Intelligence 85 (2021) 101525

Contents lists available at ScienceDirect

Intelligence

journal homepage: www.elsevier.com/locate/intell

The secular trend of intelligence test scores in the present century: The Danish experience

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ARTICLE INFO

Keywords:
Intelligence
Secular trend
Flynn effect
Denmark

ABSTRACT

The present register-based study investigated the secular trend of intelligence test scores during the period from 2006 through 2019 in a Danish population-representative sample, as well as whether the observed trend could be explained by changes in parental age, dysgenics, and immigration or changes in the format of the intelligence test and sample characteristics. The study population consisted of all Danish men appearing before a draft board during the study period (N = 400,288). Intelligence test scores were obtained by the use of Børge Priens Prøve, typically at age 19. For each of the included draft board cohorts, the intelligence test score mean and standard deviation were estimated. The results showed that changes in mean intelligence test scores were minimal during the study period. A slight decline was observed from 2006 to 2010. Furthermore, there was a drop of 1.5 IQ points from 2010 to 2011, which coincided with the change in the format of the intelligence test from paper-and-pencil to computer-based, but there was essentially no change after 2011. Neither changes in parental age, dysgenics, or immigration seem to have influenced the observations. However, changes in sample composition may conceal a true decline in intelligence test scores given that a larger proportion of individuals with low intelligence seems to be exempted from testing. In conclusion, the study findings suggest no systematic change in intelligence test scores during the last decade, but due to changes in sample composition, it cannot be excluded that there has been a negative secular trend.

A major observation on intelligence test scores through the last century was that performances appeared to improve through successive generations. The effect was noted early but was first systematically documented by James Flynn who compared performances of the same individuals in tests which were standardized and normed at different times in the United States (Flynn, 1984) and subsequently, internationally, by comparing the performances of successive generations on the same tests (Flynn, 1987). In recognition of his work, the increasing secular trend was eponymously termed the 'Flynn Effect' (Herrnstein & Murray, 1996).

According to a meta-analysis covering most of the last century and the first decade of the present one, the Flynn Effect originally approximated 3 IQ points per decade but has been found to decrease more recently (Pietschnig & Voracek, 2015). Whether this apparent slowdown of the Flynn Effect might be due to a larger proportion of contemporary studies showing negative trends was recently reviewed by Dutton, van der Linden, and Lynn (2016) and Woodley of Menie, Peñaherrera-Aguirre, Fernandes, and Figueredo (2018), both of whom also discussed possible explanations of the secular declines. In Dutton et al. (2016), secular declines in intelligence test scores were found in nine European studies and the possible influences of sex, parental age, dysgenics, and immigration were discussed. In Woodley of Menie et al. (2018), corresponding secular declines in intelligence test scores were found in 40 studies from 13 countries worldwide and the possible influences of ability measure *g*-saturation, index of biological state (as a proxy for relaxed selection operating on *g*), and per capita immigration on the magnitude of the secular declines were examined. Based on a total sample size of 302,234 individuals and study mid-years ranging from 1920.5 to 2007.5, the authors observed that the magnitude of the secular decline in intelligence test scores strengthened over time. Furthermore, they observed that both ability measure *g*-saturation and immigration positively predicted the magnitude of decline, such that less aggregately *g*-loaded measures and high per capita immigration were associated with larger secular declines. An interaction was also

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https://doi.org/10.1016/j.intell.2021.101525
Received 20 April 2020; Received in revised form 7 January 2021; Accepted 8 January 2021
Available online 21 January 2021

observed between ability measure *g*-saturation and immigration, suggesting that more aggregately *g*-loaded measures declined fastest in countries with higher levels of per capita immigration.

However, the reviews by Dutton et al., 2016 and Woodley of Menie et al., 2018 cover studies involving data collected no later than 2012. A small number of studies in more recent years, predominantly neither European nor North American, have also shown declines (e.g. Dutton et al., 2017; Dutton et al., 2018), but these have been based on the comparison of two years typically separated by a decade. In such cases, it is not possible to determine whether there has been a continuing linear negative effect over the time interval or some other function. However, a meta-analysis suggested an inverse U-shaped trend in spatial ability performance in German-speaking countries from 1977 to 2014 (Pietschnig & Gittler, 2015), but whether this can be generalised to measures of general cognitive ability and other countries needs to be investigated.

