DOI: 10.26387/bpa.284.1

Relation between parents' education and sons' intellectual profile on Wechsler Intelligence Scale for Children – Fourth Edition

Lina Pezzuti, Morena Farese, James Dawe

Department of Dynamic and Clinical Psychology Sapienza University of Rome

lina.pezzuti@uniroma1.it

ABSTRACT. Rispetto ad altre variabili demografiche molti autori hanno sottolineato l'importanza dell'istruzione dei genitori come miglior predittore delle prestazioni intellettive dei figli ed un fattore importante per il loro sviluppo cognitivo. Sono stati studiati i profili intellettivi alla WISC-IV di 2200 bambini e adolescenti tra i 6 e i 16 anni classificati in base al livello di istruzione dei genitori. In linea con la letteratura, i risultati mostrano differenze significative tra i subtest e gli indici. Più in particolare, i bambini i cui genitori hanno conseguito un titolo di studio universitario, hanno ottenuto prestazioni significativamente più elevate rispetto ad altri gruppi in quasi tutti i subtest dell'Indice di Comprensione Verbale della WISC-IV, seguiti dai bambini i cui genitori hanno un titolo di scuola superiore. Emergono risultati simili per il QI totale e l'Indice di Abilità Generale.

SUMMARY. Many authors have highlighted the importance of parents' education as a better predictor of intellectual achievement and an important factor for the cognitive development of the child compared with other demographic variables. The presence of significant differences across the intellectual WISC-IV profiles of 2,200 children and adolescents between 6 and 16 years classified according to their parents' education was investigated. In line with the literature, our results show significant differences between subtests and indexes. We observed that children, whose parents have university degrees, obtained significantly higher performance compared with other groups in all subtests and indexes of the WISC-IV, followed by the children whose parents have high school degrees. We obtain similar results for Full Scale IQ, General Ability Index, and Cognitive Proficiency Index.

Keywords: *WISC-IV, Parents' education, Intelligence, Children, Adolescents*

INTRODUCTION

The study of demographic variables effects on intellectual performances have always aroused interest in researchers. In particular, for the gender effect there are reports showing a small average sex difference in general intelligence (*g*) favoring men (e.g. Irwing, 2012; Nyborg, 2003); however, there are many also reports finding a null or negligible sex difference in *g* (e.g. Colom, Garcìa, Juan-Espinosa & Abad, 2002; Colom, Juan-Espinosa, Abad & Garcìa, 2000; Dolan et al., 2006; Jensen, 1998; Pezzuti & Orsini, 2016; Saggino et al., 2014; Tommasi et al., 2015). Again, it is widely acknowledged that differences in educational level are related with cognitive performance differences (e.g. Dolan et al., 2006; Gustafsson, 2001; Tommasi et al., 2015).

Then, the relationship between socio-economic status (SES) and cognitive development continues to receive special attention from researchers. In a recent study on the relationship between socio-economic factors and brain morphometry, Noble and colleagues (2015) found that parents' education and family income are associated with changes in the structural development of brain regions designed to language, executive functions and memory, all functions closely associated with intellectual functioning. Similar brain regions also have been linked with performance on intelligence tasks (e.g., Ebisch et al., 2012; Ebisch et al., 2013). Many authors (Brooks, 2011; Cianci, Orsini, Hulbert & Pezzuti, 2013; Craig, 2006; Meekes et al., 2015; Mercy & Steelman, 1982; Rindermann & Baumeister, 2015; Scarr & Weinberg, 1978;) have highlighted the importance of parents' education as a better predictor of intellectual achievement and important factor for the cognitive development of the child compared with other demographic variables. In particular, these authors observe that parents' education represent an indicator of parental IQ and reflect environmental and genetic factors, among which parents' cognitive abilities and their educational behavior, which influence directly and indirectly children development. Parents with high educational level may offer more educational and cultural inputs and a model of intellectual ability, determination and motivation to succeed (Brooks-Gunn, Han & Waldfogel, 2002).

However, the influence exerted by each of these factors varies with the phase of development of the person. The literature suggests that in the transition from childhood to adolescence the individual's cognitive development is most influenced by the environmental factor than the transition from adolescence to adulthood, when the influence on the cognitive development of the person is almost completely exercised by the genetic factor (Clarke-Stewart, Perlmutter & Friedman, 1988; Johnson, 2010; Sellers, Burns & Guyrke, 1996; Vanderploeg, Schinka, Baum, Tremont & Mittenberg, 1998). Again, an Italian study (Balsamo, Romanelli & Saggino, 2010) about elderly people showed that cognitive abilities differentiate from adolescence to adulthood and then this process is reversed in later adulthood.

