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Intelligence in the West African State of Benin

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This paper reports the first measurement of intelligence on a representative sample from Benin. The SPM+, a test of non-verbal abstract reasoning, was administered to 4,054 schoolchildren aged between 6 and 18 years, 56% male and 44% female. A mean British-scaled IQ of 71.96 was obtained by the sample. There were only limited indications for sex differences favoring males, but clear signs for a Simber-effect at younger ages were found. Effects of the school system of Benin on changes in IQ with age are discussed. Methodological challenges in raw- to IQ-score conversions in samples with relatively low intelligence and at the level of individuals will be evaluated.

Key Words: Raven's Progressive Matrices Plus; Benin; Sex differences; Simber effect; Schooling.

The state of Benin (formerly known as Dahomey) is located in the western part of sub-Saharan Africa at the Gulf of Guinea, with a center point at the coordinates 9°30 N and 2°15 E, therefore close to the equator (CIA, 2019). It has a population of around 11 million, of which one half is Christian and a quarter Muslim, and shares a typical sub-Saharan African demographic profile with a very young median age of 18.4 years, more than 40% of its population below the age of 15, a high total fertility rate of 4.67 (ranks 22nd worldwide) and a low life expectancy of 62.7 (ranks 198th out of 223 worldwide). It ranks 126th out of 161 in per capita GDP (1,394 Int'l $; Maddison Project, 2013) and 136th out of 151 in inequality adjusted Human Development Index (HDI, .33; United Nations Development Programme, 2017). The status of democracy is underdeveloped (ranks 77th of 160 on the three-dimensional Combined Index of Democracy; Lauth, 2017) and it was warned (but not alerted) to become a fragile state (ranks 73rd of 178 on the Fragile State Index; Fund for Peace, 2017).

Benin is one of the countries from which so far no representative measurements of national intelligence were available, neither from psychometric tests nor from international school assessment studies. The same applies to many states of its neighborhood. Lynn and Vanhanen (2002; 2012) and Lynn and Becker (2019) reported measured national IQs of 67, 71 and 69-73 for Nigeria in the east and 74 for Burkina Faso in the northwest. For other neighboring states, only geographic means (averages of neighboring countries) are given, as 67, 70 and 71 for Niger in the northeast and 69, 70 and 60 for Togo in the west. Additionally, measured national IQs of 71, 70 and 55-64 for Ghana in the west (behind Togo) were reported. The mean of these numbers is 68 to 69, close to the average sub-Saharan African IQ of 67 reported by Lynn (2006), and appears credible regarding a mean cranial capacity of 1250-1299 cm^3, reported by Beals, Smith and Dodd (1984, Fig. 3), a low literacy rate of 38.4% in the age group of 15 and over (CIA, 2019), and low level of economic development (see above per capita GDP).

In terms of population genetics, Benin is similar to other countries along the Bight of Benin with a very strong predominance of the Y-chromosomal haplogroup E in the male population (Larmuseau, 2015). 92% of the male population are carriers of the subclade E1b1a1 (53%) or E1b1a1a1f1a (39%), similar to the 93% (72+21) from Togo and the 88% (68+20) from Burkina Faso, but different from the 41% (39+2) from Niger and 60% (47+13) from Nigeria (Cherson, 2012, online raw data). Y-chromosomal genetic distances to the population of Côte d'Ivoire are reported as insignificant (Fortes-Lima et al., 2015).

Method

In this study, results from an administration of the SPM+ to a representative sample from Benin will be reported. The administration was conducted as part of a research project initiated by researchers in Saudi Arabia at King Saud University by one of the authors after intensive training and with support from a team of assistants and schoolteachers in Benin.

The sample consisted of 4,054 schoolchildren, 2,280 (56%) males and 1,774 (44%) females, between 6 and 18 years of age (*M* = 12.15; *SD* = 3.43). The number of brothers and sisters as well as the family incomes (scale: 1 = low to 3 = high) were recorded.

The complete SPM+ (60 items) was administered to the sample. Raw scores were converted to IQ scores in three ways: from median raw scores of the total sample and sub-samples separated by age and sex by using British norms from the standardization in 2007 (Raven, 2008) (IQ1); and with conversion formulas given and validated by Lynn and Becker (2019) from the summed raw scores of each individual, then averaged (IQ2 and IQ3). The difference between IQ2 and IQ3 is the activation of a lower threshold in the case of IQ3. In the manual, a standard score (IQ) of 55, equivalent to the 0.1st percentile of the British distribution, was specified as the lower limit of the measuring range of the SPM+. This percentile can be undercut by fairly large numbers of individuals in samples with very low mean scores. Thus, a relatively large proportion of individuals in such samples would fall outside the range for which British norms are available. Variance below this limit could be caused either by measurement error, or it may represent real variance. The determination of a lower threshold can be advantageous here. However, the 0.1st percentile is more exactly equivalent to an IQ score of 53.64. So, a lower threshold of 53.64 was set to the IQ scale and given to all individuals with an IQ score below.