Following previous studies of the secular trend in intelligence test scores in the Danish male population during the period from 1959 through 2004 (Teasdale & Owen, 1987, 1989, 2000, 2005, 2008), we are here able to present annual intelligence test scores from 2006 through 2019. As illustrated in Teasdale and Owen (2005), the Danish male population's intelligence test scores increased at a decelerating rate between 1959 and 1998, since when a decline has been observed. More specifically, the gain in intelligence test scores seemed to amount to a little over three IQ points for the decades 1959–1969 and 1969–1979 and approached two IQ points from 1979 to 1989. During the period from 1989 through the peak year 1998, the gain was only about 1.3 IQ points, but by 2000, this last small gain had been lost and has not recovered up to the present time. Besides presenting annual intelligence test scores, we are here also able to investigate some of the proposed explanations of the decline observed at the beginning of this century. Broadly, the proposed explanations can be divided into four main categories: genetic and demographic, environmental, statistical, and hybrid explanations – all of which have been summarized in Woodley of Menie et al. (2018).

In the present study, the aim was therefore to investigate the secular trend in intelligence test scores during the period from 2006 through 2019 and whether proposed genetic and demographic explanations could explain this secular trend. Thus, we investigated the potential influences of parental age, dysgenics, and immigration in a subpopulation who had been followed in national demographic registers. Moreover, since the format of the intelligence test was changed in late 2010 from paper-and-pencil to a computerized administration and the proportion of individuals exempted from testing increased over the years, we also investigated the potential influences of these two factors.

1. Materials and methods

1.1. Study population

A register-based cohort study was conducted of all Danish men appearing before a draft board during the period from 2006 through 2019 ($N = 400{,}288$).

In Denmark, all men are subject to compulsory military service and men with Danish citizenship who reside in the country are required to appear before a draft board in the calendar year when they turn 18 years. However, for men who are pursuing further education, the draft board examination can be postponed until, at most, the end of the calendar year in which they turn 25 years. At the draft board examination, the eligibility of the men for military service is evaluated. They are classified as either eligible, limited-eligible, or unfit for military service based on the results of an intelligence test and a medical examination. During the study period, the proportion of men who were considered eligible, limited-eligible, or unfit for military service corresponded to 50%, 7%, and 43%, respectively. For about half of the men who are considered unfit for military service, the requisite draft board appearance is waived due to documentation of existing health issues, submitted in advance to the draft board (M. R. Nielsen, personal communication, 12 September 2017). Furthermore, men who volunteer to the military forces before draft age do not appear before a draft board, but this only includes a few hundred cases.

The selection of the study sample is illustrated in Fig. 1. During the study period, information on all individuals appearing before the Danish draft board, as well as all men called up, has been recorded in the Conscription Registry ($N = 601{,}005$). Of these, we excluded 23,676 females as draft board testing is purely voluntary for females, as well as 177,041 duplicate observations, which were caused by some men being examined more than once by the draft board authorities. Therefore, the study sample consists of 400,288 men examined by the draft board authorities during the period from 2006 through 2019, which we will refer to as the full cohort. A subsample of 287,688 men examined during the period from 2006 through 2015 has also been followed in national demographic registers.

As the proportion of men exempted from appearing before a draft board has increased over the years, we wanted to investigate whether characteristics of these men might explain the secular trend of intelligence test scores. Because men who are exempted do not have an examination date, we identified the individuals examined and exempted among the birth cohorts 1988–1996, which are the birth cohorts of the subsample of men followed in national demographic registers. Thus, we identified 244,529 men born in the period 1988–1996 who had appeared before a draft board from 2006 through 2015 and 51,794 men born in 1988–1996 who had been called up, but had been exempted, and compared the characteristics of these two groups in a supplementary analysis.

