Fluid g in Scandinavia and Finland: Comparing results from PISA Creative Problem Solving and the WAIS IV matrices subtest

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Abstract
The Scandinavian (Sweden, Norway, Denmark) standardization of the WAIS IV on the matrices subtest is presented. The score of Scandinavia on the WAIS IV matrices is higher than Finland (weighted means 105.1 and 103.1, relative to a US norm of 100). However, the difference is not statistically significant. Finland scores higher than Scandinavia on PISA Creative Problem Solving 2012. We meta-analyze the data from both studies and estimate the Scandinavian Matrices IQ at 99.1 and the Finnish at 102.3 or 102.4 (based on US norms) depending on which sample sizes are used. Finally, we discuss theories that attempt to explain this difference.

Key Words: Intelligence, WAIS IV, matrices, PISA, Creative Problem Solving, Finland, Scandinavia, Denmark, Norway, Sweden

1. Introduction

Dutton, te Nijenhuis and Roivainen (2014) presented data indicating that Finland has the highest IQ in Europe. These data are the following: 1) Finland's scores on PISA tests. These draw upon very large and representative samples and are strongly correlated with IQ. Finland's score has always been the highest in Europe or anywhere outside Northeast Asia. 2) Finland's WAIS IV (Wechsler, 2014), which indicates that it has a Greenwich IQ (where the UK IQ is set at 100) of 101.9 on the matrices (3) Finland's strength in several weaker correlates of IQ, such as average education, health, political stability and lack of corruption, law abidingness, trust levels and happiness.

In this article, we further test Dutton et al.'s theory by focusing on fluid *g*, as tested by the WAIS IV matrices subtest and the PISA Creative Problem Solving (CPS) test.[3] These two tests are strongly comparable, as the WAIS IV matrices is a test of non-verbal and non-mathematical reasoning as is the PISA Creative Problem Solving test. To our knowledge, this is the first English language published study of the WAIS IV matrices subtest with Scandinavian data. The Scandinavian WAIS IV standardization was carried out in 2010 in Sweden, Norway and Denmark. The test items were in Swedish, Danish and Norwegian respectively. The total sample had 780 individuals, 260 from each country. The sample was divided into 11 age groups, each with 56 to 85 persons, half men and half women. Compared to census data from 2008, the sample is representative of the Swedish, Danish and Norwegian populations for education. The norms for four verbal subtests are based on the national samples, and the nonverbal tests are based on the pooled results of the whole sample. Since we were interested in the (nonverbal) matrices subtest, this means that we can only look at the Scandinavian countries as one group.

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[3] Our PISA 2012 CPS data is copied from the full compilation by Davide Piffer, which can be found here. Data on the PISA scores of the Finland-Swedes and Finns has been given to us by Kari Nissinen of the Finnish Institute for Educational Research, Jyväskylä.

The Finnish WAIS IV standardization is based on a random sample of 657 persons from the Finnish population register. The sample was divided into 11 age groups, each composed of 57 to 63 individuals, 27 to 32 men and 28 to 33 women. Compared to data from the 2011 population register, the sample is representative of the Finnish population for education. The testing was carried out during fall 2011 and spring 2012. In all cases, exclusion criteria were the following: ADHD, schizophrenia, other psychotic disorders, depression, epilepsy, cerebral tumor, alcoholism or drug dependence, Alzheimer's or other dementia, impaired sight or impaired sense of hearing, and the use of antipsychotic, anti-depressive or anxiolytic medication. Clearly, most of these issues mainly develop in adulthood (with the exception of ADHD) (see Lynn, 2002) and, as such, those who may go on to develop them will be part of the PISA sample because the PISA results are from school-aged children. In addition, the Scandinavian WAIS IV excluded all those whose mother tongue was not Swedish, Norwegian or Danish while the Finnish WAIS IV excluded all those whose mother tongue was not Finnish. In making our comparison to PISA, we used only the results for 'non-immigrants'.

