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Are high-IQ students more at risk of school failure?

Ava Guez[a,*], Hugo Peyre[b,c], Marion Le Cam[d], Nicolas Gauvrit[e], Franck Ramus[a]

[a] LSCP, Département d'études cognitives, ENS, EHESS, PSL Research University, CNRS, Paris, France
[b] Department of Child and Adolescent Psychiatry, Robert Debré Hospital, APHP, Paris, France
[c] INSERM U1141, Université Paris Diderot, Sorbonne Paris Cité, DHU Protect, Paris, France
[d] Direction de l'Evaluation, de la Prospective et de la Performance (DEPP), Ministère de l'Education Nationale, France
[e] Human and Artificial Cognition Lab, EPHE, Paris, France

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ABSTRACT

While it is well-established that intelligence tests positively predict academic achievement, there remain widespread beliefs that gifted students experience difficulties at school and are particularly at risk of school failure. Many studies have provided evidence to the contrary, however few were based on representative population samples. This paper intended to assess whether prior results on the academic success of gifted children could be generalized to a large sample from the general French population. We analyzed a database of French middle school students (N = 30,489), including scores in a fluid intelligence test in grade 6 and a variety of school performance measures in grade 9 (results at a national exam, teachers' grades, academic orientation in high school). In addition, self-efficacy and motivation were assessed. Our results replicate and extend previous findings: high-IQ students scored much better on all academic performance measures, which was corroborated by higher levels of motivation and self-efficacy. Consistently with the previous literature, there was a robust positive relationship between fluid intelligence in grade 6 and academic performance in grade 9 in the whole sample, which was also observed within high-IQ students. Exploratory analyses revealed that IQ moderated the association between social background and children's achievement, such that the positive link between parental education and achievement levelled off for high-IQ children. The positive association between high-IQ and achievement was similar for boys and girls.

1. Introduction

Intelligence tests were originally designed with the explicit purpose of predicting school success (Binet & Simon, 1904). Since then, after a century of further development of tests and theorising, scores provided by intelligence tests remain a robust predictor of academic achievement (Deary, Strand, Smith, & Fernandes, 2007; Rohde & Thompson, 2007; Roth et al., 2015). More generally, IQ is positively correlated with a large array of life outcomes, including income (Zagorsky, 2007), mental and physical health (Der, Batty, & Deary, 2009; Gale, Hatch, Batty, & Deary, 2009), or life expectancy (Batty, Deary, & Gottfredson, 2007).

In this context, it may seem surprising that there remain widespread beliefs about gifted children suffering from social and emotional difficulties. For example, the National Association for Gifted Children states that gifted children “may be at greater risk for specific kinds of social-emotional difficulties if their needs are not met”, such as “heightened awareness, anxiety, perfectionism, stress, issues with peer relationships, and concerns with identity and fit” (‘Social & Emotional Issues | National Association for Gifted Children’, 2018). Similarly, on the website of the National Register of Health Service Psychologists, James T. Webb writes that many professionals “are unaware that talented and gifted children are at risk for underachievement, peer relationship issues, power struggles, perfectionism, existential depression, and other problems, and that bright adults often have job difficulties, problems with peers, spouses or children, and existential depression that stem from giftedness.” (Webb, 2014). These beliefs are supported by studies that show positive associations between high IQ and anxiety (Lancon et al., 2015), depression (Jackson & Peterson, 2003), internalizing and externalizing problems (Guénolé et al., 2013) and various psychological and physiological disorders (Karpinski, Kinase Kolb, Tetreault, & Borowski, 2018). However, these studies relied on case studies or biased samples (such as members of Mensa in Karpinski et al. (2018),[1] or clinically referred children in Guénolé et al. (2013)).

Even more surprising, some people seem to think that gifted

* Corresponding author at: Ava Guez, LSCP, Département d'Etudes Cognitives, Ecole Normale Supérieure, 29 rue d'Ulm, 75005 Paris, France.
E-mail address: ava.guez@ens.fr (A. Guez).

[1] For detailed comments on this article see https://pubpeer.com/publications/2F26A22D54A2032B460B3037AF26C0

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children are more at risk of school failure, potentially due to the above mentioned social and emotional problems, but also to lower self-efficacy or motivation (Reis & McCoach, 2000), heightened risk of bullying (Peterson & Ray, 2006), boredom in class (Vannetzel, 2009) or perfectionism (Webb, 2014) – even though some studies argue against these hypotheses (Feldhusen & Kroll, 1991; McCoach & Siegle, 2003; Peters & Bain, 2011; Roznowski, Hong, & Reith, 2000). Other authors argue in favour of the existence of a "negative Pygmalion effect", that would encourage the child to conform to its environment and the lower demands of the school in order to be accepted by others, which, as a consequence, would increase socio-emotional problems and heighten the risk of failure (Terrassier, 2009). Thus, popular media report that 20% of gifted student may drop out of school in the US (Kuzujanakis, 2013), while in France, the reported proportion of gifted children failing at school goes from one third (Bourgeois, 2017; Colonat, 2018; Le Saint, 2017) to up to 70% (Quillet, 2012). Here again, these figures are supported by little evidence, or come from biased samples – e.g. the estimate of one third of failing gifted students in France comes from a survey of parents of children belonging to the French Association for Gifted Children (Côte, 2005).