1.2. Variables

1.2.1. Intelligence

Intelligence is assessed by the draft board using a standardized test, originally developed in the early 1950s by the Danish psychologist Børge Prien and named as the 'BPP' (Børge Prien's Prøve) (Rasch, 1980). The test comprises four subtests assessing logical, verbal, numerical, and visuospatial abilities. Each involves approximately 20 items with a total of 78 in all, and it is the total score (0–78) which is recorded from the

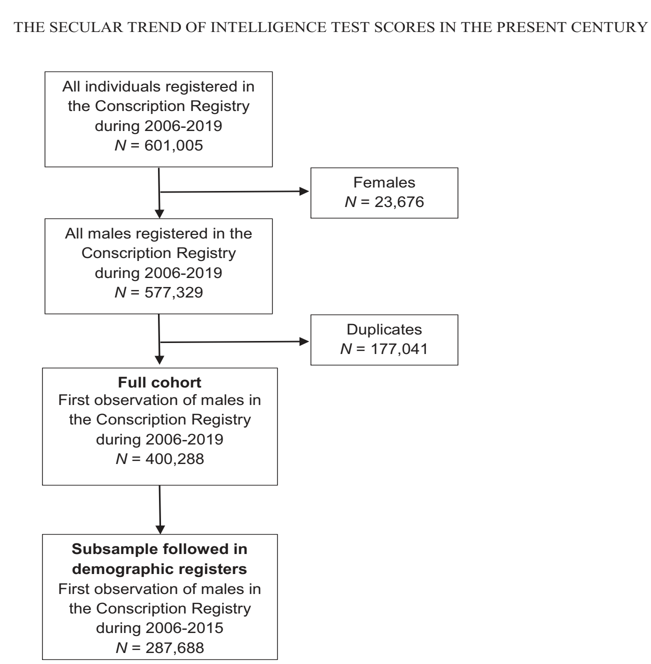

Fig. 1. CONSORT chart illustrating the number of men in the full cohort and in the subsample, which has been followed in national demographic registers.

test. None of the subtests involves multiple-choice questions, and the total test duration is 45 min. The BPP is administered in groups of ca. 25–30 men with invigilation.

Between the introduction of the BPP for draft board assessment purposes in 1957 until the fall of 2010, the test was presented as a paper booklet with answers to be pencilled in. In the fall of 2010, a computerized replacement version of the test was rolled out at assessment centres across Denmark. The individual items in the four subtests remained the same, but they are now presented, one at a time, on a computer screen. As with the previous paper-and-pencil version, the testee is at liberty to switch back and forth among the items within a subtest and to change answers. The four subtests are presented in the same fixed order, and the testee cannot switch between them. The switch from the paper-and-pencil to the computer version appears to have made the BPP fractionally more difficult. Further details of the BPP are presented elsewhere (Teasdale, Hartmann, Pedersen, & Bertelsen, 2011).

Information needed to investigate whether proposed genetic and demographic factors might explain the secular trend in intelligence test scores was available for the subsample of men examined from 2006 through 2015 which was followed in national demographic registers as part of a previous study (Hegelund, Flensborg-Madsen, Dammeyer, & Mortensen, 2018).

1.2.2. Parental age

Parental age at birth has been suggested to influence offspring intelligence test scores due to age-related alterations in the intrauterine environment and the accumulation of deleterious mutations in the germ cells with increasing parental age (e.g. Myrskylä, Silventoinen, Tynelius, & Rasmussen, 2013; Saha et al., 2009). Since both the mean age of motherhood and fatherhood have been increasing during the study period, we wanted to investigate whether increasing parental age had influenced the secular trend in intelligence test scores. Therefore, we obtained the dates of birth of both parents from Statistics Denmark's registers and calculated maternal and paternal ages at birth of the study population.

1.2.3. Dysgenics

Dysgenics has been suggested to lead to a decrease in populations' mean intelligence test scores over time due to the negative association between fertility and intelligence test scores (e.g. Lynn, 2011). Although we did not have information on the fertility of our study population, it was possible to obtain information on number of siblings and use this as a proxy for the proposed dysgenic processes. Therefore, we identified all the study population's siblings in Statistics Denmark's registers and calculated the number of full- and maternal half-siblings.