Furthermore, in their work on clinical use and interpretation of the WISC-IV, Prifitera, Saklofske and Weiss (2005) cite numerous studies that observed the existence of the relationship between IQ and SES. The authors argue that parents' education is a good measure of SES and find that children with parents who have at least a university degree achieved an IQ score significantly higher than all the others with parents who have a lower level of education. Similarly, using the WISC-IV U.S. standardization sample. Brooks (2010) finds a relationship between low scores on the WISC-IV and fewer years of parental education. Subsequently, he also observes similar findings in the study conducted on Canadian Standardization of WISC-IV (Brooks, 2011).

The aim of the present was to examine the relationship between the parental education level on the WISC-IV intellectual profile (subtest scores, four indexes, Full Scale Intelligent Quotient, and two optional WISC-IV Index scores) of the Italian standardization sample (Orsini, Pezzuti & Picone, 2012). In particular, the aim was to study if these influences are the same on all cognitive abilities measured by WISC-IV.

METHOD

Participants

The normative sample of the Italian standardization of Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV; Wechsler, 2003; Orsini et al., 2012) was used. This sample comprises of 2200 children and adolescents between 6 and 16 years classified in 11 groups according to their age year.

Instrument

We used the Italian adaptation of the WISC-IV (Orsini et al., 2012) that retains the Full Scale IQ and the four main factor indexes, and also includes the two additional indexes (GAI

and CPI). Judging from the WISC-IV Italian test manual, internal consistencies, standard errors of measurement and reliability are comparable with those of the English version (Wechsler, 2003).

For the purposes of the present study, we examined the scores obtained in the 10 core subtest (*Block Design, Similarities, Digit Span, Picture Concepts, Coding, Vocabulary, Letter-Number Sequencing, Matrix Reasoning, Comprehension, Symbol Search*), and 5 supplemental subtests (*Picture Completion, Cancellation, Information, Arithmetic and Word Reasoning*) of the WISC-IV.

We calculated the Full Scale IQ (FSIQ) from the sum of the 10 subtests, and the 4 core factor indexes: the Perceptual Reasoning Index (PRI), which includes *Block Design, Picture Concepts* and *Matrix Reasoning*; the Verbal Comprehension Index (VCI), including *Similarities, Vocabulary* and *Comprehension*; the Working Memory Index (WMI) including *Digit Span* and *Letter-Number Sequencing*; and the Processing Speed Index (PSI) including *Coding* and *Symbol Search*. We then calculated the scores for the two additional indexes: the GAI, obtained from the VCI and the PRI; and the CPI, obtained from the WMI and the PSI. Additional information on the subtests, main factor indexes and additional indexes are available elsewhere (Flanagan & Kaufman, 2004; Orsini & Pezzuti, 2014, 2016; Wechsler, 2003).

Procedure

In the present study, we considered as independent variables age and parental education, and as dependent variables the 15 subtest scaled scores, the Full Scale Intelligence Quotient (FSIQ), the four main indexes of Verbal Comprehension Index (VCI), Perceptual Reasoning Index (PRI), Working Memory Index (WMI) and Processing Speed Index (PSI) and the two additional indexes of General Ability Index (GAI) and Cognitive Proficiency Index (CPI).

For age variable we considered the classification used in the WISC-IV Italian version, and for parental education variable we divided the sample into four groups (groups-edu), according to the level of parental education and Italian scholastic system: elementary school, middle school, high school and academic degree. Individuals classified into the four groups-edu according to the highest level of education achieved by either parent, in line with the findings in Scarr and Weinberg (1978) and Cianci et al. (2013), which show that parental education is a good predictor regardless of parental gender.

To compare the performance of individuals in the subtests, indexes, FSIQ, GAI and CPI by both parental education and age group, the data are analyzed through a series of MANOVAs and ANOVAs using SPSS-20 software. Effect sizes were also calculated using Eta-squared, considering effect sizes of Eta-squared of .01 as "small", those arounds .06 as "medium" and those exceeding .14 as "large" effect.

