Intelligence xxx (xxxx) xxx–xxx

Contents lists available at ScienceDirect

Intelligence

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

Einstein and dyslexia: Is giftedness more frequent in children with a specific learning disorder than in typically developing children?

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ARTICLE INFO

Keywords:
Specific learning disorder
Intelligence
Giftedness
WISC-IV
Dyslexia

ABSTRACT

It has been argued that there may be a higher proportion of exceptional intelligence profiles and giftedness among children with learning disorders (LD) than among typically developing (TD) children, but this impression is only based on anecdotal evidence concerning famous individuals. In a large dataset of 1413 intellectual profiles of children with a diagnosis of LD (assessed with the WISC-IV scale), the proportion of children with an overall intelligence quotient higher than 130 was < 1%, well below the proportion expected in the typical population (2.28%). It has been claimed, however, that the WISC-IV general ability index (GAI) may better represent the central aspects of intelligence, particularly in the case of children with LD, and using the GAI criterion, the gifted children amounted to 3.75% of the LD population analyzed. Aspects relating to working memory and processing speed, as measured by the WISC-IV, were also examined, and gifted children with LD had higher scores in both components than the other children with LD, but lower scores than equally "gifted" TD children. The various aspects of intelligence revealed significantly different age-related growth trajectories: at a younger age, gifted children with LD resembled gifted TD children in terms of working memory phonological aspects, but the former fell behind the latter as they grew older; the opposite was true of the processing speed aspects of intelligence.

1. Introduction

Students who are gifted intellectually but have a learning disability (labeled here as G/LD) have been defined as "twice-exceptional" (Assouline, Nicpon, & Whiteman, 2010) and cited as examples of a specific learning disorder (LD) often associated with genius. The relationship between LD and intelligence has led to puzzling, often contrasting conclusions, however. It has been argued that children with academic difficulties are often particularly intelligent. This opinion stems from certain popular books, often based on anecdotal evidence or partial information, such as the notion that famous individuals renowned for their intelligence - Leonardo da Vinci and Einstein, for example - suffered from LD (Aaron, Phillips, & Larsen, 1988; Sartori, 1987). There has also been speculation that superior intelligence and LD might coexist as a consequence of some common brain abnormality (Webb, 2000). On the other hand, some authors have suggested that students with learning difficulties are less intelligent (e.g. Spearman, 1904), meaning that cases of G/LD are extremely rare; this would support the use commonly made nowadays of achievement measures to infer children's intellectual levels (Lynn, 2010).

To our knowledge, the frequency of occurrence, and the specificity of the intellectual profile of G/LD has yet to be studied systematically so far, as research on G/LD individuals has focused mainly on the related diagnostic and treatment practices (e.g. Lovett, 2011; Lovett & Lewandowski, 2006). To investigate the issue more methodically, we took advantage of a large dataset of 1413 children diagnosed with LD who had been assessed using the Wechsler Intelligence Scale for Children-IV (WISC-IV; Wechsler, 2003), and whose intellectual level had been examined. As a first step, we considered their IQ. An overall IQ of 125 has sometimes been considered as a cut-off for defining a child as "gifted" (e.g. Assouline et al., 2010), while other researchers have proposed an IQ of 130 or more (i.e. at least two standard deviations above the population average). Given the large size of our sample population, we scored them on intelligence adopting the more conservative cut-off, i.e. an IQ of 130 or more.