1.2.4. Immigration

Immigration has likewise been suggested to lead to a decrease in populations' mean intelligence test scores in Western countries due to immigrants with higher fertility and lower intelligence slowly diluting the original population of individuals with relatively lower fertility and higher intelligence (e.g. Dutton & Woodley of Menie, 2018). Since immigration has been increasing during the study period, we wanted to investigate whether this increase had influenced the secular trend in intelligence test scores. Therefore, we obtained information on immigrant status, i.e. whether the individual was of Danish ethnic origin, an immigrant, or a descendant of immigrants, from Statistics Denmark's registers. An individual of Danish ethnic origin was defined as someone – irrespective of birthplace – who was born to parents at least one of whom was a Danish citizen and born in Denmark. An immigrant was defined as an individual born abroad whose parents were both foreign citizens. Finally, a descendant was defined as an individual born in Denmark whose parents were either immigrants or descendants with foreign citizenship.

1.2.5. Characteristics of the exempted

As previously written, the proportion of individuals exempted from the draft board examinations has been increasing during the study period. Therefore, we wanted to investigate whether the secular trend in intelligence test scores might be explained by cognitive ability differences between the examined and exempted. Although intelligence test scores were only available for the examined individuals, information on other characteristics correlated herewith was available for both groups from Statistics Denmark's registers: ethnicity, birth region, parental socioeconomic position at birth as measured by the parents' highest educational attainment, out-of-home care in childhood (i.e. out-of-home placements and other preventive measures), psychiatric diagnoses in childhood, neurological diagnoses in childhood, and perinatal diagnoses and congenital deformities (see Supplementary Material 1 for the specific ICD codes).

1.3. Statistical methods

The main analysis investigated the trend of intelligence test scores during the period from 2006 to 2019 by separately estimating the IQ mean and standard deviation (SD) for each of the included draft board cohorts. The data were scaled against a baseline in 1960, which was standardized to the IQ convention of a mean of 100 and an SD of 15. Five possible explanations for the observed trend of intelligence test scores were evaluated: (I) Parental age, (II) dysgenics, (III) immigration, (IV) change in the format of the intelligence test (paper-and-pencil versus computerized), and (V) change in the proportion of individuals exempted from testing.

All statistical analyses were carried out using SAS version 9.4.

2. Results

Table 1 shows the mean IQ score in relation to the year of draft board examination among the 400,288 Danish men examined from 2006 through 2019. In 2006, the mean IQ score was 111.5 (SD: 12.4). This is a consequence of the considerable rise in IQ scores in the decades immediately after the baseline year of 1960. From 2006 to 2011, a slight decline in mean IQ score from 111.5 (SD: 12.4) to 109.1 (SD: 11.9) was observed. This was followed by a plateau throughout the rest of the period. The median age at examination was 19 years during the study period, and the interquartile range was 19–20 from 2006 through 2014 and 19–19 hereafter.

Information needed to investigate whether genetic and demographic factors had influenced the observed mean intelligence test scores was available for the subsample followed in national demographic registers. Regarding parental age, both mean maternal age and paternal age increased during the study period. More specifically, maternal age

Table 1
Mean IQ scores in relation to the year of draft board examination in the full cohort.

Year of draft board examination	*N*	*M* (*SD*)
2006	25,128	111.5 (12.4)
2007	27,319	111.1 (12.5)
2008	24,555	110.8 (12.5)
2009	27,157	110.7 (12.4)
2010	30,888	110.6 (12.1)
2011	30,766	109.1 (11.9)
2012	29,747	109.2 (11.7)
2013	30,669	109.0 (11.4)
2014	32,479	109.1 (11.2)
2015	28,980	109.3 (11.0)
2016	28,351	109.2 (11.1)
2017	30,424	109.1 (11.0)
2018	26,969	108.7 (10.9)
2019	26,856	108.8 (10.8)
Total	400,288	109.7 (11.6)

increased from 27.9 years for individuals examined in 2006 to 29.5 years for individuals examined in 2015. Paternal age likewise increased from 30.9 years for individuals examined in 2006 to 32.2 years for individuals examined in 2015. However, we found positive individual-level correlations with offspring IQ score for both maternal and paternal age (Table 2). Thus, maternal age correlated 0.13 with offspring IQ score across the period, ranging from 0.12 to 0.16 year-by-year, and paternal age correlated 0.07 with offspring IQ score across the period, ranging from 0.05 to 0.10 year-by-year. Overall, parental age therefore did not appear to have influenced the observed mean intelligence test scores.