We have chosen to compare Finland and Scandinavia because they are geographically and culturally close and yet, as we will see below, relatively genetically distinct. As such, comparing them can, to some extent, allow us to explore a partly genetic hypothesis. In addition, on a purely practical level, we had access to the Scandinavian WAIS IV and thus it seemed a useful opportunity to test Dutton et al's hypothesis.

2. Results

The results of the comparison can be seen in Tables 1 and 2. The WAIS IV manuals for Finland and Scandinavia do not give us the standard deviations, so we have estimated them using the reverse engineering method described in Beaujean and Sheng (2014). This involves finding the raw scores equivalent to one standard deviation above and below the mean, calculating how many raw score points each score was from the mean and squaring it to get two estimates of the variance, averaging the two variances and then taking the square root of the average to get an average standard deviation.

Table 1. Finland and the USA on the WAIS IV Matrices

Age	N	Mean Raw Score (FIN)	Raw score -1sd	Raw score +1sd	Estimated sd (FIN)	Mean Raw Score (US)	Estimated sd (US)	Finnish IQ (US Norm)
16-17	57	19	15.5	23	3.75	19	4.5	100
18-19	59	20	17	23.5	3.25	19	4.5	104.6
20-24	60	20	17	24	3.5	19	4.5	104
25-29	61	20	17	23	3	19	4.4	103
30-34	57	21	17.5	24	3.25	18.5	4.3	108
35-39	62	19.5	16	23	3.5	18.5	4.9	103
45-54	61	17.5	12.5	22	4.75	16.5	4.8	103
55-64	62	16	11.5	20	4.25	15	4.8	103
65-69	58	14	9.5	18.5	4.5	13.5	5	102
70-74	63	13	9	17	4	12	5	103
75-92	57	12	8	16	4	10	-	-

Table 2. Scandinavia and the USA on the WAIS IV Matrices

Age	N	Mean Raw Score (SCAN)	Raw score -1sd	Raw score +1sd	Estimated sd (SCAN)	Mean Raw Score (US)	Estimated sd (US)	Scand IQ (US Norm)
16-17	70	20	15	22.5	3.75	19	4.5	104
18-19	70	20	15	22.5	3.75	19	4.5	104
20-24	80	20	15	22	3.5	19	4.5	104
25-29	80	20	15	22	3.5	19	4.4	104
30-34	67	20	14.5	22	3.75	18.5	4.3	106
35-39	85	18.5	12.5	22	4.75	18.5	4.9	100
45-54	85	18.5	12.5	22	4.75	16.5	4.8	106
55-64	67	16.5	10.5	20.5	5	15	4.8	105
65-69	56	16.5	10.5	20.5	5	13.5	5	109
70-74	60	14.5	9.5	19.5	5	12	5	108
75-92	60	12.9	-	-	5.19[4]	10	-	109

Using the weighted average, we find that based on US norms Finland has an IQ of 103.1 while Scandinavia has one of 105.1. This gives us Greenwich IQs of 101.1 and 103.3. The difference is not statistically significant (p=.398, using Welch's test because standard deviations of raw scores could not be assumed to be identical).

In addition, in Table 3, we have the averages of the PISA 2012 Creative Problem Solving (CPS) test converted into Greenwich IQ (Greenwich IQ refers to UK norms and is so termed due to the Greenwich Meridian in international time comparisons). To make the conversion we used the formula IQ=((CPS-517)/96)*15+100. We used 96 as the SD of CPS scores as done by Piffer and Lynn (2014).[5] We use only the scores for non-immigrants so that they are comparable to the WAIS IV matrices scores. In that we compared those to US norms, we also give the US IQ calculation based on PISA. The US non-immigrant score for PISA CPS is 512. So we used the equation, ((CPS-512)/96)*15+100.

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[4] The SD for this group is reported in the manual.