RESULTS

The MANOVA for the 15 WISC-IV subtests shows that highest parental education is a significant factor ($F_{(45, 6422)} = 8.99$; $p<.0001$; $\eta^2 = .06$) while age is not significant ($F_{(150,\ 21402)} = .88$; $p = .8500$; $\eta^2 = .01$) neither interaction between parental education and age ($F_{(450,\ 32102)} = 1.11$; $p = .0510$; $\eta^2 = .01$). So, a second MANOVA was performed, only with parents' education as an independent variable resulted significant ($F_{(45, 6542)} = 9.62$; $p<.01$; $\eta^2 = .06$). Table 1 shows the univariate comparisons results (ANOVAs) with the means, standard deviation (*SD*), differences maximum–minimum between the means, F, *p*, and effect size (η^2) for all scores obtained in each subtest, by the highest level of education achieved by either parent.

By post-hoc comparisons (with Sheffè-method), the subtest most influenced by the parents' education, with a large effect ($\eta^2 = .13$), is *Vocabulary*, and there are statistical significant differences across different parental education groups. Others subtests influenced by parents' education are: *Similarities* ($\eta^2 = .10$), *Information* ($\eta^2 = .10$), *Comprehension* ($\eta^2 = .06$) and *Word Reasoning* ($\eta^2 = .06$). Also for these subtest, the significant difference is between each pair of parent's education levels; these subtests belong all to the Verbal Comprehension Index. *Coding* is the subtest less influenced by the parents' education ($\eta^2 = .01$) showing a significant difference only between the middle school parental education group and the two groups of parents with the highest educational level (high school and academic degree).

If we observe the differences between maximum and minimum means of subtests we note that they may be between 3-4 scaled scores (i.e. *Similarities, Vocabulary, Information* subtest), then 1 standard deviation of scaled scores.

Subsequently, a MANOVA was carried out with 11 groups-age and 4 parental educational groups as independent variables on the four indexes as dependent variables, from

Table 1 – Univariate comparisons: subtest × group-edu

Subtest	Parental education level								
	[1] n = 80	[2] n = 604	[3] n = 1070	[4] n = 446	Difference max-min of means	$F_{(3,2196)}$	p	η^2	Sig. post-hoc (Scheffè)
	M (SD)	M (SD)	M (SD)	M (SD)					
Block Design	9.28(3.05)	9.42(2.80)	10.13(2.90)	10.80(3.11)	1.5	21.28	.0001	.03	[1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Similarities	7.99(2.74)	8.85(2.77)	10.26(2.87)	11.38(2.80)	3.4	85.39	.0001	.10	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Digit Span	9.29(2.86)	9.35(2.97)	10.07(2.94)	10.88(2.78)	1.6	25.34	.0001	.03	[1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Picture Concepts	9.25(3.18)	9.39(2.88)	10.14(2.95)	10.85(3.03)	1.6	23.25	.0001	.03	[1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Coding	9.76(3.02)	9.57(2.96)	10.10(3.00)	10.40(2.95)	.8	7.43	.0001	.01	[2]<[3]; [2]<[4];
Vocabulary	7.59(2.59)	8.74(2.58)	10.21(2.91)	11.54(2.80)	3.9	108.05	.0001	.13	[1]<[2]; [1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Letter-Number Sequencing	8.55(2.61)	9.45(2.85)	10.09(2.94)	10.88(2.90)	2.3	27.78	.0001	.04	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Matrix Reasoning	8.75(3.03)	9.28(2.85)	10.12(2.95)	11.08(2.89)	2.3	35.83	.0001	.05	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Comprehension	8.61(2.55)	9.17(2.80)	10.12(2.95)	11.08(2.89)	2.5	44.26	.0001	.06	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Symbol Search	9.45(2.68)	9.46(2.81)	10.14(3.11)	10.53(2.81)	1.1	13.14	.0001	.02	[1]<[4]; [2]<[3]; [2]<[4]
Picture Completion	8.51(2.51)	9.33(2.91)	10.10(2.90)	10.90(2.93)	2.4	32.82	.0001	.04	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Cancellation	9.54(2.72)	9.49(2.82)	10.09(3.02)	10.56(3.07)	1.1	12.07	.0001	.02	[1]<[4]; [2]<[3]; [2]<[4]
Information	7.70(2.71)	8.91(2.85)	10.20(2.82)	11.23(2.75)	3.5	77.93	.0001	.10	[1]<[2]; [1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Arithmetic	8.97(3.09)	9.32(2.93)	10.10(2.89)	10.91(2.89)	1.94	29.4	.0001	.04	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
Word Reasoning	8.01(2.65)	9.31(2.81)	10.18(2.91)	11.00(2.87)	3.0	44.07	.0001	.06	[1]<[2]; [1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]