With regard to dysgenics, negative individual-level correlations were found between family size and IQ score (Table 2). More specifically, family size correlated −0.11 with IQ score across the period, ranging from −0.09 to −0.12 year-by-year. The negative correlations suggested that dysgenics may have influenced the observed mean intelligence test scores. However, a linear regression model revealed that the change in year-by-year correlations explained less than 0.01% of the variance in intelligence test scores although it had a small positive influence (Supplementary Table 1).

With regard to immigration, there was a negligible increase during the study period. More specifically, the proportion of men with Danish origin decreased from 96.8% in 2006 to 96.4% in 2015, the proportion of immigrants remained constant around 1.7% (fluctuating between 1.6 and 1.8%), and the proportion of descendants of immigrants increased slightly from 1.5% in 2006 to 1.9% in 2015. To check whether this negligible immigration might nonetheless have influenced the observed mean intelligence test scores, we examined the trend in mean intelligence test score after exclusion of all immigrants and all immigrants and descendants, respectively, leaving only those men of Danish origin. The secular trend in mean intelligence test scores did not change at all when excluding immigrants and descendants (data not shown), so immigration did not seem to have influenced the observed mean intelligence test scores.

As previously described, the format of the intelligence test was changed from paper-and-pencil to computer-based in the fall of 2010. As can be seen in Fig. 2, this change coincided with an exceptional drop in mean IQ score from 110.6 (SD: 12.1) in 2010 to 109.1 (SD: 11.9) in 2011, suggesting that the change in format was responsible for the sudden drop.

Finally, in the full cohort, the proportion of individuals exempted from testing increased with increasing birth year from 16.3% for those born in 1988 to 23.8% for those born in 2000. Table 3 shows the characteristics of those examined and exempted in the subpopulation who was followed in national demographic registers. For both those examined and those exempted, the proportion of immigrants remained more or less the same during the study period. However, among the examined individuals, the proportion born in the Capital Region of Denmark increased slightly over time, whereas the proportion born in the more rural Central Denmark Region decreased somewhat. Among the exempted individuals, the proportion born in the Central Denmark Region increased slightly, whereas the proportion born in the Region of Southern Denmark decreased. The proportion of individuals whose parents had a high educational attainment increased in both groups, but the increase was most pronounced among those examined. In contrast,

Table 2
Individual-level correlations between IQ score and maternal age, paternal age, and family size in the subsample followed in national demographic registers.

Year of draft board examination	$r_{maternal\ age}$	$r_{paternal\ age}$	$r_{family\ size}$
2006	0.15	0.09	−0.09
2007	0.15	0.10	−0.12
2008	0.13	0.08	−0.11
2009	0.16	0.09	−0.11
2010	0.13	0.07	−0.12
2011	0.14	0.08	−0.11
2012	0.13	0.07	−0.11
2013	0.13	0.07	−0.11
2014	0.12	0.05	−0.11
2015	0.12	0.06	−0.10
Total	0.13	0.07	−0.11

All correlations are statistically significant at α = 0.001.

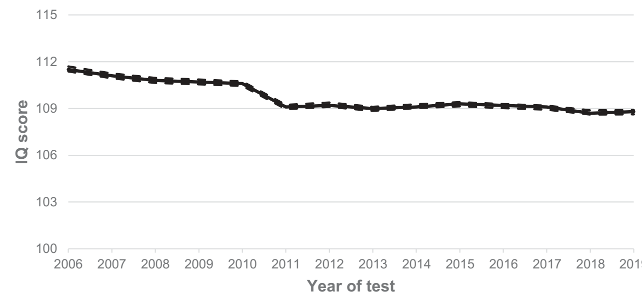

Fig. 2. Mean IQ score in relation to the year of draft board examination for the full cohort.
The dotted lines indicate the 95% confidence interval.

Table 3
Characteristics of individuals coming up before a Danish draft board and individuals exempted from meeting in person (*N* = 60,273).

