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African cognitive ability: Research, results, divergences and recommendations

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ABSTRACT

In the past different researchers have come to diverging cognitive ability estimates for people in Africa and of African descent. The paper tries to check the validity of past results by comparing them with outcomes of two new psychometric test studies from East and South Africa; with results from student assessment studies; with predictions based on those variables which, outside Africa, correlate most strongly with intelligence; and by comparing them with further indicators of cognitive ability (descriptions of everyday life and human accomplishment). Integrating these cognitive ability measures with the application of several corrections (due to the higher age of students in Africa, lower African school enrollment, selectivity of samples and higher African secular IQ rise), the best guess for an African average is IQ 75. Finally, possible environmental and genetic (evolutionary, therefore past environmental) causes are discussed and suggestions are given how to enhance cognitive development in African countries.

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1. Cognitive ability research in Africa

Cognitive abilities and differences between groups have been a hotly debated subject in research, with the differences between “Whites” (people of European descent) and “Blacks” (people of sub-Saharan African descent), in particular, causing scientific and non-scientific conflicts (e.g. Segerstråle, 2000). Within the US and other Western countries the mean cognitive ability difference in various tests (from psychometric IQ to student competence tests as SAT or TIMSS) averages around one standard deviation (Gonzales, 2000, p. 59, 61; Hunt, 2011, p. 411f.). The ability levels for Africans in Africa are the subject of strong disagreement. Rushton studied positively selected samples (South African university engineering students; Rushton, Skuy, & Fridjhon, 2003), but the mean differences between Africans and Europeans (14 IQ points) were similar to the ones found in Western countries. Lynn and Vanhanen (2006) estimated that sub-Saharan African countries had a mean IQ of 70. Wicherts, Dolan, and Maas (2010) using a different selection procedure came to a mean IQ of 82.

This paper will present data from two independently conducted psychometric intelligence studies, reanalyze student achievement data, use predictive variables, which have been validated in the rest of the world, to estimate mean African ability, and give a short overview on everyday life indicators of cognitive abilities.

2. Cognitive ability

Cognitive ability (equivalent to cognitive competence) comprises the ability to think (intelligence), knowledge (true and relevant knowledge) and the intelligent use of this knowledge. A broad concept of “intelligence” also includes knowledge aspects (“crystallized intelligence”). Cognitive ability enhances the individual's understanding of concepts and causal relationships, it increases insight, foresight, and rationality. It leads to proximal consequences, such as higher quality of work and more reasonable decisions in everyday life. Higher cognitive ability also improves individuals' access to better environments and enables individuals, institutions, societies, and cultures to improve the quality of the available environment. Cognitive ability also brings about distal consequences, such as greater wealth and health; a more democratic society; political and economic liberty; a more complex culture; and longitudoinally, by backward effects of these environmental factors, again enhanced cognitive ability (e.g. Rindermann, 2012; Rindermann & Meisenberg, 2009; Rindermann & Thompson, 2011).

3. Preliminary remarks on research

Science sometimes creates tensions between research findings and society. Epistemic-scientific principles can be at conflict with legitimate economic, cultural or ideological interests, usually represented by the political class, media, church, intellectuals or the public. However, also in hotly debated areas of research, fundamental principles of scientific thinking should be applied. Science is seen as a process based on epistemic rationality guided by logicity,

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empiricity and argumentativity. Scientists write for an abstract, rational reader who can be convinced (an ability and a willingness) through argumentation using logic, empirical facts and systematic reasoning. Freedom of research and respect for others in their scientific endeavor will help the entire scientific community to progress (Ceci & Williams, 2009; Flynn, 2007).

Other, in their fields legitimate orientations are empirically relevant, but not for science as endeavor to pursue truth. In science, from an epistemic-scientific view, only the truth or falseness of statements matter and an angel's truth is as true as a devil's truth. It is irrelevant, if a statement is blue or red, progressive or conservative, up or down, welcomed by the x or y, right or left, pc or non-pc, published here or there, welcomed and repeated by the right or wrong people. Of importance is, if it is correctly describing the world and explaining it, and secondly, if it is new and develops stimulating theoretical approaches.