Note. [1] elementary school (>5 years); [2] middle school (6-8 years); [3] high school (9-13 years); [4] academic degree (> 13 years).
For interpretation of Eta-squared η^2: η^2 = .01, small effect; η^2 = .06, medium effect; η^2 = .14, large effect.

which emerges the only statistical significant effect of parents' education ($F_{(12, 6455)} = 27.32$, $p<.01$, $\eta^2 = .05$) and no effect for age (age: $F_{(40, 8606)} = .65$, $p = .96$, $\eta^2 = .00$) and interaction (parental education × age: $F_{(120, 8606)} = 1.17$, $p = .1000$, $\eta^2 = .02$). By second MANOVA only with parents' education as an independent variable ($F_{(12, 6575)} = 29.25$, $p<.01$, $\eta^2 = .051$, power = 1.00), emerged results similar to those previously discussed for the subtests. In particular, by univariate comparisons emerge the VCI is mostly influenced by the parents' education variable, followed by the PRI, WMI, and from the PSI (see Table 2).

Finally, three ANOVAs were conducted to investigate the presence of significant differences on the FSIQ, the GAI and the CPI, obtained from 4 parental education groups and from 11 age groups. The findings show the significant differences for each parent's education level for all composite scores (FSIQ: $F_{(3,2156)} = 86.98$, $p = .0001$, $\eta^2 = .11$, GAI: $F_{(3,2156)} = 94.69$, $p = .0001$, $\eta^2 = .12$; CPI: $F_{(3,2156)} = 34.51$, $p = .0001$, $\eta^2 = .05$). For age, there are no significant differences (FSIQ: $F_{(10,2156)} = .78$, $p = .6500$, $\eta^2 = .00$; GAI: $F_{(10,2156)} = .94$, $p = .50$, $\eta^2 = .00$; CPI: $F_{(10,2156)} = .57$, $p = .839$, $\eta^2 = .00$). Also no significant differences emerged for interaction age × parental education (FSIQ: $F_{(30, 2156)} = .99$, $p = .470$, $\eta^2 = .01$; GAI: $F_{(30, 2156)} = 1.17$, $p = .240$, $\eta^2 = .02$; CPI: $F_{(30, 2156)} = .71$, $p = .874$, $\eta^2 = .01$).

Table 2 shows the univariate comparisons results (ANOVAs) on FSIQ, GAI and CPI: by univariate comparisons emerge the FSIQ and GAI are mostly influenced by the parents' education variable.

DISCUSSION

The results of present paper show significant differences obtained by 2,200 children and adolescents, belonging to four parental education groups with respect to WISC-IV subtests and indexes scores. Univariate comparisons show that children whose parents have university degrees obtained significantly higher performance compared with other groups in all subtests and indexes of the WISC-IV, followed by the children of parents have high school degrees.

This study presents evidence of a significant effect of parents' education on children and adolescent performance on the WISC-IV, similarly to what observed in the literature (e.g. Carneiro, Meghir & Parey, 2013; Cianci et al., 2013; Kaufman & Lichtenberger, 2006; Meekes et al., 2015; Rindermann, & Baumeister, 2015). However, this effect is most noticeable in the subtests that require verbal reasoning skills (*Vocabulary, Similarities, Information, Comprehension* and *Word Reasoning* subtests) governed by the crystallized intelligence, particularly affected by environmental and social conditions (Horn & Cattell, 1967; Picone, Pezzuti & Ribaudo, 2013). According to Bradley and colleagues (Bradley, Corwin, Burchinal, McAdoo & Garcia Coll, 2001) the parents with higher levels of education may have the opportunity to give their children significant educational and cultural input. Such parents are more likely to share with or enroll their children in after-school activities, including arts, foreign languages and the use of computers. So, these parents encourage the openness to experience (related to psychometric intelligence), development of knowledge and skills relevant for school learning, for example, vocabulary, information, comprehension skills and the understanding of the importance of evidence in argument (Carneiro et al., 2013; Evans, Kelley, Sikora & Treiman, 2010; Saggino & Balsamo, 2003).