According to the calculator for Flynn effect correction in the NIQ-dataset (V1.3.1) (Becker; 2018; based on data from Pietschnig & Voracek, 2015), a reduction of only 0.21 IQ scores would be necessary and is therefore neglected here.

The internal reliability of the SPM+ was tested in two ways via Cronbach's *α*: (1) internal variation of all items; (2) average inter-item correlation.

Results

Table 1 gives the results from the test of internal reliability. Only 57 of the 60 administered items could be included in the observation of inter-item correlation since three items (1; 6; 48) showed no internal variance (correct or incorrect

across all individuals). Both Cronbach's *α* were above .80 and therefore interpreted as good.

Table 1. *Internal reliability.*

Sample	Benin (2017-2018)
Test	SPM+
k (items)	60 (57)*
Σσ (*Σ* of *σ* across all items)	9.23
σ (across summed raw-scores)	64.35
r_M (mean item intercorrel.)	.08
Cronbach's *α* (by var of item)	0.87
Cronbach's *α* (by mean of intercorrel.)	0.83

Note: *60 items were administered but only 57 showed variances (three were correctly or incorrectly answered by all tested individuals).

The median raw score of the total sample was 19 (Mean = 19.76; *SD* = 8.02), equivalent to the 1st British percentile and an IQ1 of 66 (*SD* = 16.80), whereas IQ2 (71.92) and IQ3 (72.85) are higher. On average, males scored higher than females with a mean raw score of 20.00 (*SD* = 7.85), equivalent to the 3.23rd British percentile and a British IQ2 of 72.28 (*SD* = 16.61), versus a mean raw score of 19.45 (*SD* = 8.22), equivalent to the 3.07th British percentile and a British IQ2 of 71.94 (*SD* = 17.04). IQs were highest at the age of 6 (*M* = 87.29; *SD* = 19.78) and lowest at the age of 11 (*M* = 58.10; *SD* = 20.73). IQ scores were normally distributed (*S.E.* = 0.26), with a minimal left-sided skewness of 0.16 but a more substantial kurtosis of 0.68.

As indicated above, during the evaluation of the individual data, three items with no internal variance were surprisingly found. Item 1 was correctly answered by all participants, which is expectable, because this is the easiest item and also used for introduction. Items 6 and 48 however are anomalies, since the items are sorted in ascending order of difficulty and the correlation between item numbers and shares of participants who solved them correctly is -.86 (*k* = 60) or -.91 (*k* = 58). Due to the size of the sample, some correct answers for the two invariant items should have been achieved purely by chance, which according to raw data was not the case. It was difficult to understand where this suspected error came from, whether from the process of testing or processing the data, but it could possibly lead to an underestimation in the end result. According to a linear regression analysis between the other 58 items, predicted shares of correct answers for item 6 are 67.61% (or around 2741 correct answers) and for

item 48 10.39% (or around 421 correct answers). By enriching the given data with these predicted shares, the median raw score of the sample would increase to 20.00 and the mean raw score to 20.54, both equivalent to the 2.3rd British percentile and an IQ of 70. However, since no methodology allows us to predict which individuals could possibly be attributed with these additional correct answers, the rest of the analysis must be based on the likely erroneous raw data. This also applies to IQ2 and IQ3, which are based on individual data.

Raw scores and IQs, broken down by age and sex, are shown in Tables 2 and 3, respectively. Activating the threshold of 53.64 IQ points affected overall 10.38% of all individuals, but the shares varied strongly between age groups, from zero at the ages of 7, 9, 13, 14 and 17 up to >30% at the ages of 11, 12 and 18. The active threshold caused only a slightly higher IQ for the total sample of 73.03 (*SD* = 10.38) vs. 72.13 without threshold (Table 2). Also at the individual level the mean difference between IQ scores calculated with and without threshold was only 0.92 points (*N* = 4054; *SD* = 4.16). However, this was bigger in some age groups, e.g. 5.87 for the 11 years olds (*N* = 310; *SD* = 10.04), 1.52 for the 12 years olds (*N* = 322; *SD* = 3.14), and 6.80 for the 18 years olds (*N* = 140; *SD* = 11.48).