Not all those arguing about intelligence have observed such rules, and participants of past conflicts have suffered from offensive treatment including violent attacks (Gottfredson, 2010; Nyborg, 2003). But intellectual conflicts are not new in the history of thought, as the fate of scholars like Thomas Aquinas, Galilei, Spinoza, and Darwin show. From today's perspective many past disputes sound quite ridiculous and their formerly not questionable "arguments" are today scientifically and ethically disapproved. But the conflicts have been important in developing in the long run a climate of argumentation and thinking. The frequently difficult process of Enlightenment will not be strengthened if people shy away from such conflicts.

4. Cognitive ability measures and samples – method

A detailed data and method description can be found in the [Supplementary data file](#) ("Method and further results"). Briefly:

- (1) Data from $N = 174$ students in grades 8 and 9 were collected in Tanzania in 1999 and 2000 by the use of three culture-reduced intelligence tests (APM, MRT, LPS). For interpretation, "Flynn" corrections of German norms, Greenwich IQ correction, school enrollment correction and the larger Flynn effect in Africa were considered (we assume for the last two decades in Africa a stronger secular rise of intelligence than in western countries; Daley, Whaley, Sigman, Espinosa, & Neumann, 2003).
- (2) The cognitive ability of blind, visually handicapped and non-blind students in the age of 10 to 16 years in South Africa ($N = 153$, African ancestry 41%, Mixed/"Coloured" 34%, European 25%) and Austria ($N = 63$) were compared by the use of WISC-IV working memory and verbal comprehension scales. The results from 2008 were corrected for selection bias in South Africa, composition of the South African population, lower school enrollment in older ages and the Flynn effect. In this study the visual handicap itself is not important, but the difference between people of different descent and the possible furtherance effect by a visual handicap on working memory.
- (3) Results from student assessment studies (1964–2009, in Africa mainly TIMSS, PIRLS and SACMEQ; $N_c = 14$ countries) collected by four different research groups were combined, corrected (for school enrollment, age and grades) and restandardized to international Greenwich norm (UK set at IQ 100).
- (4) Finally, in a regression analysis the two variables most highly predictive of cognitive ability (in the rest of the world outside sub-Saharan Africa), but theoretically distinct, were selected to predict cognitive ability levels in countries populated by a majority of people with African ancestry ($N_c = 52$

sub-Saharan-African and Caribbean countries). To have a predictive value a causal theory is not necessary. The predictors stem from the two competing paradigms, nurture vs. nature: The first is the *Human Development Index* (HDI; with IQ $r = .75$ in $N_c = 107$ non-African countries), the second is *skin brightness* (or skin reflectance with IQ; $r = .75$, $N_c = 82$; correlating which each other: $r = .70$, $N_c = 78$). Their results (SD corrected) were averaged. HDI correlates more strongly with cognitive ability than education or wealth ($r = .67$, .53/.60, last logged wealth). Skin brightness cannot have a direct causal effect on cognitive ability. This variable and its relation to evolutionary development may be distressing normatively. It is also related to history, slavery, apartheid and other physical and psychological maltreatment of African people. The same ambiguity is true for HDI: Although it is a clear environmental indicator, it depends on cognitive ability and differences can depend on yet unknown genetic factors.

As a reference point Greenwich-IQ was used. Results were compared with psychometric IQ measures from Lynn and Vanhanen (2006, updated), psychometric IQ measures from Wicherts et al. (2010), and a cognitive ability measure consisting of student assessment and psychometric IQ test results. Finally a difference was calculated between the here new predicted and formerly published ability levels.