For all other subtests, the performance of children and adolescents with parents have a high-school or graduate degree is higher than that of children and adolescents whose parents have completed the elementary or the middle school. The only exception is found for the *Coding* subtest, where differences in performance are only between children and adolescents whose parents completed the middle school and those whose parents have a high-school or a graduate degree. Such subtest showed a lower and non-significant size effect.

CONCLUSION

The study finds similar results for the indexes of FSIQ, VCI and GAI: they show a difference max-min of means from 17.8 to 19.6 IQ points between lower parent's education level (with elementary school) and higher parents' education level (with academic degree), so environmental and genetic factors underlying parents' education influence the results. Indeed, parents' education represents both environmental and genetic mechanisms: for example, Rindermann and Baumeister (2015) argued that parents' education was an indicator of parental cognitive ability, educational behavior, quality of developmental environment and genes responsible for the behavior of parents and children. Similarly, Meekes and colleagues (2015) assume that parents' education is an indicator both environment and parental IQ that have

Table 2 – Univariate comparison on all indexes x group-edu

Indexes	**Parental education level**								
	[1] n = 80	[2] n = 604	[3] n = 1070	[4] n = 446					
	M (SD)	M (SD)	M (SD)	M (SD)	Difference max-min of means	$F_{(3,2196)}$	p	η^2	Sig. post-hoc (Scheffè)
VCI	88.38 (12.93)	93.52 (13.45)	101.18 (14.65)	108.00 (13.88)	19.6	110.72	.0001	.13	[1]<[2]; [1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
PRI	93.85 (15.04)	95.60 (14.12)	100.64 (14.51)	105.53 (15.26)	11.7	45.15	.0001	.06	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
WMI	93.51 (12.53)	96.39 (14.54)	100.46 (14.92)	105.26 (14.09)	11.7	37.32	.0001	.05	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
PSI	97.60 (14.32)	97.12 (14.55)	100.68 (15.41)	102.72 (14.45)	5.6	13.84	.0001	.02	[1]<[4]; [2]<[3]; [2]<[4]
FSIQ	90.56 (13.27)	93.92 (13.77)	101.01 (14.56)	107.49 (13.70)	16.9	86.98	.0001	.11	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
GAI	89.90 (13.92)	93.82 (13.52)	101.06 (14.34)	107.68 (14.24)	17.8	94.69	.0001	.12	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]
CPI	93.60 (13.94)	96.00 (14.65)	100.64 (14.92)	105.15 (14.01)	11.6	38.80	.0001	.05	[1]<[3]; [1]<[4]; [2]<[3]; [2]<[4]; [3]<[4]

Legenda. VCI = Verbal Comprehension Index; PRI = Perceptual Reasoning Index; WMI = Working Memory Index; PSI = Processing Speed Index; FSIQ = Full Scale Intelligence Quotient; GAI = General Ability Index; CPI = Cognitive Proficiency Index.
Note. [1] elementary school (>5 years); [2] middle school (6-8 years); [3] high school (9-13 years); [4] academic degree (> 13 years).
For interpretation of Eta-squared η^2: η^2 = .01, small effect; η^2 = .06, medium effect; η^2 =.14, large effect.

genetic determinants on children IQ. With regard to the environmental determinants, more educated parents offer educational and cultural input to model of intellectual ability, determination, and motivation to succeed (Brooks-Gunn et al., 2002).

Regarding the genetic determinants, as on said, Noble and colleagues (2015) found that parental education and family income related a variation in independent characteristics of brain structural development in regions that are critical for the development of language, executive functions and memory. From what has been said parents' education is a variable representing both genetic and environmental mechanisms that appear to influence children intellectual profile. Even in studies conducted in recent years on the relationship between environmental and genetic factors and general cognitive ability of children it is observed that the influence that these factors have on the intellectual functioning varies along the person's development.

In particular, the environmental influences are more important in early childhood, while the genetic influences are gaining more and more importance gradually over the years until adulthood (Cianci et al., 2013; Johnson, 2010). Therefore, for the purpose of an early identification of developmental difficulties or disabilities, in both clinical and rehabilitative contexts, it is important to highlight to the families how relevant is to offer children an environment rich in educational and cultural stimulus, as this contributes to provide a baseline for an effective rehabilitative intervention.