In contrast, scientific evidence converges towards the fact that gifted students perform better than their peers. The literature on the achievement of gifted students goes back to the 1920s with Terman's Study of the Gifted (Terman, 1926a). This longitudinal study examined the characteristics and development of 1528 high-IQ children in California, aged 2 to 13 at the beginning of the study. Gifted students from the main experimental group were selected in Californian public schools by the means of a three-step process involving teacher nomination, the National Intelligence Test, and an abbreviated version of the Stanford-Binet test (belonging to the top 1%). Results showed that the gifted participants were rated higher by teachers on the quality of their school work compared to a control group (Terman, 1926b), and performed better at the Stanford Achievement Tests by two to five times the standard deviation of the controls (Terman, 1926c). Starting in the 1970s, the Study of Mathematically Precocious Youth (SMPY) followed five cohorts of American gifted students. The first three cohorts were identified at 12–13 years old by talent searches and selected with scores at the mathematics and verbal subtests of the SAT (Lubinski & Benbow, 2006). The first cohort included 2188 students in the top 1%, the second, those in the top 0.5% ($N = 778$), the third, those in the top 0.01% ($N = 501$). By age 33, 25% of participants of the first cohort had earned a doctorate, 30% of cohort 2, and 50% of cohort 3 – compared to 1% in the general population (Lubinski & Benbow, 2006). Similarly, McCoach and Siegle (2003) have shown that gifted university students in the US (identified by school district volunteers) have higher self-reported Grade Point Averages (GPAs) than students from the general population, but their sample was small and not representative. Matthews (2006) also reported that in North Carolina, less than 1% of gifted high-school students (as identified by a talent search) dropped out. However, a common limitation to these studies is their respective selection process. Indeed, they relied on teacher nomination or talent searches, which may have favoured the inclusion of academically successful gifted students in the gifted sample at the expense of low achievers, thus potentially amplifying the difference between gifted and controls. Overcoming this limitation, Roznowski et al. (2000) led a large scale study examining various academic outcomes among 12,630 American gifted and non-gifted students from the general population. Their results show that gifted individuals (top 5%) are more likely to participate in college preparatory programs, receive A and B grades in school, spend more time on homework, be less absent, like school more, feel more at ease in academic courses, and have higher self-esteem. However, their measure of cognitive ability relied on highly academic skills (they used a composite score of vocabulary, reading and arithmetic tests – BYTEST), which considerably reduces the strength of their results.

While the belief that high-IQ student are more at risk of school failure has not been supported by the literature and seems contradictory with the generally positive correlation between IQ and achievement, it is not inconceivable that this relationship might reverse or at least level off beyond a certain IQ level, such that individuals with very high IQ might succeed less well than expected from the linear relationship observed in non-gifted children. Again, this threshold hypothesis has not been supported by the literature, as a series of studies showed the existence of differences in degrees earned and other indicators of success depending on ability levels, even within the highly gifted SMPY population (Park, Lubinski, & Benbow, 2008; Robertson, Smeets, Lubinski, & Benbow, 2010).

These findings together indicate that gifted students, far from being worse off at school, outperform their peers. However, most of these studies involved nomination or talent search as a selection step in order to find gifted participants, which implies that the participants in these studies may be biased in favour of successful gifted children. Therefore, these results were often based on non-representative samples, so that there remains a need for research on the gifted in the general population. Besides, these studies where all conducted in the United States, which raises the question of the generalisability of their findings in other countries.

In order to test whether previous results on the academic performance of gifted students could be replicated in a large representative sample and in a different population, we analyzed data from 30,489 French middle school students. Giftedness is a very broad term, which can refer to superior abilities in multiple domains, such as general intellectual ability, leadership skills, or visual/performing arts. In this paper, we investigate intellectual giftedness, i.e. superior general intellectual ability. The data used includes scores in a fluid intelligence test in grade 6 and a variety of school performance measures in grade 9 (results at a national exam, teachers' grades, academic orientation in high school). In addition, self-efficacy and motivation were assessed. This rich database thus allowed us to study the differences in a large range of school performance measures between gifted and non-gifted students in France.

In accordance with the existing literature, we formulated the following hypotheses:

a) High-IQ students show better academic achievement than other students.
b) They drop out less frequently from middle school.
c) High-IQ students show higher scores in measures of self-efficacy and motivation.
d) There is a positive relationship between IQ in 6th grade and achievement in 9th grade.
e) This relationship holds equally in high-IQ students and in the general population.

2. Method

2.1. Sample

We analyzed data from the DEPP Panel 2007, a study directed by the Direction de l'Evaluation, de la Prospective et de la Performance (DEPP), French Ministry of Education (Trosseille, Champault, & Lieury, 2013). 34,986 children were followed from their entrance in the first year of French middle school (grade 6) in 2007 to the second year of high school (grade 11). The study was compulsory and approved by the National Council for Statistical Information (CNIS) (visa n°2008A061ED and 2011A082ED), ensuring public interest and conformity with ethical, statistical and confidentiality standards. The sampling strategy was balanced sampling, i.e. the random selection of a sample that is representative of the sampling frame based on available characteristics, using the algorithm CUBE created by INSEE (Rousseau & Tardieu, 2004). The sample was randomly selected from an exhaustive sampling frame, the *Système d'information du second degré de la DEPP*, balancing the following characteristics: region, public/private status of the school, urban unit, school establishment, age of entry in grade 6 (Trosseille et al., 2013). The sample was constituted in such a way as to be representative of the French population of middle school students, with a slight over-representation of students in schools belonging to the Réseau Ambition Réussite (Success Ambition Network – schools in disadvantaged areas). Previous analyses of this dataset have been conducted before (Guez, Panaïotis, Peyre, & Ramus, 2018; Trosseille et al., 2013). Our working sample includes students for whom the intelligence score in grade 6 was available and different from zero ($N = 30{,}489$). Table 1 describes the main socio-demographic characteristics for high-IQ and non-high-IQ students in our sample.

2.2. Measures

2.2.1. Fluid intelligence

In grade 6 (2007) and grade 9, the *Raisonnement sur Cartes de Chartier* (RCC – Chartier's Reasoning Test on Playing Cards) test was administered collectively to all participants. Designed to capture fluid intelligence (*gf*) (Chartier, 2012; Terriot, 2014), the RCC contains 30 items that evaluate children's non-verbal logical reasoning skills, inspired from Raven's progressive matrices (Raven, 1998) but using playing cards as material. Each item is solved by determining which card would fill the blank in an array composed of 4 to 12 cards. The RCC is scored as the number of items correctly completed in a limited time (20 min). Internal consistency was good ($\alpha = 0.88$), and the correlation between RCC scores in grade 6 and in grade 9 was relatively strong ($r = 0.61$), indicating a good reliability (similar to findings by Watkins and Smith (2013), who found correlation coefficients for WISC-IV subtests administered 3 years apart ranging from 0.46 to 0.70, with a median of 0.56). A large number of students scored 0 (2.58%), many more than those scoring 1 (1.16%), which may mean that they were not engaged in the task, refused to take the test, or which may indicate problems with administration and scoring. Therefore, we chose to remove them from our analyses (see Fig. A1). We scaled RCC scores on the standard IQ scale ($M = 100$, $SD = 15$). The distribution of scores was negatively skewed (Fig. 1), and this remained the case after using sampling weights to make the population representative (the skewness was about equal to -0.29 in both cases). Thus the negative skew was not due to the overrepresentation of schools from disadvantaged areas. As a result, only 0.55% of students had a non-verbal IQ score higher than 130 (about 2% of examinees in a normal distribution), which is a frequent threshold above which an individual is considered gifted (Carman, 2013; Newman, 2008; the top 2% criterion is also the one applied by Mensa). Therefore, in order to have about the same proportions in our sample, we categorized as high-IQ students those with an RCC score above the 98th percentile (here equivalent to a non-verbal IQ of 126.2) ($N = 888$).