Considering a general IQ poses some problems in the case of LD, however, because the intellectual profiles of children with LD are characterized by a marked internal heterogeneity (e.g. Cornoldi, Giofrè, Orsini, & Pezzuti, 2014; Poletti, 2016; Toffalini, Giofrè, & Cornoldi, 2017). The WISC-IV, which is currently the most widely used battery

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http://dx.doi.org/10.1016/j.intell.2017.04.006
Received 20 January 2017; Received in revised form 2 March 2017; Accepted 11 April 2017

for assessing intelligence in children (Evers et al., 2012), has the advantage of enabling intelligence to be measured both as a general construct and considering specific aspects of intelligence and generating different factor scores that seem particularly appropriate in the case of LD. In fact, using the WISC-IV has shown that some components of intelligence – namely working memory (WM) and processing speed (PS) – are not only globally weaker in children with LD, they are also more weakly related to a central measure of intelligence than in the typically developing (TD) population (Giofrè & Cornoldi, 2015). It has therefore been suggested that the overall intellectual functioning of children with LD could be measured better by means of a general ability index (GAI), comprising only verbal comprehension (VC) and perceptual reasoning (PR), instead of considering their full-scale IQ (Saklofske, Prifitera, Weiss, Rolfhus, & Zhu, 2005). In fact, the GAI differs from the full-scale IQ (FSIQ) in that it does not include WM and PS. As a second step, we therefore considered children with a GAI higher than 130: the percentage was expected to remain the same as for the FSIQ in the case of TD children, but not in the case of children with LD.

Finally, as a third step, we considered the pattern of weaknesses in the children with LD and a GAI higher than 130. There are reports of a verbal WM deficit being strongly associated with LD (e.g. Giofrè & Cornoldi, 2015), so it is highly likely that the same applies to G/LD children of all ages. Such children's PS impairment has been less emphasized, and this might be partly due to an early weakness associated with schooling, or the problem may be partly overcome as the children grow older thanks to their very good cognitive resources.

2. Method

2.1. Participants

We analyzed the WISC-IV intellectual profiles of 1413 children, which were collected under the sponsorship of the Italian Association for Learning Disabilities (AIRIPA). The data, including the weighted scores in the 10 basic subtests, were provided by 27 licensed psychologists with expertise in LD assessment and treatment, working in 8 major Italian regions. A subset of these data was the object of previously-published articles (Giofrè & Cornoldi, 2015; Giofrè, Toffalini, Altoè, & Cornoldi, 2017; Toffalini et al., 2017), in which the issue of giftedness was never examined. A diagnosis of LD was based on the ICD-10 International Coding System (World Health Organization, 1992), category F81 (specific developmental disorders of scholastic skills). The National Italian Consensus Conference on Specific Learning Disorder (Istituto Superiore di Sanità, 2011) requires: (i) an academic achievement below the 5th percentile, or 2 SDs below average in at least one specific academic area (reading, writing, arithmetic), when assessed using relevant standardized tests; and (ii) no better explanation for the impairment relating to socio-cultural, educational, emotional, intellectual, sensory and neurological problems. Following the recommendations of the DSM-5 (Diagnostic and Statistical Manual of Mental Disorders, 5th edition; American Psychiatric Association, 2013), the discrepancy IQ-achievement was not considered in the diagnosis of LD. Cases with comorbid neuropsychological disorders (e.g. attention-deficit hyperactivity disorder, developmental coordination disorder) were excluded a priori. The age of the children with LD ranged from 7 to 16 years (M age = 11.48 [SD = 2.44]; 63% males).

For the TD children, we considered the WISC-IV Italian standardization sample of 2200 children (age range 6–16 years) reported in the manual (Orsini, Pezzuti, & Picone, 2012), which included no children with a diagnosis of LD.

2.2. Instrument

The Italian adaptation of the WISC-IV was used (Orsini et al., 2012). Based on the weighted scores obtained in the 10 WISC-IV basic subtests, we calculated the FSIQ, the GAI, and the four factorial indexes indicated in the Manual (Orsini et al., 2012), and in subsequently published instructions (Orsini & Pezzuti, 2014).