References

BALSAMO, M., ROMANELLI, R. & SAGGINO, A. (2010). The de-differentiation hypothesis in normal elderly persons. *Perceptual and Motor Skills*, *110*, 1, 85-88.

BRADLEY, R.H., CORWIN, R.F., BURCHINAL, M., McADOO, H.P. & GARCIA COLL, C. (2001). The home environments of children in the United States. Part II: Relations with behavioral development through age 13. *Child Development*, *72* (6), 1868-1886.

BROOKS, B.L. (2010). Seeing the forest for the trees: Prevalence of low scores on the Wechsler Intelligence Scale for Children, fourth edition (WISC-IV). *Psychological Assessment*, *22* (3), 650-656.

BROOKS, B.L. (2011). A study of low scores in Canadian children and adolescents on the Wechsler Intelligence Scale for Children, fourth edition (WISC-IV). *Child Neuropsychology*, *17* (3), 281-289.

BROOKS-GUNN, J., HAN, W.J. & WALDFOGEL, J. (2002). Maternal employment and child cognitive outcomes in the first three years of life: The NICHD study of early child care. *Child Development*, *73* (4), 1052-1072.

CARNEIRO, P., MEGHIR, C. & PAREY, M. (2013). Maternal education, home environments, and the development of children and adolescents. *Journal of the European Economic Association*, *11* (Suppl. 1), 123-160.

CIANCI, L., ORSINI, A., HULBERT, S. & PEZZUTI, L. (2013). The influence of parents' education in the Italian standardization sample of the WISC-III. *Learning and Individual Differences*, *28*, 47-53.

CLARKE-STEWART, A., PERLMUTTER, M. & FRIEDMAN, S. (1988). *Lifelong Human Development*. Canada: John Wiley & Sons.

COLOM, R., GARCÍA, L.F., JUAN-ESPINOSA, M. & ABAD, G.J. (2002). Null sex differences in general intelligence: Evidence from the WAIS-III. *The Spanish Journal of Psychology*, *28* (3), 29-35.

COLOM, R., JUAN-ESPINOSA, M., ABAD, F.J. & GARCÍA, L.F. (2000). Negligible sex differences in general intelligence. *Intelligence*, *28*, 57-68.

CRAIG, L. (2006). Parental education, time in paid work and time with children: An Australian time-diary analysis. *The British Journal of Sociology*, *57* (4), 553-575.

DOLAN, C.V., COLOM, R., ABAD, F.J., WICHERTS, J.M., HESSEN, D.J. & van der SLUIS, S. (2006). Multi-group covariance and mean structure modeling of the relationship between the WAIS-III common factors and sex and educational attainment in Spain. *Intelligence*, *34*, 193-210.

EBISCH, S.J., MANTINI, D., ROMANELLI, R., TOMMASI, M., PERRUCCI, M.G., ROMANI, G.L. & SAGGINO, A. (2013). Long-range functional interactions of anterior insula and medial frontal cortex are differently modulated by visuospatial and inductive reasoning tasks. *Neuroimage*, *78*, 426-438.

EBISCH, S.J., PERRUCCI, M.G., MERCURI, P., ROMANELLI, R., MANTINI, D., ROMANI, G.L. & SAGGINO, A. (2012). Common and unique neuro-functional basis of induction, visualization, and spatial relationships as cognitive components of fluid intelligence. *Neuroimage*, *62* (1), 331-342.

EVANS, M.D.R., KELLEY, J., SIKORA, J. & TREIMAN, D.J. (2010). Family scholarly culture and educational success: Books and schooling in 27 nations. *Research in Social Stratification and Mobility*, *28* (2), 171-197.

FLANAGAN, D.P. & KAUFMAN, S. (2004). *Essentials of assessment with WISC-IV*. New York, Wiley.

GUSTAFSSON, J.E. (2001). Schooling and intelligence: Effects of track of study on level and profile of cognitive abilities. *International Education Journal*, *2*, 166-186.

HORN, J.L. & CATTELL, R.B. (1967). Age differences in fluid and crystallized intelligence. *Acta Psychologica*, *26*, 107-129.

IRWING, P. (2012). Sex differences in g: An analysis of the US standardization sample of the WAIS-III. *Personality and Individual Differences*, *53*, 126-131.

JENSEN, A.R. (1998). *The g factor.* Westport, CT: Praeger.

JOHNSON, W. (2010). Understanding the genetic of intelligence: Can height help? Can corn oil? *Current Directions in Psychological Science*, *19* (3), 177-182.