Sex differences are also shown in Table 2. Most are trivial and their direction is inconsistent, except a statistically significant male advantage at the age of 8 (*d* = 0.47). Here, we used the interpretation suggestions from Ferguson (2009), which are much stricter than Cohen's, but because of the methodological weaknesses of the sample we use, they appear reliable to avoid misinterpretations. A comparison of the IQ distributions for both sexes is shown in Figure 1. Females showed a stronger skewness than males (0.27 vs. 0.08) but a similar kurtosis (0.63 vs. 0.75), however all differences are statistically non-significant.

Table 2. *SPM+ raw scores by age and sex in the Benin (2017-2018) sample.*

Age	Sex	Raw scores				
		N	***Median***	***Mean***	***SD***	***d***
	M+F	256	15	17.39	7.96	
6	M	126	15	16.63	8.12	-0.19
	F	130	17	18.12	7.80	
	M+F	238	16	16.34	5.01	
7	M	116	17	16.84	5.19	0.20
	F	122	16	15.85	4.84	

Age	Sex	Raw scores				
		N	*Median*	*Mean*	*SD*	*d*
8	M+F	318	15	15.18	5.45	
	M	172	16	16.36	5.78	0.47
	F	146	13	13.78	5.03	
9	M+F	230	16	16.47	6.27	
	M	152	17	17.09	6.21	0.29
	F	78	15	15.26	6.39	
10	M+F	322	15	15.82	6.78	
	M	194	15	16.54	6.78	0.27
	F	128	14	14.73	6.78	
11	M+F	310	14	15.82	7.17	
	M	204	15	15.97	7.10	0.06
	F	106	14	15.53	7.29	
12	M+F	322	16	17.81	7.90	
	M	198	16	16.85	6.91	-0.32
	F	124	19	19.35	9.26	
13	M+F	418	21	20.75	7.46	
	M	232	20	20.73	6.99	-0.01
	F	186	22	20.77	8.00	
14	M+F	432	24	22.69	8.03	
	M	232	24	22.94	7.67	0.07
	F	200	24	22.40	8.43	
15	M+F	370	25	23.83	7.02	
	M	196	26	24.09	7.09	0.08
	F	174	24	23.54	6.94	
16	M+F	474	25	23.88	7.15	
	M	244	27	25.15	6.74	0.37
	F	230	23	22.54	7.56	
17	M+F	224	26	23.56	8.20	
	M	128	27	24.27	7.48	0.20
	F	96	25	22.63	9.08	

Age	Sex	Raw scores				
		N	*Median*	*Mean*	*SD*	*d*
18	M+F	140	27	25.13	7.48	
	M	86	27	25.93	7.45	0.28
	F	54	26	23.85	7.53	
Total	M+F	4054	19	19.76	8.02	
	M	2280	19	20.00	7.85	0.07
	F	1774	18	19.45	8.22	

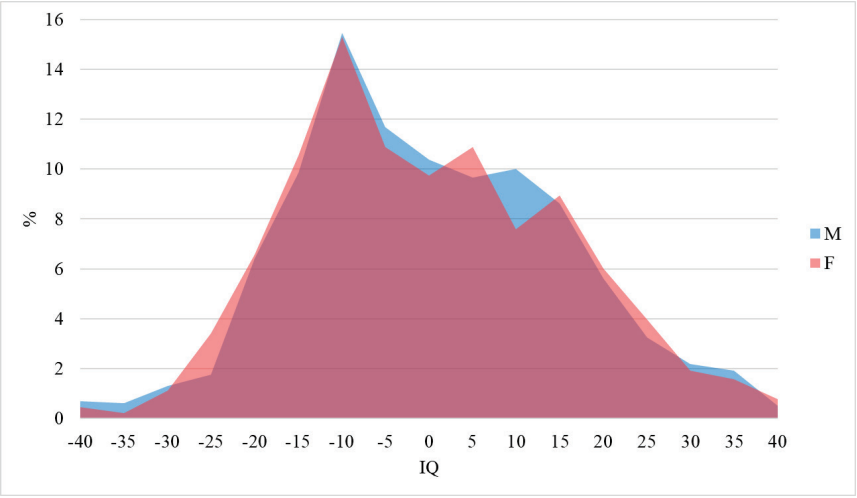
Note: *d* is Cohen's *d* with pooled *SD*s for sex differences in mean raw scores *(positives represent higher scores for males*).