	Birth cohort			
	1988		1996	
	Examined (*N* = 26,631)	Exempted (*N* = 4471)	Examined (*N* = 22,674)	Exempted (*N* = 6497)
Ethnicity, N(%)				
Danish	24,811 (93.2)	4249 (95.1)	21,087 (93.0)	6214 (95.8)
Non-Danish	1799 (6.8)	218 (4.9)	1581 (7.0)	274 (4.2)
Missing	21 (–)	4 (–)	6 (–)	9 (–)
Birth region, N(%)				
Capital Region of Denmark	7303 (28.4)	1281 (29.6)	6822 (30.4)	1930 (30.0)
Region Zealand	3653 (14.2)	593 (13.7)	3129 (14.0)	875 (13.6)
North Denmark Region	2456 (9.6)	410 (9.5)	2005 (9.0)	630 (9.8)
Central Denmark Region	5940 (23.1)	962 (22.3)	4916 (21.9)	1511 (23.5)
Region of Southern Denmark	6374 (24.8)	1076 (24.9)	5540 (24.7)	1482 (23.1)
Missing	905 (–)	149 (–)	262 (–)	69 (–)
Parental educational attainment at birth[a], N(%)				
Low	4593 (18.0)	947 (22.0)	2660 (11.9)	1161 (18.1)
Medium	12,818 (50.3)	2048 (47.6)	11,247 (50.4)	3265 (50.8)
High	6038 (31.7)	1310 (30.4)	8417 (37.7)	1998 (31.1)
Missing	8066 (–)	166 (–)	350 (–)	73 (–)
Out-of-home care in childhood, N(%)				
Yes	1114 (4.2)	628 (14.1)	516 (2.3)	668 (10.3)
No	25,517 (95.8)	3843 (86.0)	22,158 (97.7)	5829 (89.7)
Psychiatric diagnoses in childhood, N(%)				
Yes	200 (0.8)	247 (5.5)	235 (1.0)	688 (10.6)
No	26,431 (99.3)	4224 (94.5)	22,439 (99.0)	5809 (89.4)
Neurological diagnoses in childhood, N(%)				
Yes	2897 (10.9)	823 (18.4)	2458 (10.8)	1125 (17.3)
No	23,734 (89.1)	3648 (81.6)	20,216 (89.2)	5372 (82.7)
Perinatal diagnoses and congenital deformities, N(%)				
Yes	1827 (6.9)	659 (14.7)	2436 (10.7)	1209 (18.6)
No	24,804 (93.1)	3812 (85.3)	20,238 (89.3)	5288 (81.4)

[a] The categorisation is based on the International Standard Classification of Education (ISCED): Low (levels 1–2): Primary education and lower secondary education. Medium (level 3): Upper secondary education. High (levels 5–8): Short-cycle tertiary education, Bachelor's or equivalent level, Master's or equivalent level, and doctoral or equivalent level.

the proportion of individuals with out-of-home care in childhood declined in both groups and the decline was most pronounced among those exempted. With regard to health and wellbeing, the proportion with psychiatric diagnoses in childhood increased in both groups over time whereas the proportion with neurological diagnoses in childhood declined; both trends were most pronounced among those exempted. Finally, the proportion with perinatal diagnoses and congenital deformities increased in both groups over time. Thus, it seems that the two groups of examined and exempted individuals have changed in similar ways over time. However, since the proportion of exempted has increased during the study period and this group generally seems to be worse off with regard to the above-mentioned characteristics that are all correlated with intelligence test scores, this suggests that changes in the sample composition may have inflated the population mean. In other words, if a larger proportion of individuals in the bottom-percentiles of the intelligence scale are being exempted from testing, the observed stagnation in mean intelligence test scores may conceal a true secular decline.