KAUFMAN, A.S. & LICHTENBERGER, E.O. (2006). *Assessing adolescent and adult intelligence (3rd ed.)*. New York: Wiley.

MEEKES, J., van SCHOONEVELD, M.M.J., BRAAMS, O.B., JENNEKENS-SCHINKEL, A., van RIJEN, P.C., HENDRIKS, M.P.H., BRAUN, K.P.J. & van NIEUWENHUIZEN, O. (2015). Parental education predicts change in intelligence quotient after childhood epilepsy surgery. *Epilepsia*, *56* (4), 599-607.

MERCY, J.A. & STEELMAN, L.C. (1982). Familial influence on the intellectual attainment of children. *American Sociological Review*, *47* (4), 532-542.

NOBLE, K.G., HOUSTON, S.M., BRITO, N.H., BARTSCH, H., KAN, E., KUPERMAN, J.M. & SOWELL, E.R. (2015). Family income, parental education and brain structure in children and adolescents. *Nature Neuroscience*, *18* (5), 773-778.

NYBORG, H. (2003). *The scientific study of general intelligence: Tribute to Arthur Jensen*. Risskov, Denmark: University of Aarhus.

ORSINI, A. & PEZZUTI, L. (2014). The General Ability Index of the WISC-IV [L'indice di abilità generale della scala WISC-IV]. *Psicologia Clinica dello Sviluppo*, *XVIII* (2), 301-310.

ORSINI, A. & PEZZUTI, L. (2016). *L'interpretazione clinica della WISC-IV alla luce della taratura italiana. Con CD Rom allegato.* Firenze: Giunti Psychometrics.

ORSINI, A., PEZZUTI, L. & PICONE, L. (2012). WISC-IV. Contributo alla taratura italiana. Firenze: Giunti OS Organizzazioni Speciali.

PEZZUTI, L. & ORSINI, A. (2016). Are there sex differences in the Wechsler Intelligence Scale for Children – Forth Edition? *Learning and Individual Differences*, *45*, 307-312.

PICONE, L., PEZZUTI, L. & RIBAUDO, F. (2013). *Teorie e tecniche dei test. Uso e interpretazione*. Roma: Carocci Editore.

PRIFITERA, A., SAKLOFSKE, D.H. & WEISS, L.G. (2005). *WISC-IV clinical use and interpretation, scientist-practitioner perspectives*. London: Elsevier Inc.

RINDERMANN, H. & BAUMEISTER, A.E.E. (2015). Parents' SES vs parental educational behavior and children's development: A reanalysis of the Hart and Risley study. *Learning and Individual Differences*, *37*, 133-138.

SAGGINO, A. & BALSAMO, M. (2003). Relationship between psychometric intelligence and the five-factor model of personality in a normal elderly sample. *Psychological Reports*, *92*, 1151-1161.

SAGGINO, A., PEZZUTI, L., TOMMASI, M., CIANCI, L., COLOM, R. & ORSINI, A. (2014). Null sex differences in general intelligence among elderly. *Personality and Individual Differences*, *63*, 53-57.

SCARR, S. & WEINBERG, R.A. (1978). The influence of "family background" on intellectual attainment. *American Sociological Review, 43* (5), 674-692.

SELLERS, A.H., BURNS, W.J. & GUYRKE, J. (1996). Prediction of premorbid intellectual functioning of young children using demographic information. *Applied Neuropsychology*, *3*, 21-27.

TOMMASI, M., WATKINS, M., ORSINI, A., PEZZUTI, L., CIANCI, L. & SAGGINO, A. (2015). Gender differences in latent cognitive abilities, and education links with g in Italian elders. *Learning and Individual Differences*, *37*, 276-282.

VANDERPLOEG, R.D., SCHINKA, J.A., BAUM, K.M., TREMONT, G. & MITTENBERG, W. (1998). WISC-III premorbid prediction strategies: Demographic and best performance approaches. *Psychological Assessment*, *10*, 277-284.

WECHSLER, D. (2003). *Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV): Administration and scoring manual*. San Antonio, TX: The Psychological Corporation.

WECHSLER, D. (2012). *Wechsler Intelligence Scale for Children – Fourth Edition (WISC-IV): Administration and scoring manual*. Adattamento italiano di A. Orsini, L. Pezzuti e L. Picone. Firenze: Giunti Psychometrics.