Table 1
Descriptive statistics for sociodemographic variables and fluid intelligence.

Variable	High-IQ $N = 888$		Others $N = 29{,}601$		Difference (High-IQ - Others)	
	M or %	*SD*	*M or %*	*SD*	*d or OR*	*p*
RCC score (fluid intelligence) in grade 6 (out of 30)	26.75	0.92	15.06	5.83	2.03	< 0.0001
Age in grade 6 (years)	10.93	0.35	11.16	0.48	0.48	< 0.0001
Parental education (years)	13.61	3.24	11.87	3.47	0.50	< 0.0001
Disadvantaged school (%)	10.09		18.43		0.50	< 0.0001
Both parents born abroad (%)	1.87		10.53		0.58	< 0.0001
Sex (% Female)	51.01		49.53		1.06	0.7603

Note: RCC = Chartier's Reasoning Test on Playing Cards. Mean (M) and Cohen's *d (d)* are indicated for differences in continuous variables (RCC scores, age in grade 6, years of parental education); percentages (%) and odds ratios (OR) are indicated for differences in proportions (disadvantaged school, both parents born abroad, sex).

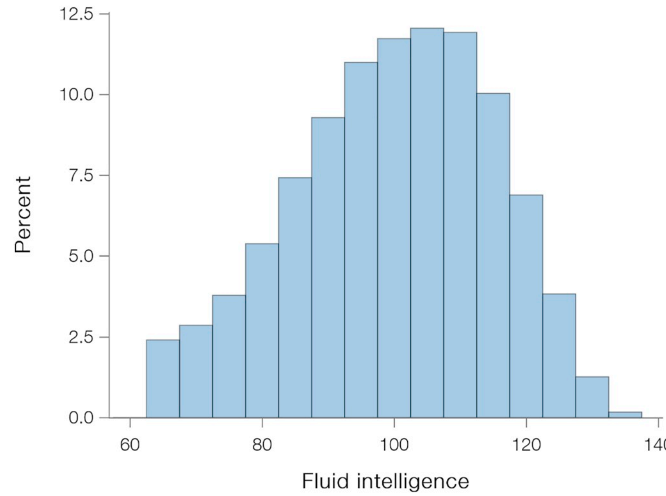

Fig. 1. Distribution of fluid intelligence in grade 6.

2.2.2. Academic achievement

At the end of middle school (grade 9), all French students take a national examination, the *Diplôme national du Brevet* (hereafter referred to as DNB). The final grade at the DNB is composed of continuous monitoring throughout grade 9 (teachers' grades in all subjects) and of results at the national examination. Raw final grades undergo a "harmonization" process, whereby grades are somewhat standardized across academic regions, and grades just below the pass threshold are raised just at the threshold. At the time of the study, the DNB examination included three anonymously graded tests: one in French, one in Mathematics and one in History and Geography. Our dataset includes results at the national examination in the three subjects, grades in the continuous monitoring, and the final DNB grade.

2.2.3. Academic orientation

In addition to these results, we evaluated later academic success using orientation decisions at the end of middle school and at the end of the first year of high school. In France, middle school is general and common to all students. Academic paths split at the end of grade 9, when students can be oriented, depending on their wishes, on their academic record and on the school staff decision, to general and technological high school (*Lycée général et technologique*), to vocational high school (*Lycée professionnel*), or to the preparation of a vocational diploma (*Certificat d'aptitude professionnelle* or *Brevet d'études professionnelles*). Similarly, at the end of grade 10, students in general and technological high school can either be oriented to one of the three general tracks (*Premières générales: Première S* – scientific, *Première ES* – economics and social science, and *Première L* – literature track) or to one of the nine technological tracks, ranging from management to catering or industrial sciences and technologies (*Premières technologiques:* STI2D, STD2A, STG, STL, ST2S, BT, Hôtellerie, TMD, and STAV).

2.2.4. Perceived self-efficacy

In grade 9, students answered questions from the Children's Perceived Self-Efficacy scales (Bandura, 1990), closely translated into French (Blanchard, Lieury, Le Cam, & Rocher, 2013). It is a 37-item questionnaire which measures three types of self-efficacy: perceived academic self-efficacy (19 items), i.e. students' perceived ability to manage their learning, to master different academic subjects (mathematics, science, etc.…), and to fulfill parents' and teachers' expectations; perceived social self-efficacy (13 items), i.e. efficacy regarding leisure group activities, the ability to form and maintain social relationships and manage interpersonal conflicts, and self-assertiveness; and perceived self-regulatory efficacy (5 items), i.e. students' perceived ability to resist peer pressure to engage in high-risk activities (alcohol, drugs, transgressive behaviors). For each item, students had to evaluate their ability to perform each activity using a 5-point Likert scale. Principal component analysis confirmed the three main factors structure, based on the scree plot, as in Pastorelli et al. (2001). Three perceived self-efficacy scores (academic, social, and self-regulatory) were then constructed using confirmatory factor analysis. Internal consistency was good for the three indicators (Cronbach's α above 0.80).