5. Results

The mean of the two newer unpublished psychometric studies ($N_c = 2$ countries, Table 1, column 1, S1–2; see online [Supplement "Table 1"](#)) in 2010 norms is IQ 79. The mean result in student assessment studies ($N_c = 14$ countries, Table 1, column 2, SAS-k) in international norms (majority of studies 1995–2007) is IQ 71. Lynn's 1979 norm data have a mean of IQ 70 ($N_c = 52$), or of IQ 76 (in 2010) after Flynn correction (larger than in UK since 1979). Wicherts' collection ($N_c = 17$) results in IQ 77. Rindermann's collection results in IQ 68 ($N_c = 52$), or IQ 73 after Flynn correction. HDI predicts a mean IQ of 70 ($N_c = 48$), skin brightness IQ 68 ($N_c = 42$), both together IQ 70 ($N_c = 50$). Flynn-corrected for 2010, the predicted IQ's are around IQ 75. The total mean range of all studies and different values discussed by the authors is between 68 and 82. If one considers only 2010 estimates and excludes outliers the range is between 71 and 78. Student assessment studies with their larger school-related test content and therefore larger dependence on educational quality seem to boost the difference to more developed countries.

HDI based IQ-predictions are higher than measured IQ's for countries in the Caribbean and in South-Africa, and they are higher for countries with formerly only by neighboring countries' test results estimated data. In the Caribbean and in South-Africa the general living conditions are better than expected by cognitive ability. The near Western world may positively affect the living conditions, and the additional effects of minorities and of enduring institutions of past mother countries (UK, Netherlands) could influence the fate of nations even today (Harrison, 2006). Past estimations (especially with downward corrections) seem to underrate IQs. Other countries such as Zimbabwe and Mozambique are less developed than expected by their measured cognitive ability level, perhaps because of past civil war or bad government.

"Skin brightness", compared to "HDI", is the better predictor (less deviation of the predicted from measured and estimated values: mean squared difference for the HDI-predictions is $D^2 = 76.14$, for the skin brightness-predictions $D^2 = 31.09$). In the same sample of $N_c = 17$ countries the Lynn-data correlate more highly with the

predicted IQ than the Wicherts-data ($r = .34$ vs. $r = -.02$). The deviance from predicted IQ is smaller for the Lynn-IQ ($D^2 = 29.86$ vs. 149.50).

The described IQ means vary between IQ 68 and 78. Averaging the given means for 2010 results in an estimated IQ of around 75 for African majority countries. This result is based on many assumptions and corrections, such as properly given tests and understood test instructions, sample representativity and school enrollment rates and their corrections, mean IQ growth per year at school and per age year, and a higher African Flynn-effect. Researchers diverge in selection and correction criteria. Given the quality of the data, it is *not possible* to come to a really *precise result*. Compared to other developing regions the results are not astonishing (e.g. Bali in South-East Asia with IQ 79; Rindermann & te Nijenhuis, 2012). There are further arguments indicating overestimation (student assessment studies not corrected for older age) or underestimation (less test-wiseness). The usual phrase “further research is needed” is very appropriate here: We need representative samples of the ages 10–70; samples representative of the full range of school education, including the share without or with only little education; the use of fluid (school-distant) and crystallized (school-near) cognitive ability tests; and up-to-date norms from Great Britain. Furthermore, as African samples have less cognitive task experience, the estimates could be increased by a short test training or a more general cognitive training (Skuy et al., 2002).

The South African study compared people of African and European descent from South Africa and Austria and from different SES levels. In a regression analysis the most important predictor (highest) was evolutionary-ethnic background, then SES and then country. Additionally, the more visually handicapped a person was, the stronger was his or her working memory (IQ 119, 108 and 105), perhaps because visually handicapped persons develop a stronger working memory to compensate for their reduced ability to store information in written form. This is strong support for the *malleability* of even a very basic cognitive ability!

6. Further indicators

Test studies of intelligence differences across nations have been criticized for artificiality of test situation, low representativity and validity, and cultural bias. Some claimed that results stand for “How well can *they* do *our* tricks?” and not for cognitive ability. The concept of intelligence and tests were developed in the Western world as well as e.g. gravity and the meter. But taking e.g. instead of height the weight or using non-metric units does not change people's height. Important is to properly define a construct and find appropriate ways to measure it. Then it is unimportant where and by whom it was developed. However, it is true that research should look for further indicators of cognitive ability, especially in everyday life and in cultural sediments. Before reading the following descriptions, we would welcome it if readers think for five minutes which indicators they would choose to estimate cognitive ability.

