put her body to work. A true talent (or ability) is not some dormant gene that needs to be discovered. It cries for attention, it overwhelms the individual, it drives her life in one direction and not the other.

V. Conclusions

> *"More and more, emphasis on formal rigor is being supplanted today by a different kind of balance: one between stubborn facts, shared values, and rival interests. The need to keep these varied considerations in harmony may lead in unforeseen directions"* Stephen Toulmin[1]

Research findings from the field of intelligence research fall, without a doubt, in the domain of dangerous knowledge.[2] The dangers are manifold. Most conspicuous among them is the danger of scientifically-supported racism.[3] The wind of change in the scientific landscape seems to blow in an unfavourable direction for social constructionists. If in the past it was easy to refute racist claims as pseudoscientific, the new techniques used in human genetics and neuroimaging, as well as the new, culture-free modalities for assessing the neurobiological foundations of intelligence[4] will make it excruciatingly difficult to credibly use the same old strategies[5] of refutation. The thorny question of race aside, there are additional dangers

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[1] Steven Toulmin,) *Return to Reason* (Cambridge, MA: Harvard University Press, 2001), 213.

[2] Haidt, "Faster evolution means ..."

[3] Rushton and Jensen, "Thirty Years of Research…"; Gottfredson, "What If the Hereditarian…"; Templer and Arikawa, "Temperature, Skin Colour…"; Lynn, *Race Differences…*; Lynn and Vanhanen, *IQ and global inequality.*

[4] Jensen, *Clocking the Mind…*; Haier, "Neuro-Intelligence, Neuro-Metrics…".

[5] Excruciatingly difficult, but not impossible: see Steven Rose, "Darwin 200: Should Scientists Study Race and IQ? NO: Science and Society Do Not Benefit", *Nature* (February 12, 2009); S. J. Ceci and Wendy M. Williams, "Defeating the Specter of Lysenkoism: In Support of 'Untouchable' Science" *Nature* (February 12, 2009); for a detailed exposure of the ideological use of misinformation in recent IQ debates see Linda S. Gottfredson, "Logical Fallacies Used to Dismiss the Evidence on Intelligence Testing", in *The True Measure of Educational and Psychological Tests: Correcting Fallacies about the Science of Testing*, ed. R. Phelps (Washington, DC: American Psychological Association, 2009), 11–65.

coming from the study of gender differences in intelligence,[1] as well as from the study of the correlation between levels of intelligence and social class.[2]

I think therefore that we cannot study intelligence but as an integral part of the critical project in geography and environmental studies. However, the danger that haunts critical geographers resides in their subtle but pervasive tendency to use the moralistic fallacy,[3] i.e. to derive 'what is' from 'what should be'. We turn our back to the facts uncovered by empirical science and fail to understand that the unpleasant facts do not disappear just because we turned our back to them. Most people committed to the ideal of human equality will find the *g* factor a truly disturbing fact and will go at great lengths to deny its reality and/or significance. But denial is an infantile defence mechanism and I propose an actual engagement with *g*. If leftist academics tend to violently deny *g*, whilst mainstream intelligence researchers tend to enjoy advertising the reality of *g*, I think critical geographers should *confront g*. This does not mean proving it wrong, but proving wrong those attempts that justify reactionary politics on the reality of *g*. The theoretical resources at hand are powerful, ranging from Rawls' theory of justice[4] to Sternberg's operational understanding of wisdom,[5] and from the ideal of universal human dignity[6] to the reality of the democratic dilemma.[7]

Alfred Norton Whitehead used to say that wisdom is the way in which we hold knowledge.[8] The task ahead for those critical geographers

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[1] Johnson, Carothers and Deary, "Sex Differences…".

[2] Murray, "IQ and Income Inequality…", as well as Ian J. Deary et al., "Intergenerational Social Mobility and Mid-Life Status Attainment: Influences of Childhood Intelligence, Childhood Social Factors, and Education", *Intelligence* 33 (2005): 455–472.

[3] Brian Davis, "The Moralistic Fallacy", *Nature*, March Issue (1978).

[4] John Rawls, *A Theory of Justice* (Oxford: Oxford University Press, 1973).

[5] Robert J. Sternberg, "What Is Wisdom and How Can We Develop It?", *The Annals of The American Academy of Political and Social Science* 591 (2004): 164–174.

[6] Charles McCrudden, "Human Dignity and Judicial Interpretation of Human Rights", *European Journal of International Law* 19, no. 4 (2008): 655–724.

[7] Gardner, *Excellence: Can we be equal…*

[8] Alfred Norton Whitehead, *The aims of education and other essays* (New York: Free Press, 1967). For an exemplary way to be wise about intelligence research see Ian J. Deary et al., '"Intelligence and civilisation": A Ludwig Mond lecture delivered at the University of Manchester on 23rd October 1936 by Godfrey H.

seduced by the siren song of intelligence research would then be to study the *g* nexus in a way that is at once honest and humane, scientific and wise.

Thomson. A reprinting with background and commentary', *Intelligence* 37 no. 1 (2009): 48–61.