3. Discussion

3.1. Main findings

Changes in mean intelligence test scores were minimal among the 400,288 Danish men who were examined by the Danish draft board authorities during the period from 2006 through 2019. A slight decline in mean IQ score was observed from 2006 to 2010, which can be seen as a continuation of the decline previously reported between 1998 and 2004 (Teasdale & Owen, 2008). Furthermore, there was a drop of 1.5 IQ points from 2010 to 2011, which coincided with the change in the format of the intelligence test from paper-and-pencil to computer-based, but there was essentially no change after 2011. Neither changes in parental age, dysgenics, nor immigration seem to have influenced the observed mean intelligence test scores. However, changes in the sample composition may have inflated the mean intelligence test scores since the proportion of exempted has increased during the study period and this group generally seems to be worse off with regard to characteristics that are all correlated with intelligence. In other words, if a larger proportion of individuals with low intelligence are being exempted from testing, the observed stagnation in mean intelligence test scores may conceal a true secular decline.

3.2. Comparison with the existing literature

In contrast to recent reports of a negative secular trend in population performances on intelligence tests, we observed virtually no change during the period of 2006 through 2019. We have had the opportunity to rescale the mean intelligence test scores from the Danish draft board examinations reported by Teasdale and Owen (2008) against our baseline year 1960 to compare them with our observations. The rescaled mean IQ scores are as follows: 1988: 111.0 (SD: 13.0); 1998: 112.4 (SD: 12.7); 2003/4: 111.1 (SD: 12.8). As can be seen, there was an increase from 1988 to 1998 followed by a small decline from 1998 to 2003/4. The mean IQ score in 1998 remains the highest recorded using Danish draft board data, whereas the mean IQ score in 2003/4 is comparable with our mean intelligence test score in 2006. As such, there has been a decline of 1.8 IQ points during the period from 1998 through 2010 followed by a drop of 1.5 IQ points which is probably due to the change in the format of the intelligence test and virtually no change from 2011 through 2019. However, the variance has declined significantly throughout the study period, corresponding to a decline of 0.15 SD per year ($p < 0.001$). A previous study has suggested that the negative secular trend observed in developmental test performances may be rooted in declining performances of the top percentiles (Flynn & Shayer, 2018), leading to declining variances. If this is also true in our study where the proportion of individuals with low test intelligence scores who were exempted from testing has increased over time, this might explain our observation of no change in mean intelligence test scores, but a declining variance.

Another proposed explanation for the secular trend of intelligence test scores is the internationally observed increase in parental age (CIA, 2016) since intelligence test scores have been reported to negatively correlate with parental age (e.g. Myrskylä et al., 2013; Saha et al., 2009). In our study, we also observed modest increases in maternal age and paternal age during the study period. However, both maternal and paternal age were positively correlated with offspring intelligence test score, suggesting that increasing parental ages have not influenced what we observed to be a virtually unchanging mean intelligence test score during the study period.

For almost a century, it has frequently been asserted that less intelligent parents have more children than more intelligent parents. Given the compelling evidence for a genetic contribution to intelligence test score variance, this would lead to a downward dysgenic trend in populations' mean intelligence test scores (e.g. Lynn, 2011). In our sample, however, changes in the year-by-year correlations between family size and intelligence test score explained less than 0.01% of the variance in intelligence test scores, suggesting that dysgenic processes do not play an important role in the observed mean intelligence test scores. This is consistent with the findings from a meta-analysis of possible correlates of the negative secular trend of intelligence test scores, which found that fertility had limited explanatory value (Pietschnig, Voracek, & Gittler, 2018).

Furthermore, it has frequently been asserted that increasing immigration would lead to a decline in populations' mean intelligence test scores. Based on Statistics Denmark's publicly available statistics on immigration in the Danish population, it can be calculated that the percentage of immigrants has increased from 8.5 in 2006 to 13.7 in 2019. However, the draft board assessment is only compulsory for men having Danish citizenship, and in our sample, the proportion of such immigrants and descendants was very small and remained relatively constant throughout the study period. Moreover, excluding immigrants and descendants did not influence the mean intelligence test scores, suggesting that immigration has not influenced the observed mean intelligence test scores. This is consistent with a meta-analysis of possible correlates of the negative secular trend of intelligence test scores (Pietschnig et al., 2018), supporting current evidence that the influence of immigration on national intelligence levels is short-lived and that performance gaps between native and immigrant populations diminish over time (e.g. te Nijenhuis, de Jong, Evers, & van der Flier, 2004). However, another data synthesis found that immigration was a significant predictor of the negative secular trend of intelligence test scores (Woodley of Menie et al., 2018). Whether the contrasting findings are due to different immigration trends is hard to tell, but it might be explained by the small and relatively constant proportion of immigrants and descendants in our sample throughout the study period.

