Cognitive and intellectual performance of children with borderline intellectual functioning: An explorative study

Bastianina Contena[1], Margherita Lang[2], Valeria Scandurra[3], Maria Rosaria Scordo[4], Rosetta Storino[4], Stefano Taddei[1]

[1]Health Sciences Department, University of Florence
[2]Department of Psychology, University of Milan, Bicocca
[3]Department of Child Neuropsychiatry, University Hospital of Siena
[4]Department of Child Neuropsychiatry, University of Florence

ABSTRACT. Introduzione: Il funzionamento intellettivo limite (*Borderline Intellectual Functioning*, *BIF*) è spesso studiato in associazione ad altre manifestazioni cliniche ma raramente vengono indagate le caratteristiche cognitive a esso associate. Metodi: A partire dal dibattito scientifico circa la performance intellettiva e il funzionamento esecutivo, il presente studio si propone di esplorare il funzionamento cognitivo di 28 bambini con BIF utilizzando la teoria PASS (Pianificazione, Attenzione, Simultaneità e Successione). Risultati: I risultati suggeriscono la presenza di una debolezza nel dominio verbale dell'intelligenza e dei processi cognitive di Pianificazione e Attenzione. Conclusioni: Il funzionamento cognitivo è discusso in relazione ai differenti profili emersi e ai problemi comportamentali associati.

SUMMARY. Introduction: Borderline Intellectual Functioning (BIF) is often investigated with other clinical conditions, but little it is known about the cognitive functioning of children with this intellectual performance. Methods: Starting from the scientific debate about the relationship between intellectual performance and executive and cognitive functioning, the present study uses the Planning, Attention, Simultaneous and Successive (PASS) theory to explore the cognitive functioning of 28 children with BIF. Results: Results suggest the presence of weaknesses in the verbal domain of intelligence and in the cognitive profile, particularly concerning Planning and Attention. Conclusions: The cognitive functioning is discussed in its relationship with the different profiles and the behavioral problems associated.

Keywords: *Cognitive processes, PASS theory, Borderline intellectual functioning, Neurodevelopmental disorders, IQ, Executive functions*

INTRODUCTION

Borderline Intellectual Functioning (BIF) refers to children with IQ scores ranging from 71 to 84 and, in the fifth edition of Diagnostic and Statistical Manual of mental disorders (DSM 5; APA, 2013), this category indicates a special focus for clinical attention that suggests special needs in diagnosis and treatment. The DSM 5 (APA, 2013) suggests differentiating carefully between BIF and mild intellectual disability (MID), a category of intellectual developmental disorder. In fact, the IQ scores of BIF are between -2 and -1 standard deviations, and so BIF, represents a normal variation of intellectual level (Fernell & Ek, 2010). This intellectual level below the mean causes a particular slowness in learning processes, and in fact, people with BIF have inadequate occupations, more mental health and social problems, and longer hospital admissions then individuals with a normal IQ (Masi, 1998; Van Nieuwenhuijzen, Castro, Aken & Matthys, 2009). People with BIF represent the largest population at risk for school failure (Shaw, 2008), and they are commonly referred to as "slow learners". Although it is estimated that individuals with BIF comprise more than 7% of the school population, few studies are mainly directed at assessing their problems and cognitive functioning (Fernell & Ek, 2010).

The main part of research about BIF refers to this functioning in conjunction with pathological conditions such as genetic syndromes (Bartocci et al., 2008), autism spectrum disorder (Embregts & Van Nieuwenhuijzen, 2009), Attention Deficit Hyperactivity Disorder (ADHD; van der Meere, Van Der Meer, Kunert, Borger & Pirila, 2008), communication disorders (Ek, Norrelgen, Westerlund, Dahlman, Hultby & Fernell, 2012), specific learning disabilities (Bonifacci & Snowling, 2008), and conduct and disruptive behavior disorders (López-Villalobos, Llano, Sánchez-Azón, Sanguino-Andrés & Alberola-López, 2012). These studies highlight how the condition of BIF is generally associated with different disorders and it affects their severity and their outcomes in term of physical health (Emerson & Robertson, 2010) and mental health (Emerson, Einfeld & Stancliffe, 2010). Even if BIF is studied in its association with other developmental disorders, it remains poorly studied as a condition by itself (Fernell & Ek, 2010; Ferrari, 2009). Ferrari (2009) has considered that since BIF has been ruled out from the categories of intellectual disability, the diagnosis of specific learning disabilities increased significantly; although, it was not demonstrated to be a cause-effect relationship. Furthermore, some studies have investigated the academic achievement of people with BIF, showing how most of them reach only the lower levels of education and receive inadequate aid because of a lack of recognition of their difficulties (Emerson & Robertson, 2010; Fernell & Ek, 2010). Some authors suggest deepening our understanding of cognitive functioning associated with BIF (Schuchardt, Gebhardt & Mäehler, 2010): the simple presence of a low IQ is not sufficient neither for understanding the school and social problems of these subjects, nor for developing appropriate diagnosis and treatment processes.