Table 3. *British-scaled IQ scores calculated with different methods (see text).*

Age	Sex	IQ1	IQ2		%<53.64	IQ3	
			Mean	*SD*		*Mean*	*SD*
6	M+F	82	87.29	19.78	1.17	87.34	19.69
	M	82	87.07	18.21	0.79	87.08	18.17
	F	86	87.51	21.20	1.54	87.60	21.06
7	M+F	84	85.05	12.61	0.00	85.05	12.61
	M	86	86.29	13.08	0.00	86.29	13.08
	F	84	83.88	12.14	0.00	83.88	12.14
8	M+F	75	78.37	12.80	1.89	78.43	12.69
	M	77	81.16	13.67	0.00	81.16	13.67
	F	71	75.07	11.70	4.11	75.21	11.42
9	M+F	70	75.71	11.99	0.00	75.71	11.99
	M	73	76.84	12.05	0.00	76.84	12.05
	F	68	73.50	11.86	0.00	73.50	11.86
10	M+F	55	67.33	13.68	9.94	67.66	13.29
	M	55	68.67	13.76	6.19	68.83	13.54
	F	55	65.30	13.57	15.63	65.89	12.92
11	M+F	55	58.10	20.73	44.52	63.97	14.47
	M	55	58.53	20.53	43.14	64.19	14.25
	F	55	57.29	21.13	47.17	63.54	14.88

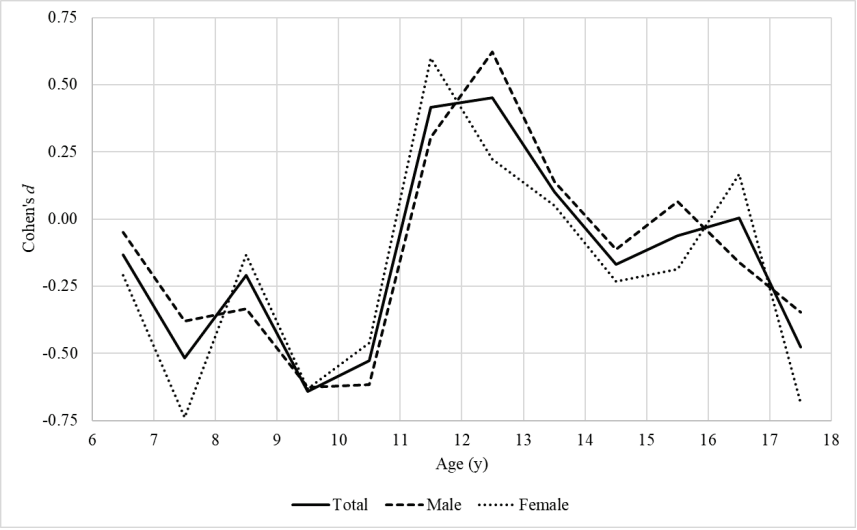
Age	Sex	IQ1	IQ2		%<53.64	IQ3	
			Mean	*SD*		*Mean*	*SD*
	M+F	58	66.03	17.26	32.92	67.55	15.64
12	M	58	63.72	14.96	32.32	65.01	13.66
	F	66	69.72	20.42	33.87	71.59	18.36
	M+F	67	72.46	11.44	0.00	72.46	11.44
13	M	65	71.86	11.28	0.00	71.86	11.28
	F	68	73.22	11.64	0.00	73.22	11.64
	M+F	71	73.71	13.62	0.00	73.71	13.62
14	M	71	73.58	13.42	0.00	73.58	13.42
	F	71	73.86	13.86	0.00	73.86	13.86
	M+F	72	71.42	13.39	3.78	71.43	13.38
15	M	74	72.08	13.33	2.04	72.09	13.32
	F	69	70.67	13.46	5.75	70.69	13.44
	M+F	72	70.57	14.37	15.61	71.09	13.67
16	M	77	72.97	14.04	13.93	73.36	13.43
	F	67	68.03	14.71	17.39	68.69	13.92
	M+F	65	70.62	12.54	0.00	70.62	12.54
17	M	68	70.79	12.19	0.00	70.79	12.19
	F	63	70.40	12.99	0.00	70.40	12.99
	M+F	68	62.35	23.06	34.29	69.15	14.02
18	M	68	64.81	22.84	30.23	70.63	14.67
	F	65	58.45	23.40	40.74	66.79	12.92
	M+F	66	72.13	16.80	10.38	73.03	15.18
Total	M	66	72.28	16.61	10.04	73.18	14.95
	F	64	71.94	17.04	10.82	72.85	15.46