2.2.5. Motivation

Lastly, students' academic motivation was assessed in grade 9 with questions derived from the Academic Self-Regulation Questionnaire (SRQ-A) (Ryan & Connell, 1989), adapted and translated into French (Blanchard et al., 2013; Leroy, Bressoux, Sarrazin, & Trouilloud, 2013). This is a self-report measurement which assesses individual differences in motivational styles (intrinsic motivation, identified regulation, introjected regulation, external regulation and amotivation). In this framework, intrinsic motivation is defined as the most self-determined form of motivation, where a student engages in a behavior spontaneously, out of interest and enjoyment. Identified regulation, introjected regulation and external regulation are different types of extrinsic motivation, i.e. motivational styles in which a behavior is driven by factors external to the activity itself. Lastly, amotivation refers to the absence of motivation: students perceive no link between a behavior and its outcomes. 12 items from the SRQ-A were present in the grade 9 questionnaire. The items asked students the reasons why they do their homework, work on their classwork and try to do well in school. Each item provides a possible reason that represents a certain motivational style (for example: "I do my classwork because I want to learn new things", or "I do my classwork because I'd be ashamed of myself if it didn't get done"). Each item was answered using a 5-point Likert scale. A principal component analysis on the 12 motivation items in grade 9 yielded a three factors solution (the first three eigenvalues were higher than 1, but not the fourth[2]): the first factor corresponding to intrinsic motivation, the second to amotivation, and the third to extrinsic motivation. We thus created three motivation scores (amotivation, intrinsic motivation, extrinsic motivation) using a confirmatory factor analysis. Internal consistency was average to good for the three indicators (Cronbach's α equal to 0.85 for intrinsic motivation, and 0.68 for extrinsic motivation and amotivation).

2.3. Analyses

2.3.1. Descriptive statistics

Our working sample includes students for whom the RCC score was available in grade 6 and was different from zero ($N = 30{,}489$). We tested the difference in the main outcome variables (academic results, orientation decision in high-school, perceived self-efficacy and motivation) between high-IQ and non-high-IQ students using a *t*-test (for continuous outcomes), a Chi-square test (for categorical outcomes), or Fisher's exact test (for categorical outcomes with less than 5 counts in a given cell), as appropriate. For continuous variables, we estimated the effect size of the difference using Cohen's *d*, which indicates the standardized difference between two means (Cohen, 1988), and we used odds ratio for categorical variables. We also compared the proportion of missing DNB grades between high-IQ and non-high-IQ students (with a Chi-square test). For all group comparisons, we assessed significance with an alpha threshold of $p < .0025$ to take multiple testing into account (Bonferroni corrected threshold for 20 tests).

2.3.2. Regression analyses

We first ran univariate regressions of grade at the DNB examination (in grade 9) on non-verbal IQ score (in grade 6). We ran this model in our entire working sample first and then in our sample of high-IQ students, in order to check whether the positive relationship between non-verbal IQ and achievement that has been widely described in the literature holds for high-IQ students. As a sensitivity analysis, we recalculated this regression at different thresholds for our high-IQ category (top 5% and top 1%).

Further, as additional exploratory analyses, we investigated whether IQ moderated the association between social background and academic achievement, and between sex and academic achievement. It has been argued that gifted children from disadvantaged social and cultural backgrounds could indeed suffer much more from a "negative Pygmalion effect" or lack of family support, and thus be more at risk of underachievement (Terrassier, 2009). In such a case, it may be that high-IQ students' achievement is more related to their socio-economic status (SES) than that of other students, i.e. the interaction term between high-IQ and SES would be positive. This is one possible rendering of the more general hypothesis that high intellectual potential requires good environmental conditions to fully flourish, and therefore that the difference between high-IQ students and others is smaller in a low-SES background. Conversely, one might hypothesize that high IQ buffers against the effects of social disadvantage, which would predict a larger difference between both groups at low SES, and therefore a negative interaction term. Similarly, we explored whether the relation between high IQ and achievement is the same in both sexes, as some have argued that gifted boys may be more vulnerable than gifted girls (Terrassier, 2009). In their sample, Roznowski et al. (2000) had indeed found that the difference in A and B grades reported between girls and boys (in favour of girls in all ability groups) was larger among gifted students than their peers. We investigated these questions by regressing results at the DNB examination on a dummy variable equal to 1 if the student is in the high-IQ group (*High-IQ*), on parental education (*SES*) and on sex (*Girl*, dummy variable equal to 1 if the student is a girl), and on two interaction variables: one between high-IQ and sex *(High-IQ × Sex)*, and one between high-IQ and parental education *(High-IQ × SES)*. We assessed significance with an alpha threshold of $p < .01$ (Bonferroni corrected threshold for 5 tests).

3. Results

3.1. Differences between high-IQ and non-high-IQ students

We first checked whether gifted students showed better academic achievement than other students (Hypothesis a). Academic achievement was assessed with results at the DNB and academic orientation after middle school. Tables 2 and 3 present descriptive statistics for outcome variables. High-IQ students had on average statistically significantly higher scores than others in all DNB subjects (their final grade was higher by 2.6 points out of 20; $p < .0001$). Besides, only 1.66% had an average grade strictly lower than the pass threshold (10 out of 20) – compared to 15.55% among non-high-IQ students (see Table 2 and Fig. 2).

Such higher performance at the DNB exam logically resulted in a higher proportion of high-IQ students continuing to general and technological high school compared to others (89.49% versus 61.76%; $p < .0001$), and a lower proportion being retained in grade 9 (1.56% versus 3.05%, but not statistically significant – $p = .0165$). Guidance decisions at the end of grade 10 indicate that high-IQ students kept on doing well in high school, as 82.91% of students took a general track,

[2] We used both the eigenvalue and the scree plot to decide the number of factors retained: the eigenvalue criterion led to 3 factors (95% confidence intervals for the third and fourth eigenvalue: [1.12;1.15] and [0.67;0.70]) and the scree plot indicated a solution with 4 factors. The 3 factor solution afforded a more coherent interpretation, thus we chose to retain it.

Table 2
Descriptive statistics for grades, self-efficacy and motivation scores in grade 9.

