A Negative Flynn Effect in Khartoum, the Sudanese capital

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We compare the results of the Standard Progressive Matrices on two samples from Khartoum, one from 1999 (N = 6877) and the other from 2010 (N = 5659), both aged between 9 and 25. We show that in 7 out of 12 age groups there has been a significant Negative Flynn Effect over this period. Among those aged 9 to 18 - directly comparable as they are population samples - we found a significant aggregate loss of 2.13 IQ points between 1999 and 2010 comparing these two groups. The sample, in part, is elite and we note that a cessation of the Flynn Effect has also been reported in an elite Brazilian sample; another developing country. We examine a number of factors which may be behind our finding, in particular changes in the Sudanese education system, changes in the Khartoum population, and dysgenic fertility in Sudan.

1. Introduction

The Flynn Effect (e.g. Flynn, 2012) refers to a secular rise in IQ scores. This has been observed in many countries across the twentieth century, with the rise amounting to an average of roughly 2 IQ points per decade. A recent systematic literature review by Dutton, Van der Linden, and Lynn (2016) has highlighted the fact that a Negative Flynn Effect - defined, in their review, as a decline in overall IQ score on a representative population sample over a period of at least 5 years - has now been found in seven countries. These are: Norway, Denmark, Finland, Estonia, Britain, the Netherlands, and France. The IQ decline per decade has been calculated to range from 0.38 points to 8.4 points, the latter (outlier) case being Estonia where, unlike in the other cases, the Standard Progressive Matrices (SPM) was employed. The average decline was 2.44 points per decade when removing the outlier. An ongoing positive Flynn Effect has been reported in many developing countries, such as Kenya, Saudi Arabia, and Dominica (see Flynn, 2012, Ch. 3). Also, a study noted in Dutton et al.'s (2016) literature review found a cessation of the positive Flynn Effect in a wealthy area of Brazil (Bandeira, Costa, & Arterche, 2012).

This raises the question of what is causing the Flynn Effect and the Negative Flynn Effect. A meta-analysis by Pietschnig and Voracek (2015) highlights a number of possible causes and important variations. It reports that some studies have found that the Flynn Effect has occurred on general intelligence, while most have concurred that it has not. Indeed, the meta-analysis finds, overall, that the Flynn Effect is stronger on low-g subtests. Pietschnig and Voracek provide evidence, based on their meta-analysis, for a number of environmental factors which appear to predict the Flynn Effect. They single out life history speed slowing down as the best supported explanation for the Flynn Effect. Pietschnig and Voracek note that factors such as increasing educational exposure, improvements in nutrition, and diminished parasite - underpinned by industrialization - could all act on the phenotype via a common developmental pathway. This would be life history speed, as each of these things is treated as indicators of reduced extrinsic morbidity and mortality. They also note that LH speed is uncorrelated with g, but is predictive of degree of cognitive specialization, hence slowing LH makes people more sensitive to opportunities to cultivate specialized abilities. This is reflected in prolonged schooling. GDP growth, it is suggested, probably relies upon cognitive specialization as this is a major source of comparative advantage both between individuals and populations. Thus, the main factor is national prosperity, especially as manifested in increasing average level of education. Smaller contributions are made from degree of exposure to technology and mass media, and the authors aver that it is possible that decreasing family size plays some small role as well. Pietschnig and Voracek cautiously rule out a number of other factors as failing to adequately fully explain the speed or nature of the Flynn Effect. These include...
hybrid vigour caused by decreasing levels of inbreeding as people become more mobile. Accordingly, Pietschnig and Voracek's conclusion is that the Flynn Effect is primarily environmental, not on g, and seemingly substantially a function of a slowing LHS leading to a more specialized and educated society.

Flynn (2012) has proposed a model for explaining why increasing education levels lead to the Flynn Effect. He notes that the Industrial Revolution created an environment that forced us to don 'scientific spectacles,' and so think in a more analytical way. This would have pushed to its phenotypic limit a number of very specific abilities near the base of the intelligence pyramid and if it had done so sufficiently it would not only have cloaked any putative fall in g, but actually meant that a rise in IQ was reported in spite of this. If this were the case, then the effect would have a phenotypic limit and then plateau, with any genetic changes in intelligence then manifesting themselves on the IQ test. The fact that IQs have now begun to decline in Western countries, argue Dutton et al. (2016), is consistent, in part, with a change in genetic IQ which has been cloaked by the Flynn Effect. They argue that this change may be a result of the negative association between general intelligence and fertility in industrial societies, or the impact of dysgenic immigration upon Western societies (see Lynn, 2011), or a combination of these. In favour of Flynn's hypothesis, they have noted evidence in favour of the so-called Co-occurrence Model (e.g. Woodley & Meisenberg, 2013). It has been shown that the Flynn Effect has occurred on the least g-loaded and the least heritable parts of the IQ test, whereas the Negative Flynn Effect has occurred on the most g-loaded and the most heritable parts of the IQ test. This 'Jensen Effect' aspect of the Negative Flynn Effect has been specifically shown in the Netherlands and in France (Woodley & Meisenberg, 2013; Woodley of Menie and Dunkel, 2015, cf. Dutton & Lynn, 2015).

This, in itself, it might be argued, does not necessarily prove the case for a genetic cause to the Negative Flynn Effect, in that proponents of the ability differentiation hypothesis have noted that as IQ declines the correlation between different abilities appears to become more pronounced (e.g. Tucker-Drob, 2009). But it can be countered that if g declines and specialized abilities increase, this necessitates a break-down in the strength of the positive manifold among abilities. Therefore, it might be averred that one necessarily entails the other.