[5] 96 is the OECD average SD. It is better than using country SDs because using individual countries SDs inflates the IQ score of countries with lower SDs. For example, let us assume that country X and country Y have the same PISA score which is 50 points higher (550=500+50) than the mean OECD score. However, country X has SD 80 and country Y has SD 110. Thus, country X's score would be (50/80=) 0.625 SDs and country Y's score would be (50/110=) 0.454 SDs higher than the OECD average, despite having the same PISA score. Thus, a PISA score of 550 would correspond to two IQs of 109.4 and 106.8. This result is clearly wrong.

Table 3: PISA CPS 2012 Converted into IQ for Non-Immigrants

Country	Average Raw Score	Average Greenwich IQ	Average IQ on US Norms
Denmark	505	97.2	98.9
Finland	526	101.4	102.18
Norway	510	97.9	99.6
Sweden	501	96.5	98.28

The results from the PISA CPS are opposite to those from the WAIS-IV in that the Finns outperform the Scandinavian countries.

To arrive at a single best estimate, we performed a meta-analysis (N-weighted) based on both data sets. To do this, we weighted the PISA scores by their country sizes to get an estimate of the PISA CPS Scandinavian score (A2:D8 in datafile). Then we calculated the Scandinavian sample size of the CPS administration by summing the samples from each country (K2:N8).

Getting the sample size for Finland was more problematic. We were informed by Kari Nissinen of the Finnish Institute for Educational Research that the sample size given by the PISA report is wrong in that it includes imputed data (estimated from PISA 12 Math), and that the real sample size of non-immigrant Finnish-speaking Finns (distinct from the country's small, native Swedish-speaking minority) was 2569 as opposed to the 5910 given. The question is whether the Scandinavian samples are similarly based on partly imputed data. If they are and we use the smaller Finnish N, we will be unduly weighting the Scandinavian samples. Because of this uncertainty, we conducted the meta-analysis with both sample sizes. Results are shown in Table 4.

Table 4: Meta-analytic results for Matrix IQ

Scandinavia	IQ (US Norms)	N
CPS12	98.8	15066.467
WAIS M	105.1	780
	Weighted mean	**Total sample**
	99.1	15846.467
Finland	**IQ**	**N**
CPS12	102.18	5910/2569
WAIS M	103.1	657
	Weighted mean	**Total sample**
	102.3/102.4	6567/3226

Since the IQ estimates from the PISA CPS and WAIS IV M were similar for the Finnish sample, and in that the PISA sample dominated the WAIS IV sample, it made little difference which number we used for the sample size; a difference of only .1 IQ point. The estimated difference between Scandinavia and Finland on Matrix-type tests is then 3.2-3.3 IQ points.

3. Discussion

Our meta-analysis demonstrates that Finland has a higher fluid g than Scandinavia. If we subtract two points to create an approximate Greenwich fluid IQ then we can see that Finland's is

100.3-100.4 while Scandinavia's is 97.1. However, it must be emphasized that this is only a very blunt way of estimating the Greenwich IQ. Moreover, there is a degree to which PISA is more representative, in that the WAIS IV excludes those with various mental illnesses and personality disorders that tend to develop after the age of 15 whereas PISA includes those who will go on to develop such conditions. But certainly, we can see that our meta-analysis, in line with Dutton et al. (2014), confirms that Finland has a higher fluid IQ than Scandinavia and implies that it may be among the highest in Europe.