Researchers such as Baker (1974) and Hart (2007) have tried to develop indicators of intelligence in everyday life and cultural artifacts. Examples of such indicators include invention and use of script, of the wheel for transport, pottery, the domestication of animals, the development of law, use of abstract numbers, appreciation of knowledge and school, of ethical systems, no torture and self-mutilation, hygiene, and the quality of architecture. Using these systematic comparisons across many cultures both authors estimated the cognitive development level in Africa as not being very high.

Some may perceive such studies as biased. Every single indicator stands not only for cognitive ability but also for other phenomena depending on various conditions. If persons remain skeptical it

is recommendable to develop better justified criteria and then look at the empirical material. For instance, it would be possible to assess the quality of art, such as the ability to draw and model realistic and dynamic pictures and figures; or to develop criteria for understanding nature and life (e.g. medical knowledge and effective treatment, astronomy). Benchmarks could be works of ancient Greece or Nineveh, e.g. King Ashurbanipal hunting lions. Even in prehistoric times there may be found valuable works (e.g. Paleolithic cave painting; astronomic knowledge as Nebra sky disk and Stonehenge; the Maya calendar; inventions as yoke, compass, wheelbarrow, gunpowder and rice-farming). Of course, also African exceptional achievement will be found (e.g. Nigerian Nok culture, Ethiopian Lalibela, Great Zimbabwe). As in tests, single items are less reliable than aggregated measures and the result finds its meaning in a systematic and thorough comparison including the recognition of historical time and neighbor influence.

A major critique of the outlined indicators is that they cover only past history. All peoples were in prehistory less developed than today. *Contemporary* information is necessary. Evidence could be provided by indicators of present-day *rationality* and belief systems. According to Piaget (1953) magic thinking is indicative of *preoperational thinking* (usually in Western samples ending at age 6, at least at age 11, corresponding to an adults IQ of 50–70; Rindermann, 2011). Many researchers, anthropologists and journalists (e.g. Caldwell, 2002; Dagona, 1994; Kabou, 1991; Signer, 2004) have documented sorcery, Voodoo, and fetishism in today's African populations. Similar historical reports on belief in witchcraft can be found in Europe until 250 years ago (and relics of magic thinking remain until today as a kind of not seriously taken accompaniment in daily life, e.g. astrology and homeopathy) indicating that *cognitive modernization* is an ongoing historical process. Another example is the widespread belief that AIDS is caused by supernatural powers (Caldwell, 2002; Oesterdiekhoff & Rindermann, 2007). Such preoperational thinking in Piaget's terms unfortunately includes members of the political elite, influencing politics and culture.^{1,2}

A further evidence is *exceptional achievement*. Murray (2003, p. 284) found using Science Nobel Prizes (1901–2000) as indicators of human accomplishment in Africa 0%. However, Nobel Prizes do not only depend exclusively on individuals' cognitive ability: Higher society ability levels lead to better schools and universities, a more stimulating cultural and social environment, nets of contacts to institutions which award prizes, and higher wealth attracting scientists and enabling the donation of awards. Individuals with exceptional abilities surrounded by non-supportive conditions may fail to show their potential. Cognitive ability differences are boosted and stabilized through their institutional effects ending in reinforcing feedback-loops. Eventually, relatively small mean differences lead to large proportional differences at the highest levels.

As last indicator *government effectiveness* achieves in sub-Saharan Africa (Rindermann, Sailer, & Thompson, 2009), standardized like IQ (UK $M = 100$, international $SD = 15$), a mean score of 58 ($N_c = 48$ countries). Individual attributes are translated into institutional-social ones having retroactive effects on individuals again.