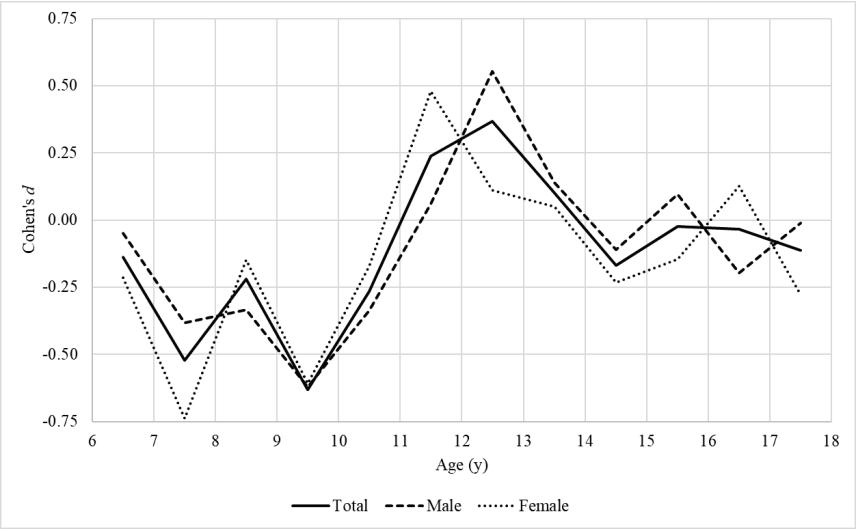
Note: IQ1 is estimated from median raw scores by norm table; IQ2 is the mean of all individual IQs calculated by NIQ-formulas without activated threshold; IQ3 is the mean of all individual IQs calculated by NIQ-formulas with activated threshold.



Note: IQ scale standardized for the Benin (2017-2018) sample (0 equivalent to 72.13 at British standard)

Fig. 1. *IQ distribution for males and females in the Benin (2017-2018) sample.*





Notes: First figure = without threshold, second figure = with threshold; Cohen's *d* calculated with pooled *SD*s; positive values for Cohen's *d* represent higher IQs in later years of life or school grades; a Cohen's *d* of 0.00 would represent a speed in cognitive development identical to that in the UK norm-sample; data in the appendix (Table A2 and A3).

Fig. 2. *Effect sizes of cognitive development across ages and school grades compared between sexes.*

Age-related trends in cognitive development were measured with Cohen's *d* between successive age groups and displayed in Figure 2. Detailed data are presented in Tables A2 and A3. For both sexes, British-scaled IQs decreased significantly until age 11, then increased between the ages of 11 and 13 years, remained relatively stable until age 17, then dropped again between the ages of 17 and 18. Trends for males and females are similar. The strongest increases of IQs were between age 11 and age 12 for females and between age 12 and age 13 for males. The activated threshold did not cause strong differences in the trends, however the strong decrease from age 17 to 18 almost disappeared.

Correlations among the variables are shown in Table 4, including IQ1 and IQ2, age ($M = 12.15$; $SD = 3.43$), sex ($M = 1.44$; $SD = 0.50$), number of siblings ($M = 4.89$; $SD = 3.45$), number of brothers ($M = 2.47$; $SD = 2.34$), number of sisters ($M = 2.42$; $SD = 2.02$) and (family) income ($M = 1.66$; $SD = 0.55$), each for the full number of 4,054 individuals. During the evaluation of the data, many very high values for the number of siblings had been found. They reached from 0 up to 36

and in the case of 218 individuals they were >10. Such high numbers of siblings could be considered implausible, however no hints were available to confirm this assumption. Therefore, it has been decided to implement a corrected variable for the number of siblings next to the uncorrected. This variable (N = 3,526; M = 3.93; SD = 2.14) includes data from all individuals with a number of siblings not higher than +1SD above the mean of the uncorrected variable. Age is negatively correlated to the British-scaled IQ (r = -.23; p<.001) despite the rise between age 11 and age 13, meaning that children in Benin tend to fall behind their peers in Britain as they get older. IQ is also negatively correlated with the number of siblings uncorrected (r = -.08; p<.001) and corrected (r = -.04; p = .012). Income is not related to IQ (r = .00; p = .873). Coefficients did not change significantly when the threshold for IQ was activated.

Table 4. *Correlation matrix for all variables from the full Benin (2017-2018) sample.*

	1	2	3	4	5	6	7	8	9
1. IQ (no threshold)	-	.97	-.23	-.01	-.08	-.04	-.09	-.03	.00
2. IQ (threshold)	<.001	-	- .24	-.01	-.07	-.04	-.08	-.02	.00
3. Age	<.001	<.001	-	.00	-.12	-.08	-.09	-.09	-.05
4. Female	.525	.495	.977	-	.04	-.06	-.04	-.03	-.05
5. *N* of siblings	<.001	<.001	<.001	.005	-	1.00	.82	.75	-.02
6. *N* of siblings (cor.)	.012	.011	<.001	.001	1.00	-	.69	.68	.01
7. *N* of brothers	<.001	<.001	<.001	.016	<.001	<.001	-	.25	-.01
8. *N* of sisters	.095	.167	<.001	.043	<.001	<.001	<.001	-	-.02
9. Income	.873	.776	.001	.004	.176	.505	.419	.169	-