Since we lack details of the intelligence test's administration, it is only possible to speculate from anecdotes regarding the cause of the exceptional drop in scores from 2010 to 2011. One possibility is that the paper-and-pencil booklet administration gave testees the brief possibility of adding a correct solution after the announcement to terminate the test, whereas the computer administration terminates the test automatically precisely at the end of the assigned time. Another possibility is that the paper-and-pencil version made it possible for a testee to 'cheat' by surreptitiously paging back to a prior subtest. A third factor could be that the fourth subtest, which involves the combining of simple geometric figures in order to construct more complex gestalts, was easier when hand-drawing on paper was possible.

A final factor that needs to be considered is the influence of the changing proportion of individuals exempted from the draft board examination, usually for documented medical reasons. The proportion of exemptions has increased steadily over time, partly owing to the smaller number of recruits required by the military forces and partly to an increase in volunteer numbers. If there is any real intelligence test score difference between the examined and the exempted, then the changing proportion might influence annual mean intelligence test scores. Although intelligence test scores were not available for the exempted individuals, this group generally seemed to be worse off with regard to characteristics correlated with intelligence test scores. Therefore, the increase in the proportion of exempted might have inflated the mean intelligence test scores, suggesting that the observed stagnation might conceal a true secular decline in mean intelligence test scores.

3.3. Strengths and limitations

The major strength of this study is its large population-representative sample of all Danish men who have appeared before a draft board during the period from 2006 through 2019, as well as information about the individuals exempted from the draft board examinations. Another strength is the use of information from Danish registers due to their high validity and completeness. Furthermore, the fact that intelligence was assessed by use of the BPP can also be considered a strength because of its high correlation with the full-scale Wechsler Adult Intelligence Scale (Mortensen, Reinisch, & Teasdale, 1989) and Raven's Progressive Matrices (Teasdale et al., 2011).

However, since the BPP has not been materially changed since its introduction six decades ago, obsolescence of test items is possible, but as the test items involve abstract reasoning that is less susceptible to become obsolete this is not a major concern. What might be more problematic is that only BPP total scores, rather than its constituent four subtests, were available, since we cannot look into whether our intelligence construct has changed over time or whether secular trends in subtest scores depend on the subtests' *g*-loadings. If the most *g*-loaded subtest scores are declining, whereas the less *g*-loaded subtest scores are increasing, these two opposite trends may be cancelling each other out and explain why we did not observe any systematic change in intelligence test scores (e.g. Woodley of Menie et al., 2015). Furthermore, the fact that the study sample is solely based on young adults may limit our findings' generalisability, since secular trends in intelligence test scores have been reported to vary by age (Flynn & Shayer, 2018). Although we did not observe any systematic change in intelligence test scores, changes in factors such as parenting, schooling, job demands, and the well-being of the elderly may have resulted in systematic changes in intelligence test scores in other age groups. With regard to sex, there is little evidence of major sex differences in general intelligence test scores (e.g. Deary, 2012). However, the lower variability in intelligence test scores in our sample compared to the standardisation sample suggests that today's conscripts may be less representative of the general population. In other words, it supports our presumption that the increasing proportion of exempted individuals may not be randomly distributed across the intelligence spectrum. In fact, our study suggests that the group of exempted generally is worse off with regard to characteristics that are all correlated with intelligence and, potentially, also with regard to intelligence. Therefore, the observed stagnation in mean intelligence test scores may conceal a true secular decline and should thus be interpreted as an upper threshold of the secular trend. Finally, it is yet to be determined how far our study findings are applicable to women and other countries, in particular developing countries.

4. Conclusions

The study found no systematic change in intelligence test scores in the Danish male population during the period from 2006 through 2019. Neither changes in parental age, dysgenics, nor immigration seem to have influenced the mean intelligence test scores. However, the increasing proportion of individuals exempted from the draft board examinations might have inflated them, suggesting that the observed stagnation might conceal a true secular decline in mean intelligence test scores.

Declaration of Competing Interest

None.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.intell.2021.101525.

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