Fiorello et al. (2007) have discussed the relevance of IQ score in the comprehension of children with disabilities; being underlined as in some conditions, like specific learning disabilities, ADHD and traumatic brain injury, the IQ score loses its predictivity, and it does not offer the possibility of understanding the difficulties of these subjects. For this reason, authors (e.g. Fiorello et al., 2007) suggest investigating the structure of intellectual functioning considering that the interpretation of global IQ can be inadequate. As suggested by Fiorello et al. (2007), the usefulness of IQ for the clinical comprehension of children with disabilities represents a challenge, and integrative evaluations of cognitive processes are often suggested (Flanagan, Fiorello & Ortiz, 2010; Willis Dumont & Kaufman, 2011).

In fact, some recent studies, focusing on cognitive processes, have underlined the importance of cognitive and executive functioning in the diagnosis and remediation of different neurodevelopmental disorders (e.g. Asonitou, Koutsouki, Kourtessis & Charitou, 2012; Taddei & Contena, 2013a), as well as in the usual context of learning (Barkl, Porter & Ginns, 2012). Studies that have investigated the executive functioning associated with BIF, have highlighted the role of inhibition response (van der Meer & van der Meere, 2004) and working memory (Alloway, 2010); these executive functions would be able to predict the low IQ. The cognitive functioning of children with BIF and MID seems related to motor functioning, influenced by the dysfunction in visual-spatial working memory, as underlined by Vuijk, Hartman, Scherder & Visscher (2010). The same dysfunctions would be able to explain even the behavioral problems of children with BIF; the lack of impulse control influences the presence of externalizing and aggressive behaviors (Van Nieuwenhuijzen et al., 2009) and inhibition skills and working memory

predict social information processing and they explain the problems in social situations and in peer relations (Van Nieuwenhuijzen, & Vriens, 2011).

For the comprehension of cognitive and executive functioning the Planning, Attention, Simultaneous and Successive (PASS; Das, Naglieri & Kirby, 1994) theory, inspired by Luria's work, seems to provide an interesting and relevant point of view (Chan, Shum, Toulopoulou & Chen, 2008).

The PASS theory conceptualizes cognitive functioning as an integrated work of four cognitive processes that operate on the knowledge basis of the subject. The different processes are localized in different areas of the brain, and they are delegated to different tasks (Naglieri, 1999). *Planning* refers to cognitive control, self-regulation, and plans formulation to achieve a desired goal. *Attention* refers to the capability of focusing cognitive activity on specific stimuli, avoiding distractions. *Simultaneous* refers to the comprehension of complex relationships between different stimuli in order to integrate the parts into a whole. *Successive* is a mental process that allows individuals to sort stimuli in a serial order. The Cognitive Assessment System (CAS; Naglieri & Das, 1997) is the operationalization of PASS theory and it measures the 4 cognitive processes and it offers a total score of cognitive functioning, named Full Scale. Studies that have used this theory, measuring cognitive functioning with the CAS, have underlined typical cognitive profiles for different clinical conditions. For example, subjects with reading disabilities have a low score in Successive process (Taddei, Contena, Caria, Venturini & Venditti, 2011). Children with ADHD show difficulties in Planning (Iseman, 2012) or in Planning and Attention at the same time (Najafi, Sadeghi, Molazade, Goodarzi, & Taghavi, 2010); those with autism spectrum disorder show low performance in Planning and Attention (Goldstein & Naglieri, 2009). The analysis of PASS cognitive functioning seems to allow differentiating between these clinical conditions and suggests a better understanding of the executive dysfunction associated with different conditions, even when IQ analysis suggests a confusing overlap (Taddei & Contena, 2013b). Planning and Attention could be considered the executive core of cognitive functioning; as suggested by Goldstein, Naglieri, Princiotta and Otero they represent the functional description of executive function because they are responsible of the goal-oriented functions controlled by prefrontal cortex commonly defined as executive function (Best, Miller, & Jones, 2009). For this reason the analysis of Planning and Attention could be used to evaluate the executive performance of subjects (Goldstein & Naglieri, 2014).