Notes: Pearson's r above and p-values below the diagonal; correlations are robust in single-sex samples with r = ±.00 to .04

Discussion

The estimated mean IQ of the sample is only slightly above the average sub-Saharan African IQ of 67 estimated by Lynn (2006) and close to those of Benin's neighbors. Therefore, it confirms not only the geographic means calculated by Lynn and Vanhanen (2002, 2012) and Lynn and Becker (2019), but also the IQs of other countries in the same region. This similarity in the countries' intelligence is congruent with the findings from population genetics. However, as in many studies from developing countries with relatively low enrollment rates, it should be noted that the sample consists exclusively of schoolchildren and is therefore only partially representative of the country's total population. Only if parents recognize the value of education are families likely to decide in favor of sending their children to school (Burke & Beegle, 2004; Chernichovsky, 1985; Gumus,

2014). This includes the need for schooling to offer significant economic benefits to children and families, in particular in the form of jobs with higher demands on education, which are more frequent in urban than in rural areas. But it does not just have to be a matter of household economics. Religious, cultural or ethnic affiliation might affect the likelihood of school attendance within a population too, possibly even with different strength for males and females.

Age-related trends in cognitive development have to be evaluated under consideration of the Simber effect, which describes an age-related decline in British-scaled IQ in developing countries due to cognitive development being slower than in the British norm sample (Bakhiet et al., 2018). The assumed cause of the Simber effect is a lower quality of schooling than in Britain, leading to slower cognitive development. Primary school in Benin usually starts at the age of 6 and ends at the age of 11, followed by four years of middle school from 12 to 15, followed by three years of secondary school from 16 to 18 (Scholaro Pro, 2018). A strong decline in the enrolment ratio was reported, from above 90% in primary school to around 60% in secondary school (UNESCO Institute of Statistics, 2019). This is reflected in our findings. IQs strongly increased at the switch from primary across middle to secondary school. This could be caused by a strong selection effect, since the sample used in this study consisted of schoolchildren only.

Otherwise, the decline from age 6 to 11 represents delayed cognitive development, most plausibly due to deficiencies in the educational system in Benin compared to education in Britain. It may also, in part, represent an ongoing Flynn effect especially since the enrolment ratios in pre-primary education increased from 14% to 25% between 2009 and 2016. Therefore, more 6-year-old than 11-year-old children from our sample should have benefited from this advancement. The strong decline at the age of 18 might be due to a higher proportion at this age of repeaters, late starters and students who interrupted schooling.

The test of the validity of the conversion formulas from the NIQ-dataset at the level of individuals showed that these formulas are more suitable for mean scores from samples within the scope of application set by the SPM+ norm tables than they are for use on individuals. However, the formulas worked well at the sample level and the problems at the individual level can be resolved by simply activating a lower threshold.

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References

Bakhiet, S.F.A., Dutton, E., Ashaer, K.Y.A., Essa, Y.A.S., Blahmara, T.A.M., Hakamia, S.M. & Madison, G. (2018). Understanding the Simber Effect: Why is the age-dependent increase in children's cognitive ability smaller in Arab countries than in Britain? *Personality and Individual Differences* 122: 38-42.

Beals, K.L., Smith, C.L. & Dodd, S.M. (1984). Brain size, cranial morphology, climate, and time machines. *Current Anthropology* 25: 301-330.

Becker, D. (2018). *The NIQ-dataset (V1.3.1).* Chemnitz, Germany. http://viewoniq.org/?page_id=9

Burke, K., & Beegle, K. (2004). Why children aren't attending school: The case of Northwestern Tanzania. *Journal of African Economies* 13: 333-355.

CIA (2019). *The World Fact Book.* https://www.cia.gov/library/publications/the-world-factbook/

Chernichovsky, D. (1985). Socioeconomic and demographic aspects of school enrollment and attendance in rural Botswana. *Economic Development and Cultural Change* 33: 319-332.

Cherson, A.D. (2012). *Atlas of Genetic Genealogy.* Greencore Environmental Information Services. From: http://atlas.xyvy.info.

Ferguson, C.J. (2009). An effect size primer: A guide for clinicians and researchers. *Professional Psychology: Research and Practice* 40: 532-538.

Fortes-Lima, C., Brucato, N., Croze, M., Bellis, G., Schiavinato, S., Massougbodji, A., Migot-Nabias, F. & Dugoujon, J.-N. (2015). Genetic population study of Y-chromosome markers in Benin and Ivory Coast ethnic groups. *Forensic Science International: Genetics* 19: 232-237.

Fund for Peace (2017). *Fragile State Index.* www.fragilestatesindex.org

Gumus, S. (2014). The effects of community factors on school participation in Turkey: A multilevel analysis. *International Review of Education* 60: 79-98.