Outcome variable	High-IQ N = 888		Others N = 29,601		Difference High-IQ - Others		
	M	*SD*	*M*	*SD*	*Cohen's d*	95% C.I.	*p*
DNB results (out of 20)							
DNB Examinations	13.13	2.73	10.00	3.19	0.97	[0.91; 1.03]	< 0.0001
DNB Teacher grades	15.11	2.20	12.79	2.72	0.85	[0.79; 0.90]	< 0.0001
DNB Final grade	14.48	2.29	11.88	2.88	0.90	[0.85; 0.96]	< 0.0001
Perceived self-efficacy (factor scores)							
Academic	−0.19	0.89	−0.57	1.05	0.36	[0.30; 0.42]	< 0.0001
Social	−0.06	0.90	0.02	0.95	−0.08	[−0.14; −0.01]	0.0317
Self-regulatory	0.31	0.51	0.17	0.70	0.20	[0.15; 0.26]	< 0.0001
Academic motivation (factor scores)							
Intrinsic motivation	0.22	0.86	−0.01	0.94	0.25	[0.18; 0.31]	< 0.0001
Extrinsic motivation	0.16	0.79	0.00	0.87	0.19	[0.13; 0.26]	< 0.0001
Amotivation	−0.16	0.76	0.00	0.90	−0.18	[−0.24; −0.12]	< 0.0001

Note: Bonferroni corrected threshold for significance is 0.0025.

Table 3
Descriptive statistics for academic orientation after middle school.

Outcome variable	High-IQ		Others		Difference (High-IQ – Others)		
	N	%	*N*	%	*Odds Ratio*	95% C.I.	*p*
Guidance decision at the end of grade 9	771		25,278				
General & technological high school		89.49		61.76	5.28	[4.18; 6.65]	< 0.0001
Vocational high school		7.00		25.05	0.23	[0.17; 0.30]	< 0.0001
Professional diploma (CAP/BEP)		1.24		7.88	0.15	[0.08; 0.27]	< 0.0001
Retention in grade 9		1.56		3.05	0.50	[0.28; 0.89]	0.0165
Work		0.26		0.63	0.41	[0.10; 1.65]	0.2472
Guidance decision at the end of grade 10	708		15,174				
General track		82.91		63.38	2.80	[2.30; 3.42]	< 0.0001
Technological track		11.72		22.24	0.46	[0.37; 0.59]	< 0.0001
Vocational high school		1.55		3.71	0.41	[0.22; 0.75]	0.0027
Professional diploma (CAP/BEP)		0.14		0.70	0.03	[0.03; 1.44]	0.0764
Retention in grade 10		3.53		9.87	0.33	[0.22; 0.50]	< 0.0001
Work		0.14		0.09	1.65	[0.22; 12.63]	0.472

Note: Bonferroni corrected threshold for significance is 0.0025.

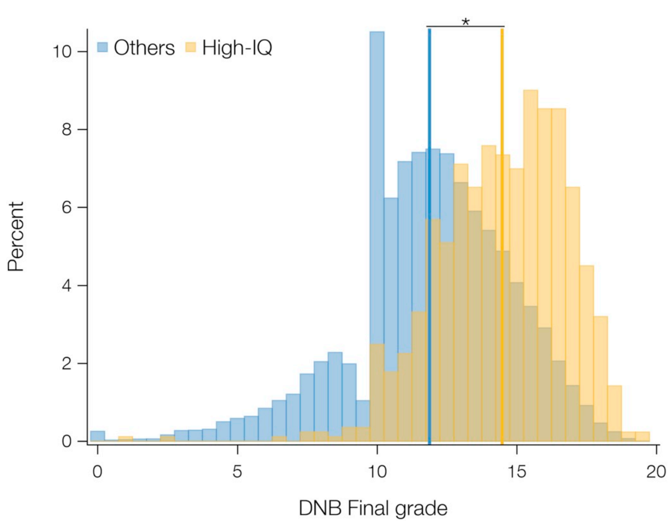

Fig. 2. Distribution of DNB grades for high-IQ and non-high-IQ students. The vertical lines represent the mean self-efficacy score for each group. *$p < 0.0025$ (Bonferroni-corrected threshold).
The odd distribution with a peak at 10 is a well-known consequence of grade adjustments whose purpose is to make more students pass the exam (grade of 10).

compared to 63.38% of students with a non-verbal IQ lower than the 98th percentile ($p < .0001$) (see Table 3). Moreover, it is highly likely that this reported proportion for non-high-IQ students is over-estimated, since the share of missing data for non-high-IQ students is much higher than for high-IQ students for this particular variable (48.74% of missing data for non-high-IQ students versus 20.27% for high-IQ students).

Our second hypothesis was that high-IQ students drop out less frequently from middle school (Hypothesis b). If high-IQ students were at high risk of school failure, it might be that they actually have dropped out from middle school even before reaching grade 9. In that case, DNB results would give positively biased information about high-IQ students' school success. However, only 5.18% of DNB results were missing for high-IQ students compared to 13.78% for others, which is inconsistent with this hypothesis.

Lastly, we had hypothesized that high-IQ students also fare better in terms of perceived self-efficacy and motivation (Hypothesis c). Results show that they indeed had statistically significantly higher levels of perceived academic self-efficacy compared to other students ($d = 0.36$; $p < .0001$), as well as perceived self-regulation ($d = 0.20$; $p < .0001$) (see Table 2 and Fig. 3). However, their level of social self-efficacy was slightly but not statistically significantly lower than others ($d = -0.08$; $p = .0317$). Lastly, they reported statistically significantly higher levels of both intrinsic motivation ($d = 0.25$; $p < .0001$) and extrinsic motivation ($d = 0.19$; $p < .0001$), as well as lower levels of amotivation ($d = -0.18$; $p < .0001$) (see Table 2 and Fig. 4).