However, although the PASS theory has been applied to the study of intellectual disabilities (Das & Naglieri, 1996) and the other neurodevelopmental disorders above mentioned, and the CAS seems to be a useful instrument to evaluate the cognitive functioning (Chan et al., 2008), research on BIF does not seem to be present in the international scientific literature.

Briefly, BIF is, as underlined above, a complex condition that is usually defined because of global IQ (Fernell & Ek, 2010). An important characteristic related to BIF is the slowness in learning processes that often causes a low academic achievement (Shaw, 2008). The association of BIF with other clinical conditions and its severe social and health-related outcomes (Emerson et al., 2010) highlight the importance of understanding its characteristics and investigating the cognitive functioning associated with it (Schuchardt et al., 2010). PASS theory seems to provide a useful framework for investigating cognitive processes in order to point out the global cognitive functioning related to different neurodevelopmental disorders (Chan et al., 2008). However, no study has directly investigated the PASS cognitive functioning in individuals with BIF. Therefore, the purpose of this study is to explore the intellectual and cognitive performance of subjects with BIF in order to understand if there is a specific PASS cognitive functioning and what kind of relationship exists between BIF, intellectual functioning, and children's behaviors.

Specific hypotheses of this study are:

- if PASS theory is a useful framework to assess the cognitive functioning (Chan et al., 2008) we should obtain a specific CAS profile for subjects with BIF. Considering the relation with PASS processes and executive function CAS profile should show a weakness in Planning and, secondarily, in Attention;
- PASS functioning should be only weakly related with IQ profile of these subjects;
- PASS functioning should be related with the behavioral problems associated with BIF.

Furthermore considering the sensitivity of CAS to differentiate the cognitive functioning within a diagnostic category, It should be possible differentiating BIF using PASS profiles.

METHODS

Participants and selection method

We selected the medical records of 33 children, referred for academic difficulties with a diagnosis of BIF from patients referred to a unit of neuropsychiatry of infancy and adolescence, in central Italy, in a period ranging from January to December 2012. Of these, 28 met the inclusion criteria: 1) IQ between 71 and 84; 2) absence of organic disease, neurological, and sensory deficits; 3) absence of severe psychopathology. The 28 participants were children aged 7 to 14 (M = 10.18; *SD* = 2.37). Twenty were male (71.4%), and eight were female (28.6%); they were homogeneous for age ($t_{(26)} = .09$; $p = .92$). From each medical record we extracted the intellectual, cognitive and behavioral evaluation obtained by clinicians using instruments specified by the clinical protocol, described in the instruments section. All children and their parents were informed about the purpose and procedures of the evaluation and had signed the informed consent form at the time of the admission to the neuropsychiatry unit.

Instruments

Intellectual performance was evaluated by the *Wechsler Intelligence Scale for Children-III* (*WISC-III*; Wechsler, 1991) in its Italian adaptation (Orsini & Picone 2006). This test allows for the evaluation of the total intelligence quotient (TIQ), the verbal IQ (VIQ) and the performance IQ (PIQ). The WISC-III, the only version of WISC in use in Italy at the time of diagnosis, is composed of 13 subtests; six are included in the verbal scale and seven in the performance scale. Each subtest score has a mean of 10 and a standard deviation 3. TIQ, VIQ, and PIQ have a mean of 100 and a standard deviation of 15.