Larmuseau, M.H.D., Vessi, A., Jobling, M.A., van Geystelen, A., Primativo, G., Biondi, G., Martínez-Labarga, C., Ottoni, C., Decortel, R. & Rickards, O. (2015). The paternal landscape along the Bight of Benin – Testing regional representativeness of West-African population samples using Y-chromosomal markers. *PLoS ONE* 10: e0141510.

Lauth, H.-J. (2017). Datensatz "Kombinierter Index der Demokratie (KID), 1996-2016". Würzburg: Institut für Politikwissenschaft und Soziologie. Retrieved from: www.politikwissenschaft.uni-wuerzburg.de/lehrbereiche/vergleichende/forschung/kombinierter_index_der_demokratie_kid/

Lynn, R. (2006). *Race Differences in Intelligence: An Evolutionary Analysis.* Atlanta GA: Washington Summit.

Lynn, R. & Becker, D. (2019). *The Intelligence of Nations.* London: Ulster Institute for Social Research.

Lynn, R. & Vanhanen, T. (2002). *IQ and the Wealth of Nations.* Westport CT: Praeger.

Lynn, R. & Vanhanen, T. (2012). *Intelligence: A Unifying Construct for the Social Sciences.* London: Ulster Institute for Social Research.

Maddison Project (2013). *New Maddison project database [horizontal-file_02-2010.xls].* Retrieved from http://www.ggdc.net/maddison/maddison-project/home.htm.

Pietschnig, J. & Voracek, M. (2015). One century of global IQ gains: A formal meta-analysis of the Flynn effect (1909–2013). *Perspectives on Psychological Science* 10: 282-306.

Raven, J. (2008). *Standard Progressive Matrices and Mill Hill Vocabulary Scale.* London: Pearson.

Scholaro Pro (2018). Education system in Benin. From: https://www.scholaro.com/pro/countries/Benin/Education-System

UNESCO Institute of Statistics (2019). *Benin.* From: http://uis.unesco.org/country/BJ

United Nations Development Programme (2017). *Human Development Reports.* From: http://hdr.undp.org/en/composite/HDI4

Appendix

Table A1. *Raw score percentile distributions for the Benin (2017-2018) sample by age-groups, 6 to 18 years*

Age →	**6**	**7**	**8**	**9**	**10**	**11**	**12**	**13**	**14**	**15**	**16**	**17**	**18**
5th %ile	8	9	7	7	7	6	7	10	10	10	10	8	12
10th %ile	8	9	8	9	8	8	9	11	12	13	14	13	14
25th %ile	11	13	11	12	11	11	11	14	15	19	18	17	18
50th %ile	**15**	**16**	**15**	**16**	**15**	**14**	**16**	**21**	**24**	**25**	**25**	**26**	**27**
75th %ile	25	20	19	21	19	20	24	27	29	29	30	30	30
90th %ile	31	24	23	26	28	27	30	30	33	32	33	34	35
95th %ile	32	25	26	28	30	30	32	32	34	34	34	35	36
S.E.	0.50	0.33	0.31	0.42	0.38	0.41	0.45	0.37	0.39	0.37	0.33	0.55	0.64
Skewness	0.61 (1.21)	0.14 (0.43)	0.46 (1.46)	0.42 (1.01)	0.78 (2.04)	0.72 (1.77)	0.53 (1.19)	-0.14 (-0.38)	-0.20 (-0.51)	-0.56 (-1.52)	-0.41 (-1.24)	-0.41 (-0.74)	-0.37 (-0.58)
Kurtosis	-0.71 (1.42)	-0.72 (2.20)	0.14 (0.45)	-0.48 (1.15)	-0.09 (0.24)	-0.04 (0.09)	-0.75 (1.67)	-1.15 (3.15)	-1.04 (2.69)	-0.36 (0.97)	-0.76 (2.27)	-0.77 (1.40)	-0.80 (1.25)

Notes: Scores in parentheses show quotient of skewness and kurtosis, calculation is skewness/*S.E.* or kurtosis/*S.E.*; statistically significant difference from zero is achieved if quotient is >1.96

Table A2. *Trends of cognitive development (measured as IQ2 scores) across ages compared between sexes (no threshold). Each age is compared with the group one year younger.*