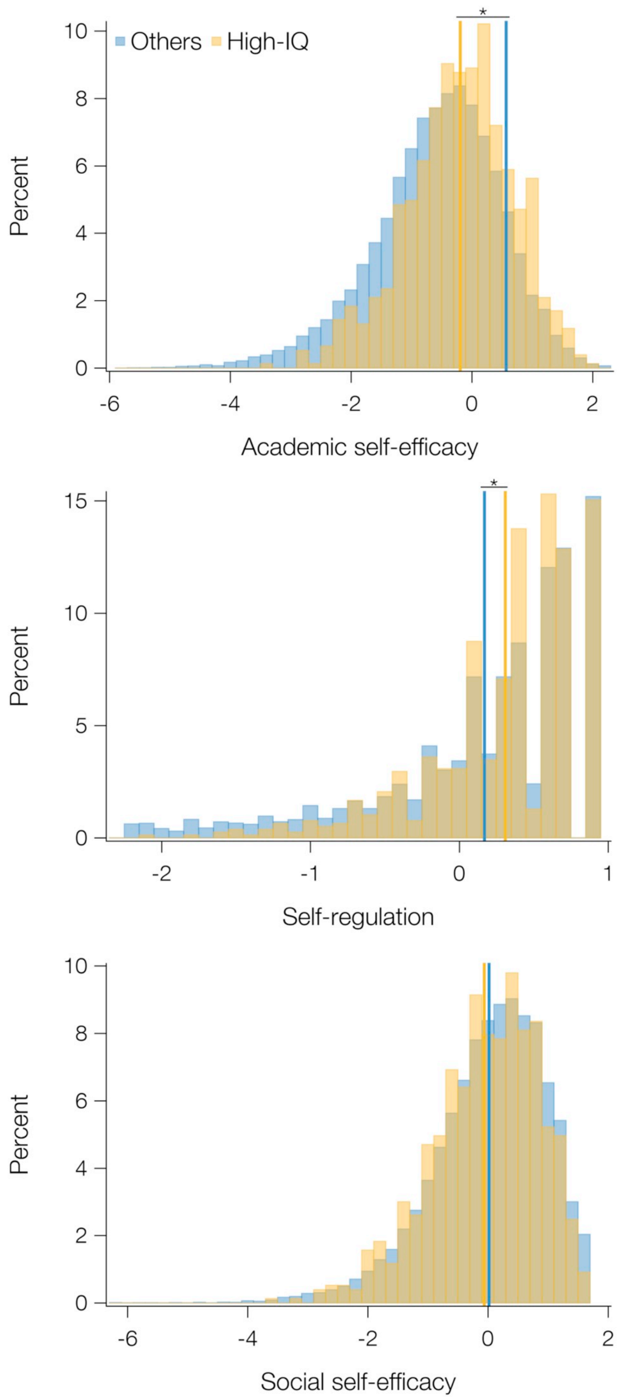

Fig. 3. Distribution of self-efficacy scores in grade 9 for high-IQ and non-High-IQ students. The vertical lines represent the mean self-efficacy scoscore for each group. *$p < 0.0025$ (Bonferroni-corrected threshold).

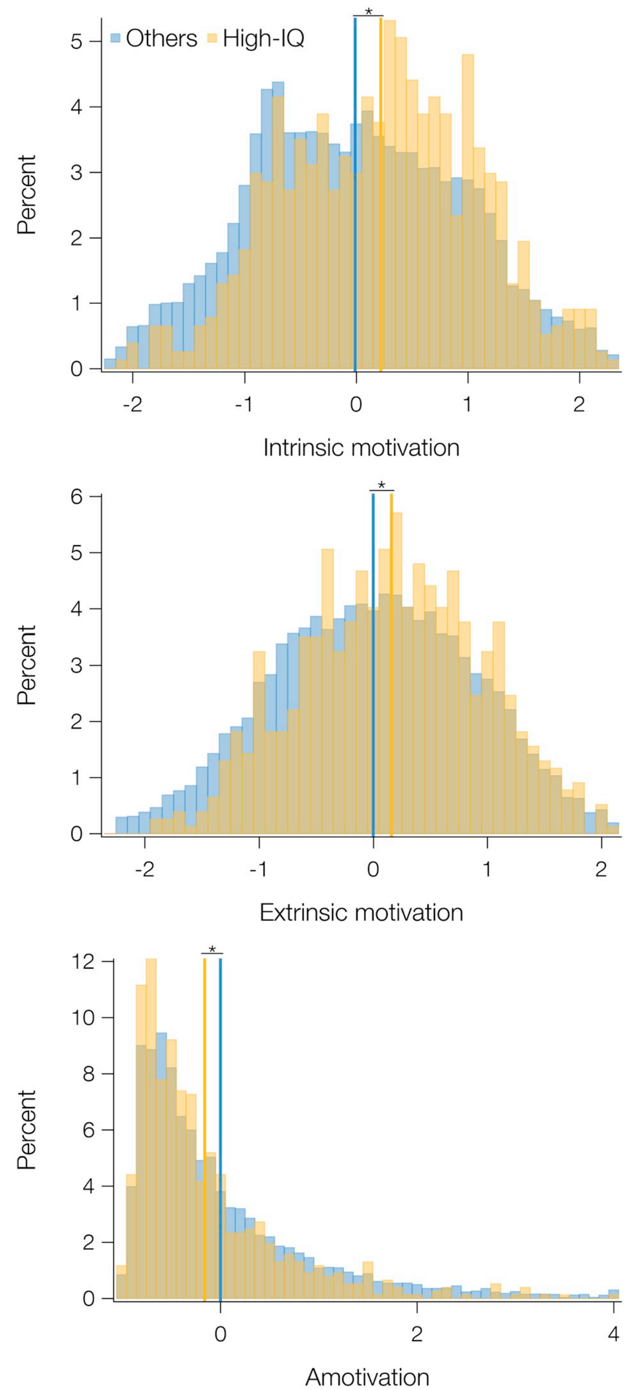

Fig. 4. Distribution of motivation scores in grade 9 for high-IQ and non-high-IQ students. The vertical lines represent the mean motivation score for each group. *$p < 0.0025$ (Bonferroni-corrected threshold).