7. Causes

Generally, within psychology two causal paradigms are distinguished: The *environmental* and the *genetic*. In educational, sociological or economic research based on intervention studies the

¹ For instance, the president of Gambia, Yahya Jammeh, claimed that he is a healer and can cure AIDS within three days by the laying on of his hands.

² South African's president Jacob Zuma mentioned that taking a shower after sexual intercourse with a HIV-infected woman protected him against HIV transmission.

environmental perspective dominates. Sometimes, especially at the group level, it is not unusual to stress one's opposition to the genetic paradigm to acquire credibility and more acceptance. E.g. "No one at the symposium believed that culture is genetically determined; rather, all believed that culture is acquired." (Harrison, 2006, p. XIII)³ Usually, the genetic paradigm is simply ignored. Within intelligence research, based on behavioral genetic studies, the hereditary view explaining individual differences dominates.

Undoubtedly, there are *environmental* conditions impairing in Africa cognitive development including knowledge acquisition: problems with nutrition and health care; parasite load; lower educational background of parents and peers; short, interrupted and lower quality school enrollment; large classes; poor school equipment; lower educational level of teachers; teacher absence; rote learning; school fees; insufficient or too expensive transport to school; poverty forcing children to work and not to learn; corruption reducing investment in education; war and violence including against schools and teachers (e.g. Glewwe & Kremer, 2006).

However, genetic theories are not excluded by showing strong environmental effects – and the environment is not excluded by assuming genetic effects. Firstly, genes also influence environment and culture – the "extended phenotype" (Dawkins, 2008/1992), but we do not know to what degree and how. Secondly, evolutionary genetic theories are in the long run environmental theories (e.g. Rushton, 2000/1995, 2004 Rushton & Rushton, 2004). As adaptationist views longitudinally contain the environment in genes via selection of the successfully adapted model, only a non-adaptationist view of evolution would lead to pure genetic effects. Thirdly, the smaller the difference between mean IQs of Africans in sub-Saharan countries and in Western countries (e.g. Wicherts et al., 2010, in their own summary IQ 82; in US in Greenwich-norm 84) the less important can be (poor) environmental conditions for explaining African-European IQ differences. Following Cavalli-Sforza (1997, p. 7724) African-Americans have on average 30% of their gene pool from Europeans. If genetic factors contribute to the African-European intelligence-difference, then this admixture would be also relevant for the higher African-American IQ compared to the one in Africa. With our lower African estimate of IQ 75 (vs. African-American IQ of 84) environmental factors causing lower African IQ outside Western countries are highly compatible. Environmentalism is supported by larger test gaps!

Evolutionary theories never denied environmental factors, but stressed that genetic factors play a crucial role (e.g. Rushton & Jensen, 2005). There is no genetic determinism, but genetic influence. There is no direct impact of genes on behavior, but indirectly through coding enzymes and influencing neurological system. However, the possible causal chain, e.g. through brain size or mental speed, is far from being clear. Both proposed mediators explain only about $d = 0.19$ (equivalent to 3 IQ; Hunt, 2011, p. 433f.).

What evidence supports the contribution of genetic factors? Although there are large overviews (e.g. Rushton & Jensen, 2005), we want to consider three further scientific arguments and two "social-scientific" and "political" "arguments":

- (1) The stability of comparatively lower cognitive ability levels – across countries, societies, indicators and time – denotes an effect of a *stable* and *strong determinant*. This can be culture; however, is culture as stable as genes and does culture exclude genetic effects?

³ Dawkins (2008/1992, p. 26) mentioned a "dogmatic and hysterical opposition to the very possibility of genetic variation in human mental abilities". Pinker (2007) judges the hypothesis of genetically based group differences in ability as the currently most "dangerous idea".