Age	Total sample				Males				Females			
	N	*M*	*SD*	*d*	*N*	*M*	*SD*	*d*	*N*	*M*	*SD*	*d*
6	256	87.29	19.78		126	87.07	18.21	-	130	87.51	21.20	-
7	238	85.05	12.61	-0.13	116	86.29	13.08	-0.05	122	83.88	12.14	-0.21
8	318	78.37	13.18	-0.52	172	81.16	13.71	-0.38	146	75.07	11.74	-0.74
9	230	75.71	12.12	-0.21	152	76.84	12.09	-0.33	78	73.50	11.94	-0.13
10	322	67.33	13.68	-0.64	194	68.67	13.76	-0.63	128	65.30	13.57	-0.63
11	310	58.10	20.73	-0.53	104	58.53	20.53	-0.62	106	57.29	21.13	-0.46
12	322	66.03	17.26	0.42	198	63.72	14.96	0.30	124	69.72	20.42	0.60
13	418	72.46	11.44	0.45	232	71.86	11.28	0.62	186	73.22	11.64	0.22
14	432	73.71	13.62	0.10	232	73.58	13.42	0.14	200	73.86	13.86	0.05
15	370	71.42	13.39	-0.17	196	72.08	13.33	-0.11	174	70.67	13.46	-0.23
16	474	70.57	14.37	-0.06	244	72.97	14.04	0.06	230	68.03	14.71	-0.19
17	227	70.62	12.54	0.00	128	70.79	12.19	-0.16	96	70.40	12.99	0.17
18	140	62.35	23.06	-0.48	86	64.81	22.84	-0.35	54	58.45	23.40	-0.68

Notes: Cohen's *d* calculated with pooled *SD*s

Table A3. *Trends of cognitive development (measured as IQ scores) across ages compared between sexes (with threshold). Each age is compared with the group one year younger.*

Age	Total sample				Males				Females			
	N	*M*	*SD*	*d*	*N*	*M*	*SD*	*d*	*N*	*M*	*SD*	*d*
6	256	87.34	19.69	-	126	87.08	18.17	-	130	87.60	21.05	-
7	238	85.05	12.61	-0.14	116	86.29	13.08	-0.05	122	83.88	12.14	-0.21
8	318	78.43	12.68	-0.52	172	81.16	13.67	-0.38	146	75.21	11.41	-0.74
9	230	75.71	11.99	-0.22	152	76.84	12.05	-0.33	78	73.50	11.86	-0.15
10	322	67.66	13.27	-0.63	194	68.83	13.52	-0.62	128	65.89	12.89	-0.61
11	310	63.97	14.40	-0.26	104	64.19	14.18	-0.33	106	63.54	14.82	-0.17
12	322	67.55	15.58	0.24	198	65.01	13.61	0.06	124	71.59	18.29	0.48
13	418	72.46	11.44	0.36	232	71.86	11.28	0.55	186	73.22	11.64	0.11
14	432	73.71	13.62	0.10	232	73.58	13.42	0.14	200	73.86	13.86	0.05
15	370	71.43	13.37	-0.17	196	72.09	13.32	-0.11	174	70.69	13.42	-0.23
16	474	71.09	13.63	-0.02	244	73.36	13.38	0.10	230	68.69	13.88	-0.14
17	227	70.62	12.54	-0.04	128	70.79	12.19	-0.20	96	70.40	12.99	0.12
18	140	69.15	13.95	-0.11	86	70.63	14.59	-0.01	54	66.79	12.84	-0.27

Notes: Cohen's *d* calculated with pooled *SD*s

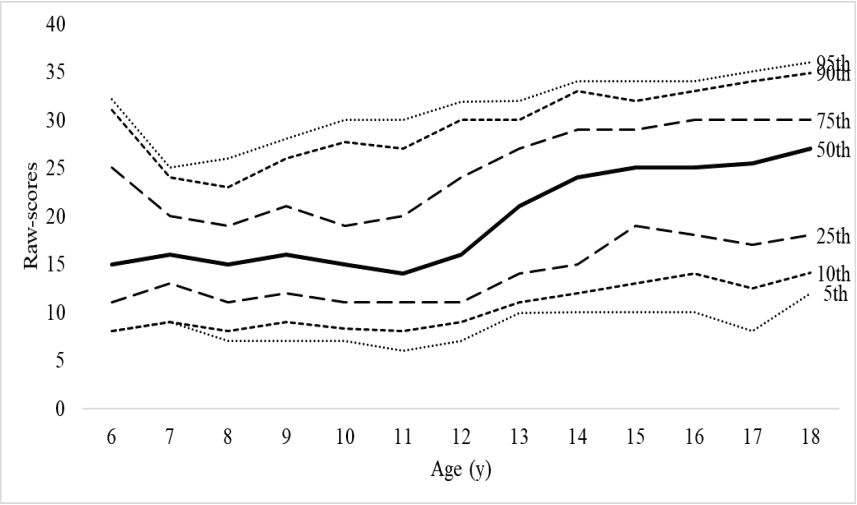

Fig. A1. *Percentile trends across ages in the Benin (2017-2018) sample*.