3. Results

A first analysis was conducted on the frequencies of cases with a FSIQ higher than 130. As intelligence is believed to follow a normal distribution, 2.28% of the population should exceed a FSIQ of 130; and the same applies for the GAI. In actual fact, 42 of the 2200 TD children had a FSIQ ≥ 130, i.e. 1.91%, a percentage slightly but not significantly lower than expected, according to the binomial test, $p = 0.28$. On the contrary only 10 of the 1413 children with LD had a FSIQ ≥ 130, i.e. 0.71%, a proportion considerably and significantly below both the expected percentage from the theoretical distribution, and the percentage in TD children, according to the binomial test, both $ps < 0.001$.

The situation changed when, in a second step, GAI was considered instead of FSIQ as the measure of intellectual ability. Forty of the 2200 TD children had a GAI ≥ 130, which amounts to 1.82%, a figure not significantly different from the theoretical percentage, $p = 0.17$. But 53 of the 1413 children with LD had a GAI ≥ 130, i.e. 3.75%, more than double the proportion of TD children, with a difference that was statistically significant, $p < 0.001$; this proportion was also significantly higher than expected from the theoretical distribution, according to the binomial test, $p < 0.001$. Of these 53 children with LD and high GAI, 16 had reading disorder, i.e. 5.06% of the children diagnosed as F81.0; four had spelling disorder, i.e. 2.65% of children diagnosed as F81.1; four had specific disorder of arithmetical skills, i.e. 4.17% of children diagnosed as F81.2; nine had mixed disorder of the scholastic skills, i.e. 1.78% of children diagnosed as F81.3; and 20 were in the remainder of the F81 category, i.e. 5.81% of children diagnosed as F81.8, F81.9 or with multiple diagnoses.

Table 1 contains demographic details and descriptive statistics concerning the WISC-IV measures for the two subsamples of TD and LD children with a GAI higher than 130, and for the remainder of the children with LD whose GAI was within normal range (i.e. 85 ≤ GAI ≤ 115), who amounted to 1020 children. The three groups clearly reveal some differences. In particular children with a diagnosis of LD were slightly younger than TD children; furthermore, there was a higher proportion of males in both LD groups – and in particular in the

Table 1
Demographic data and descriptive statistics (means and standard deviations) for G/LD, G/TD, and normal LD children.

	G/LD	G/TD	normal LD
N (% in their sample)	53 (3.75%)	40 (1.82%)	1020 (72.19%)
Age (in months)	136.77 (26.16)	144.35 (39.74)	137.73 (29.53)
% males	74%	35%	62%
General Ability Index (GAI)	135.79 (4.39)	134.98 (3.61)	101.06 (8.21)
Full Scale IQ	124.00 (6.96)	132.75 (5.98)	95.69 (8.73)
Factor indexes			
Verbal Comprehension index	133.06 (7.40)	131.55 (5.23)	100.27 (10.89)
Perceptual Reasoning index	130.00 (7.51)	130.23 (5.48)	101.78 (11.08)
Working Memory index	99.47 (10.90)	118.53 (12.99)	89.32 (12.52)
Processing Speed index	98.79 (15.25)	113.20 (12.84)	92.22 (14.08)
Subtests			
Similarities	15.79 (1.97)	15.35 (1.53)	9.75 (2.28)
Vocabulary	15.19 (2.07)	15.50 (1.47)	9.94 (2.37)
Comprehension	15.87 (1.88)	14.93 (1.80)	10.46 (2.82)
Block design	14.19 (2.82)	14.18 (2.07)	9.99 (2.37)
Visual puzzels	14.74 (2.10)	14.70 (1.67)	10.62 (2.64)
Matrix reasoning	14.85 (2.11)	15.15 (1.79)	10.26 (2.65)
Digit span	9.70 (2.79)	12.78 (2.54)	7.98 (2.41)
Letter-number seq.	10.15 (1.60)	13.40 (2.72)	8.43 (2.49)
Coding	9.42 (3.59)	12.20 (2.76)	8.26 (2.88)
Symbol search	10.54 (2.87)	12.48 (2.49)	9.10 (2.73)