The cognitive performance, as explained by the PASS theory (Das et al., 1994), was evaluated by the Cognitive Assessment System (CAS) (Naglieri & Das, 1997), in its Italian adaptation (Taddei & Naglieri, 2005). The CAS is composed of four scales, one for each PASS process, and a Full Scale (FS). The scales have a mean of 100 and a standard deviation of 15. Each subtest (three for each scale) has a mean of 10 and a standard deviation of 3. Reliability of Full and PASS scales ranges from .83 to .96. A subject's performance could be classified into descriptive categories, provided by the test manual (Naglieri & Das, 1997). Planning subtests of CAS require the application of strategies to solve a novel situation presented (for example: complete a page that contains 7 rows and 8 columns of letters without codes using the specific codes shown at the top of the page). Attention subtests require to select and to focus a stimulus, using the inhibitory control (for example Stroop test). Simultaneous subtests require to perceive objects as a whole (for example the child has to indicate "Which picture shows a circle to the left of a cross under a triangle above a square?" choosing the correct picture between different figures). Successive subtests require to operate with stimuli in a specific serial order (for example the child has to respond to questions as "The blue is yellowing. Who is yellowing?").

Children's behavior was evaluated by the Child Behavior Checklist, for ages 6-18, Parent's Report Form (CBCL) (Achenbach & Rescorla, 2001) in its Italian translation (Frigerio et al., 2004). The CBCL is a rating scale that allows for investigating the behavioral, social and emotional problems of children ages 18 months to 18 years. The 118 items are grouped into eight Empirically Based Syndrome Scales (EBSS), scored using T scores for Italy (<64 = normal; 65-69 = borderline; 70-100 = clinical). The EBSS are Anxious/Depressed (A/D; Cronbach's alpha = .77), Withdrawn/Depressed (W/D; Cronbach's alpha = .66), Somatic Complaints (SC; Cronbach's alpha = .60), Social Problem (SP; Cronbach's alpha = .54), Thought Problems (TP; Cronbach's alpha = .36), Attention Problems (ATP; Cronbach's alpha = .72), Rule-Breaking Behavior (RBB; Cronbach's alpha = .53), and Aggressive Behaviour (AB; Cronbach's alpha = .83). The A/D, W/D and SC form the Internalizing Problems score (InP; Cronbach's alpha = .83) while the RBB and AB form that of Externalizing Problems (ExP; Cronbach's alpha = .85). These scales are calculated using T scores for Italy (<59 = normal; 60-63 = borderline; 64-100 = clinical). Parents have to indicate if the item seems to apply to their child (for example: cries a lot).

Procedure

Authors examined independently each clinical report about the 33 children considering the selection criteria mentioned above. A case was enrolled for the study when at least three authors had selected it, on the basis of judges' agreement. The study-cases selected were 28.

Statistical procedures

Data were subjected to descriptive analysis. Particularly the frequency of the PIQ/VIQ discrepancy it is analyzed. This discrepancy refers to the abnormal difference in the scores of PIQ and VIQ and it is considered significant when it is major of 11 points.

In order to evaluate the relationship between intellectual performance, cognitive functioning, and behavioral problems, an analysis of correlations was conducted. In order to explore the possibility of identifying specific groups of cognitive functioning, a hierarchical cluster analysis was performed introducing the PASS scales as variables and using Average Linkage method to identify the clusters. All analyses were carried out with SPSS 21.0 (IBM, 2012).

RESULTS

In Table 1, the scores obtained from participants in the cognitive evaluation with the WISC-III and the CAS are reported. For what concern the evaluation with WISC-III, it is possible to notice that the average PIQ is higher than VIQ. Specifically, 11 subjects present scores of PIQ higher than scores of VIQ. Analyzing the frequency of the PIQ/VIQ discrepancy, it is significant (higher than 11) in 57% of cases. CAS average scores are lower for Attention and Planning. However, all mean scores are under 85, highlighting a performance that falls in the descriptive category of "low average." Subtest analysis allows underling scores below the mean in all tasks which suggest the absence of emotional disturbance and an unvarying cognitive functioning. The CBCL scores are analyzed concerning the eight EBSS and the internalizing/externalizing problems (see Table 2). Most of the subjects showed a score without clinical relevance; however, a significant percentage of subjects presented clinical scores on the W/D and ATP scales. Considering borderline and clinical scores, the 35.7% of the subjects show attention problems and symptoms of anxiety/depression and the 25% show problems with peers. The 60.7% reveal problems of internalization or externalization. Behavioral problems are lower for subjects with higher scores of PIQ than VIQ, particularly for what concern RBB ($t_{(25)} = -3.50$; $p \leq .01$) and AB ($t_{(25)} = -2.75$; $p \leq .01$), and consequently, of ExP ($t_{(25)} = -3.49$; $p \leq .01$).