- (2) In the South-African study the evolutionary-ethnic background was for cognitive ability a more important predictor than SES. The evolutionary-ethnic background does not only reflect differences in socioeconomic status. It could stand for genetic or not by SES covered environmental and cultural differences.
- (3) Outside sub-Saharan Africa national cognitive ability levels are highly related to haplogroup distributions, even after controlling for general development of nations (HDI; Rindermann, Woodley, & Stratford, 2012).
- (4) Some believe that there is a public agreement that genes are not appropriate for explaining ability differences between groups. A closer look reveals within science the contrary view: In an older opinion poll among $N = 1020$ experts (Snyderman & Rothman, 1987) 15% believed that only environment is relevant for Black-White IQ-differences, but 45% believed that *environment and genes* are relevant (1% only genes, rest no opinion). Of course, majority opinion is no criterion for truth. Furthermore, a recently published textbook from a researcher well known for his lack of enthusiasm for genetic explanations of group differences stressed the possibility of genetic factors: "Rushton and Jensen (and Lynn) are correct in saying that the 100% environmental hypothesis cannot be maintained. Nisbett's extreme statement [genes play no role at all] has virtually no chance of being true". (Hunt, 2011, p. 434)⁴ Similarly Wicherts et al. (2010, p. 17) do not exclude genes among possible causes: "Although it cannot be precluded that genetic effects play a role in the low IQ performance of Africans, we view environmental circumstances as potentially more relevant to the present-day difference in mean."
- (5) If we see only the environment responsible for intelligence differences this has a positive impact for improving cognitive ability because we can change environment. Environment is a mainly human-made environment, made by us, by our society, our ancestors and our culture. However, this theory also blames low IQ people: Why they have not changed the environment now and in the past? Denying any genetic effect means putting all the responsibility on human factors and on Africans (if not given the responsibility for the low IQ of Africans to external factors). But the higher mean IQ and general living conditions of Africans in the US and in similar countries compared to Africans in Africa underscores the positive impact of European culture. A genetic explanation firstly is a scientific hypothesis, true or not and has to be checked in this regard; only secondly it is a political or moral issue. In this second meaning a genetic explanation excuses in the positive (no blame and guilt) and negative way (does not stimulate further own effort). It is not accusing or disparaging, by contrast, it could motivate to put more effort in compensation (Lindsay, 2010).

8. Limitations, future and suggestions

Mean differences do not deny overlaps and larger individual differences. There are significant overlaps between nations, and between biologically or culturally defined human subgroups. There are smart Africans and dull Europeans. We are strictly opposed to any political misuse of this research. From an ethical viewpoint, persons have to be treated as individuals and not as a mere representative of any group. E.g. if job applicants have to be selected, only individual achievement is allowed to count (no racial discrimination

⁴ Nisbett disputes any genetic cause of group differences. But in his 2009 book he argued for a genetic effect in explaining low spatial reasoning of Jews: "The single ethnic difference that I believe is likely to have a genetic basis is the relative Jewish incapacity for spatial reasoning" (Nisbett, 2009, p. 254).

due to any reason; Sowell, 2004).⁵ Only if in an individual case no or mere bad quality information is given and the duty to acquire reliable individual level information was not possible to fulfill, it is rational and ethically acceptable, to use information from non-individual categorizations (Sesardic, 2005).

The presented results reflect past and current cognitive ability measures and they reflect a state of intelligence in historical and evolutionary development. Modernization will lead to narrowing gaps. Overcoming the most serious environmental obstacles as deficits in health care, nutrition and education could lead in Africa within one generation to a rise of 10 to 15 IQ. Globalization is likely to lead via cultural exchange and via mixing to a phenotypically and genetically more homogenous human species. No matter which factors are relevant for differences between human subgroups, environmental improvement is important, as effective support at different levels of abilities and ages helps to provide a more beneficial development and to enable a life in self-responsibility. This can be done by better nutrition, health care, more and better education for students and teachers, and cognitive training. The large IQ rise in the last decades in more progressing African countries as Kenya (Daley et al., 2003) supports positive expectations. More globally, interventions should also successfully target broader human capital (achievement motivation, discipline, self-concept and conscientiousness). This will improve cognitive development but also helps to deal at all ability levels with given ability.

Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.paid.2012.06.022>.

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⁵ King (1986/1963, p. 219): "I have a dream that my four little children will one day live in a nation where they will not be judged by the color of their skin but by the content of their character".