Indeed, consistent with the arguments of Woodley, te Nijenhuis, and Murphy (2014), that the IQ decline is partly driven by dysgenic fertility, Dutton et al. (2016) further observe that immigration as a factor can be confidently ruled out as being behind the negative Flynn Effects reported in Norway, Finland and Estonia. So, there does appear to be a case in favour of explaining the positive Flynn Effect in terms of environmental enrichment which has cloaked a genetic fall in intelligence, and the Negative Flynn Effect, in part, in terms of the phenotypic limit being reached, meaning the underlying genetic decline has manifested itself. Moreover, Woodley et al. (2014) have presented evidence of a secular lengthening of reaction times since the nineteenth century, which would be consistent with this hypothesis. Woodley of Menie and his team have also provided a number of other proxy lines of evidence for the secular decline of intelligence. These 'Woodley Effects' (Sarraf, 2017) are worsening colour discriminatory ability (Woodley of Menie & Fernandes, 2015a), the secular decrease in the use of difficult words (Woodley of Menie, et al., 2015), worsening backward digit span (Woodley of Menie & Fernandes, 2015b), increasing fluctuating asymmetry (Woodley of Menie & Fernandes, 2015c), and decreasing levels of per capita genius and innovation (Woodley, 2012). Crucially, a recent study has shown a decline in polymorphisms in Iceland which predict educational success (Kong, Frigge, Thorleifsson, et al., 2017), strongly validating Woodley of Menie's hypothesis. Also, Kim (2011) has reported declining secular levels of creativity, which would also be consistent with it.

Returning to the Brazilian study, if this model is correct then if the living conditions in the Brazilian region in question are comparable to the developed world – which the authors in fact suggest they are - then it would make sense that the Flynn Effect had plateaued or even gone into reverse in that part of Brazil, partly for genetic reasons. A slowing down of the Flynn Effect, at least, has been shown to have occurred prior to the commencement of the Negative Flynn Effect in the meta-analysis of the Flynn Effect in the twentieth century by Pietschnig and Voracek (2015). They demonstrate that the pace of the effect slows in more recent samples and many related countries have since been shown to have gone into a Negative Flynn Effect. In this study, we will present evidence of a Negative Flynn Effect in the Sudanese capital of Khartoum, this being a sample which is also elite, albeit in part. We will then look at the degree to which it is commensurate with a partly genetic explanation or with other explanations.

It should be noted, before we begin, that 'Sudan' refers to the Republic of Sudan. This is now only the northern part of the Sudan, of which the capital is Khartoum. The southern part broke away from the old Republic of Sudan in 2011 to form 'South Sudan,' the capital of which is Juba. Sudan is predominantly Sunni Muslim while South Sudan is mainly Christian and animist.

2. Method

For our data, we drew upon two already published studies. The first, the results of which were published in Khaleefa, Khatib, Mutwakkl, and Lynn (2008) drawing on Khatib and Mutwakkl (2001), took the standardization of the Standard Progressive Matrices for Sudan from ages 9 to 25. This was administered in Khartoum in 1999 to a sample of 6877 (45.5% male). Those 18 or under were tested in schools which were representative of Khartoum in terms of socioeconomic differences within the city's districts while those over 18 were tested in representative universities in Khartoum State, the region surrounding the capital. Schooling in Sudan is only mandatory up until the age of 13, so the sample aged 14 and older can be regarded as elite. The literacy rate, it should be noted, for 15 to 24 year olds in Sudan was 54% in 2007 (UNESCO, 2012a, 2012b). The literacy rate in Khartoum was 68% in 1999 (Thundu, Kiaga, & Mwangi Omoni, 2008).

We compared the 1999 sample to a test of the SPM administered in Khartoum in 2010 applied to a ‘random stratified sample’ of 5659 participants, aged between 9 and 25 who were 52.6% male, from three areas of Khartoum. These results had been published in Khaleefa (2011). All 60 SPM items were administered. The author claims that, 'Socioeconomic levels were considered in the selection of the data from 3 geographical zones in Khartoum,' meaning that the sample was ensured to be representative of Khartoum in terms of socioeconomic differences such as parental income and parental education level.

3. Results

The results indicate that in Khartoum between 1999 and 2010 there has been a statistically significant Negative Flynn Effect among 9, 13, 14, 15, 16, 17 and 19 year olds. There has been a non-significant Negative Flynn Effect among 11 and 18 year olds, a non-significant positive Flynn Effect among 10 and 12 year olds, and a significant positive Flynn Effect among those aged 20 to 25. These can be summarised as relatively large losses at age 9, small gains for ages 10 to 12, mainly large losses for ages 13 to 19, and small gains for adults aged 20 to 25.

In Table 2, we have excluded those aged 19 to 25 as they are not comparable between samples. The 19 to 25 year olds cannot be compared because the 1999 sample is a university sample whereas the 2010 sample is a population sample. Accordingly, as we would expect, the 19 year olds in 1999 (the students) do score significantly higher than their population counterparts in 2010. Oddly, however, the population sample in 2010 actually scores higher than the student population in 1999, an anomaly which we will discuss below. Limiting our sample to those aged 9 to 18, it can be seen that there is a significant decline in IQ between 1999 and 2010 of 2.13 IQ points. This
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