What might explain the difference between Finland and Scandinavia? There are a number of possibilities. The first is simply that the education system is superior in Finland when compared to Scandinavia and that a better educational system improves fluid g. However, as the education systems are relatively similar (see Kananen, 2014) it is unclear how this might be the case. Even granting that the Finnish educational system is better, this may itself be caused by a higher genotypic g instead of being a cause of it. Likewise, differences in political stability between the countries would at least partly reflect differences in g (see Lynn & Vanhanen, 2012). However, Finland has a much bigger advantage in PISA Maths, Reading, and Science performance than in fluid g. This may suggest that variables associated with educational attainment, such as better schooling or higher conscientiousness (see Chamorro-Prezumic & Furnham, 2006), may be contributing factors. However, Finland's 5.4% Swedish-speaking minority has a lower score (521) on the CPS than the Finns (526). Indeed, this minority, which are on average wealthier, healthier, and better educated than the Finns (see Dutton et al., 2014) score lower than the Finns on every PISA subtest in all years of assessment. There is a body of evidence that this minority are genetically between the Finns and Swedes (e.g. Virtaranta-Knowles et al., 1991 or Salmela et al., 2011). This would argue against a purely cultural explanation. With a relatively small difference on PISA between native Finns and Scandinavians, it is possible that there is a cultural explanation but it is unclear what this is. By contrast, Dutton et al. (2014) have suggested a feasible genetic explanation, which we examine as our fourth possibility.

A second possibility is that the results reflect differences in immigration history between Finland and Scandinavia. PISA classifies students as 'native' if they and both their parents were born in the country where the test takes place. The Scandinavian countries have experienced mass immigration from developing countries for longer and a larger percentage of their populations are third generation immigrants (and thus classified as 'natives' by PISA) than is the case in Finland, which has only experienced immigration of this kind since around 1992 (Dutton & Lynn, 2013). Based on Lynn and Vanhanen (2012), who have found that IQs are significantly lower than Scandinavia in third world countries, it might be argued that this difference would reduce the fluid IQ of Scandinavia in comparison to Finland. Although this may explain the difference to some extent, it is unlikely to explain all of difference. Sundet et al. (2004) drew upon Norwegian conscript data to find that the Norwegian conscript IQ reached a peak in 1997 and has declined since. According to Sundet (pers. comm. 13 Feb. 2013): 'Men from Asian and African countries have around 5-6 IQ points lower than non-immigrants. But they seem to comprise not more than around 2-3% of the conscripts in this period. This would deflate the total mean IQ by around 0.1-0.2 IQ points.' In order to be 'native,' a 15 year old in 2012 of, for example, Iraqi descent would require two parents also born in Norway. They would have been born there at the latest in around 1980, only two years after most of the 1997 conscript cohort. As such, this would imply that these ethnic differences would only explain a small element of the difference between Finland and Scandinavia.

A third possibility is that, as Dutton et al. (2014) argued, Finns have higher levels of conscientiousness (a personality trait from the Big Five model of personality, see Nettle, 2007) than do the Scandinavians and this explains some of their superior performance in the PISA CPS test. This is possible, however a meta-analysis by Kirkegaard (2014) of all the PISA results showed only weak evidence of conscientiousness explaining variance that was not explainable by measured IQs,

and this was only for reading (standardized β = .17, p = .03) not for the CPS test which we used here (standardized β = -.03).

A fourth possibility, as discussed in Dutton et al. (2014), is that Finland industrialized later than the rest of Scandinavia which meant that dysgenic fertility set in later later than the rest of Scandinavia. Moreover, Cold Winters theory and the presence of significant Northeast Asian admixture in the Finnish population (see Dutton et al., 2014 or Kittles et al., 1998) would all predict that Finns would have higher genotypic *g* than the Scandinavians.[6] This partly genetic hypothesis would be congruous with Piffer and Gilfoyle's (2014) finding that Finns have the highest score in Europe on alleles associated with educational attainment. Unfortunately, though there are British samples in their results there are none from Scandinavia.

Datasets and peer review history
The datasets used can be found here on Google Drive: 1) Dataset for WAIS matrices analyses, 2) Dataset for meta-analysis.
The peer review history of this publication is public and can be found at the journal's forum.

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[6] For a map of the influence of East Asian genes in different European countries see Eupedia (2014). It can clearly be seen that Finland has the highest East Asian genetic influence of any European country.

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