3.2. Relationship between IQ and school performance

In a second step, we tested the hypotheses that there is a positive relationship between IQ in grade 6 and achievement in grade 9 (Hypothesis d), and that this relationship holds equally in high-IQ students and in the general population (Hypothesis e). Fluid intelligence measured in grade 6 positively predicted results at the DNB in grade 9 among high-IQ students ($\beta = 0.11$, $p = .0058$) as well as in the whole population ($\beta = 0.10$, $p < .0001$, illustrated in Fig. 5). This result was unchanged when we included as high-IQ all students with non-verbal IQ scores higher than the 95th percentile (top 5%, $N = 1602$): the regression coefficient was still positive and statistically significant ($\beta = 0.15$ with $p < .0001$). However, when we increased the threshold of high-IQ to the top 1% of the non-verbal IQ distribution ($N = 435$), the model yielded a still positive but not statistically significant regression coefficient for non-verbal IQ ($\beta = 0.09$ with $p = .1887$), which may result from restriction of range and the smaller number of high-IQ students in the top 1%.[3]

[3] Our aim in this section was not particularly to examine whether the relationship between IQ and achievement was non-linear, but rather to examine whether the well-established linear relationship (also observed here), remains

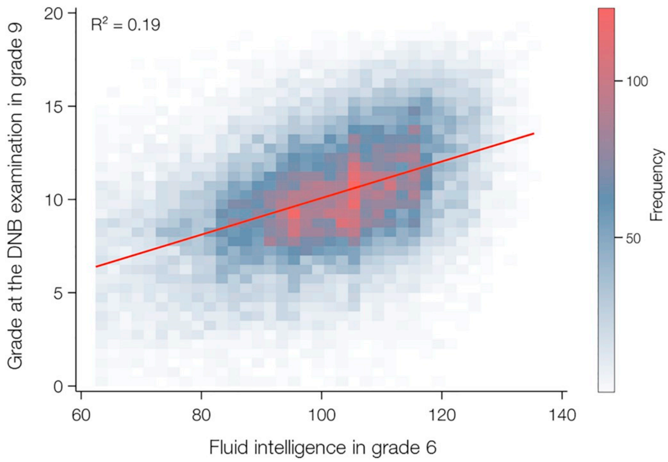

Fig. 5. Relationship between fluid intelligence and results at the DNB Examination in the whole population.

3.3. Interactions between high-IQ, parental education and sex

Finally, we explored potential interactions between high IQ, sex and parental education. Table 4 presents the results of the regression of DNB Examination Grade (range: 0–20) on high-IQ status, sex and parental education (henceforth, SES). Model 1 only includes main effects of these three variables, whereas Model 2 includes interactions between high-IQ and sex, and high-IQ and SES. Model 1 shows that DNB grade is positively associated with high-IQ, but also with being a girl and with parental education. In Model 2, the coefficient of the interaction parameter *High-IQ*SES* indicates the difference in DNB results associated with one additional year of parental education between high-IQ students and others. Results show that this difference is negative ($\beta = -0.11$, $p = .0002$), thus suggesting that high-IQ students' performance is less related to social background than their peers' (see Fig. 6). Hence it does not seem to be the case that a low-educated family environment is more detrimental to high-IQ's performance than others'. There was no statistically significant interaction between high-IQ and sex ($p = .5742$), suggesting that the relationship between high-IQ and achievement is the same in both sexes: girls do not seem to outperform boys more among high-IQ students than among non-high-IQ students. However, it is worth noting that including the interactions in the regression only increased the R^2 by 0.04%: there was no practical gain in explained variance.

4. Discussion

This paper aimed at assessing the differences in various school success measures between high-IQ (top 2% of non-verbal IQ distribution) and non-high-IQ students in a large representative sample of French middle school students. Our results supported the hypotheses that gifted students achieve higher academic results than other students (Hypothesis a) and drop out less (Hypothesis b), thus replicating findings from the previous literature on gifted students (Lubinski & Benbow, 2006; Roznowski et al., 2000; Terman, 1926c), and extending them to a large sample of French students from the general population. We also hypothesized that high-IQ students show higher scores in measures of self-efficacy and motivation (Hypothesis c), which was also

(*footnote continued*)
the same in the high-IQ range. However, for interested readers, the fit of the linear regression model with DNB as dependent variable and IQ (continuous) as independent variable ($R^2 = 0.194$) was very similar to the fit of a model with an additional quadratic term ($R^2 = 0.196$), and with both quadratic and cubic terms ($R^2 = 0.196$). The nonlinearity of the relationship is thus very weak.

Table 4
Regression of DNB examination grade (range: 0–20) on high-IQ, sex and parental education (SES).

Predictors	Model 1 $R^2 = 0.2271$		Model 2 $R^2 = 0.2275$	
	β (SD)	*p*	*β (SD)*	*p*
High-IQ	2.45 (0.09)	< 0.0001	3.86 (0.43)	< 0.0001
Girl	0.46 (0.04)	< 0.0001	0.46 (0.03)	< 0.0001
SES	0.41 (0.01)	< 0.0001	0.42 (0.01)	< 0.0001
High-IQ*Girl			0.10 (0.18)	0.5742
High-IQ*SES			−0.11 (0.03)	0.0002

Note: Bonferroni corrected threshold for significance is 0.01.

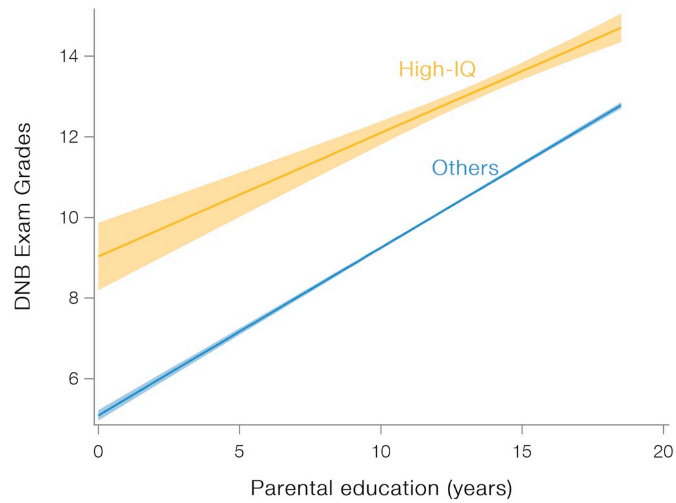

Fig. 6. Interaction effect between High-IQ and Parental Education on DNB Exam Grades. Linear fit and 95% confidence bands from the regression of DNB examination grades on parental education, high-IQ status, and their interaction term.

validated in our data: high-IQ students had higher levels of academic self-efficacy and self-regulatory self-efficacy – however, their social self-efficacy was not statistically significantly different from the non-high-IQ sample. They also showed higher levels of intrinsic motivation, extrinsic motivation, and lower levels of amotivation. These results are consistent with Roznowski et al. (2000) and with Calero, García-Martín, Jiménez, Kazén, and Araque (2007), who had found that gifted children have better self-regulatory abilities than a comparable group of non-gifted children. McCoach and Siegle (2003) also reported higher academic self-perceptions in a gifted student sample compared to a general school sample.

Lastly, we hypothesized that there is a positive relationship between IQ in grade 6 and achievement in grade 9 (Hypothesis d), and that this relationship holds equally in high-IQ students and in the general population (Hypothesis e). In agreement with the past literature (Deary et al., 2007; Roth et al., 2015), we found a statistically significant positive relationship between non-verbal IQ in grade 6 and academic performance in grade 9 in the whole sample. This well-established link remained when the analysis was restricted to high-IQ students (thresholds of 2% and 5%). Furthermore, not only did the positive relationship remain, but the regression coefficient barely changed when applying different high-IQ thresholds.

As an exploratory analysis, we finally explored possible interactions between high-IQ, social background and sex. Our results suggest that academic performance is less related to social background (as measured by parental education) for high-IQ students than for their peers. Hence it does not seem to be the case that a low-educated family environment is more detrimental to high-IQ students' performance than others'. On the contrary, our results support the hypothesis that high IQ buffers against the effect of low SES on achievement. The positive association between high IQ and achievement was similar for boys and girls. However, adding these interactions did not increase the explained variance in school performance, suggesting that their effects are without practical significance.

Overall, these results argue against the beliefs that high-IQ students are particularly at risk of school failure. This popular opinion originates from personal accounts (of failing gifted students) or from clinicians, who commonly see gifted children referred to child psychiatry services for various problems including school underachievement (Grobman, 2006; Guénolé et al., 2013). Obvious sampling biases are inherent to clinical practice and may have contributed to spreading stereotypes regarding school failure but also psychological difficulties (Peyre et al., 2016) in gifted children. It is possible that such beliefs remain prevalent due to a lack of research based on representative populations – especially in France. The present paper intended to fill this gap, and showed that these beliefs are not supported by evidence in the French middle school context.

Thus, high-IQ children seem to be very successful in the French school environment: they earn much better grades (by about one standard deviation) at the final grade 9 national exam, and are at much lower risk of grade retention, orientation in a professional track and school drop-out. This does not imply that all of them are successful: some are not, and those ones deserve close attention, as do all pupils who do not succeed well in school. Our results do not imply either that the French education system is optimally suited to the needs of high-IQ children: they might succeed even better, or more happily, if their educational needs were better met. However, the data collected in the present study do not address the question of how to further improve the education of high-IQ children. It simply suggests that there is no major school failure problem to tackle concerning this group, and provides no basis for the necessity of a systematic screening of intellectually gifted children, as sometimes urged by associations.

4.1. Limitations

A potential limitation of our study comes from the fact that general intelligence was assessed through only one test measuring fluid intelligence (Chartier's Reasoning Test on Playing Cards). This led us to use one particular definition of giftedness, which relied exclusively on non-verbal intelligence. No measure of verbal intelligence was available in the data from the DEPP Panel 2007, therefore we could not compute a composite score more comparable to full scale IQ. However, we see no reason to suspect that the results might have differed if a measure of verbal intelligence had been included. Indeed, including verbal intelligence should only affect our results if it affects school performance differently among non-high-IQ and high-IQ students. We do not see any reason why this should be the case.

Another limitation linked to our measure of IQ is its low stakes: students were not rewarded for performing well on it, and it was the last test in the battery. Previous research has suggested that motivation in low-stakes IQ test could be an important issue for the interpretation of the results. Compared with a rewarded condition, low-stakes would decrease IQ scores, and would do so to a larger extent for individuals with the lowest intelligence (Duckworth, Quinn, Lynam, Loeber, & Stouthamer-Loeber, 2011). However, the evidence is mixed, as other papers have pointed towards a positive effect of rewards on the level of effort, but that is not reflected in the IQ scores obtained (Borghans, Golsteyn, Heckman, & Humphries, 2016; Gignac, 2018). In our study, Duckworth et al. (2011)'s results could imply that we may be missing some gifted but unmotivated students in the high IQ group. Such unmotivated gifted students would be more at risk of school failure, so we might be underestimating the phenomenon. However, since the effect of motivation affects more students with low IQ, this would imply that many more students in the non-high-IQ group have their IQ underestimated. Such students should nevertheless have obtained higher DNB results than expected from their underestimated IQ. Therefore, the potential confounding effect of motivation could have been to inflate DNB results of our non-high-IQ group, thus reducing the difference between high-IQ students and their peers. Hence, if anything, the effect sizes would be underestimated. Furthermore, scores at our non-verbal IQ test were very weakly correlated with scores of intrinsic motivation, extrinsic motivation, and amotivation.[4] It is likely that these motivation scores are associated to some degree with motivation to take the RCC. If this is indeed the case, then the low correlations between RCC scores and motivation scores suggest that it is implausible that our non-verbal IQ scores are confounded with motivation.

A third limitation may be that the DNB final grade, which was the main variable with which we assessed school success, followed an odd distribution: there was a peak at 10 due to grades harmonization carried out by a jury, and this peak was much more marked for non-high-IQ students than for high-IQ students. Thus, the final results of the non-high-IQ students were artificially inflated compared to those of the high-IQ students, which means that the difference between the two groups was under-estimated. However, this bias does not affect our conclusion that high-IQ students perform better than others and are less at risk of school failure (i.e. obtaining less than 10).

Lastly, our sample slightly over-represented students from schools in disadvantaged areas (*Réseau Ambition Réussite*), in which non-high-IQ students were schooled more than high-IQ students. However, correcting for this slight over-representation by using survey weights did not change our results.

4.2. Conclusion

Data from the French Depp Panel 2007 do not support the widespread belief that students with high IQ are more at risk of school failure than their peers. On the contrary, our study replicated previous findings in US samples showing that they perform better than their classmates. This result was corroborated by higher levels of motivation and self-efficacy among high-IQ students.

Acknowledgements

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[4] The correlation between fluid IQ and intrinsic motivation was equal to 0.05, that between IQ and extrinsic motivation was equal to 0.03, and that between IQ and amotivation was equal to −0.07.

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