The analysis of correlation allows us to obtain interesting results (Table 3). For what concern correlation within IQ dimensions, TIQ is correlated only with the PIQ (r = .41), while the correlation between TIQ and VIQ is not significant from a statistical point of view. PIQ and VIQ are inversely correlated (r = −.66). Correlations within CAS scales show that all PASS scores are correlated only with the Full Scale (respectively r = .53, r = .70, r = .64, r = .71). Concerning the correlations between WISC-III and CAS, it is possible to notice that TIQ is correlated only with Planning (r = .40), while VIQ does not present correlations with PASS scores.

Correlations between problematic behaviors, intellectual performance, and cognitive performance are reported in Table 4. It seems important to emphasize the presence of a statistically significant inverse correlation between VIQ and externalizing problems (r = −.45), SC (r = −.48) and RBB (r = −.46), and between SU and SP (r = −.55) and FS and SP (r = −.46).

Cluster analysis, with Average Linkage method, highlights the presence of three different groups (Figure 1): 3 subjects fall into the first group, 22 in the second and 3 in the third. A qualitative analysis of these cluster allow highlighting that these three groups do not differ in intellectual performance (Figure 2) and present similar scoring of TIQ and PIQ, while it is possible to notice a difference in their cognitive performance (Figure 3) for what concern Attention scale, Successive scale and Full scale. For what concern the differences between groups in behavioral problems, the more relevant difference seems to be on SP scale. Particularly first group, with the highest score on Attention scale, presents even a lower score of Social Problems.

DISCUSSION AND CONCLUSIONS

The intellectual assessment of these subjects with BIF shows a general weakness in the verbal domain of intelligence with a consistent discrepancy between verbal and performance IQ; these subjects seem to be characterized by poor verbal competence. The PASS profile of subjects with BIF shows, in line with the IQ assessment, a general weakness in the cognitive functioning. As suggested by Schuchardt et al. (2010) the cognitive evaluation of these subjects allow a better comprehension of their problems. The general weakness in Planning, as hypothesize, is consistent with the presence of an executive dysfunction, as suggested in different studies (Alloway, 2010; van der Meer & van der Meere, 2004). The relative strength in Successive and its relation with the ability to cope with social environment

Table 1 – Observed minimum and maximum, mean, and standard deviation of WISC-III and CAS

		Min_o-Max_o	**Mean (SD)**
WISC-III	Verbal IQ (VIQ)	60-90	75.25 (7.08)
	Performance IQ (PIQ)	73-99	87.25 (7.58)
	Total IQ (TIQ)	72-84	79.04 (3.23)
CAS	Planning (P)	56-96	80.86 (10.39)
	Attention (A)	60-114	79.57 (12.21)
	Simultaneous (SI)	64-98	82.54 (9.64)
	Successive (SU)	62-124	84.89 (13.89)
	Full Scale (FS)	55-99	75.11 (10.64)
CAS SUBTEST	Matching Numbers (MN)	2-14	7.11 (2.66)
	Planning Codes (PlCd)	4-11	7.79 (2.06)
	Planning Connections (PlCn)	2-10	6.29 (2.34)
	Expressive Attention (EA)	4-11	7.54 (1.88)
	Numbers Detection (ND)	1-15	7.39 (2.30)
	Receptive Attention (RA)	3-12	7.61 (2.60)
	Non verbal Matrices (NvM)	1-15	6.79 (3.30)
	Verbal-Spatial Relations (VSR)	5-19	8.29 (2.73)
	Figure Memory (FM)	1-12	6.39 (2.59)
	Word Series (WS)	4-15	8.00 (2.23)
	Sentence Repetition	2-12	7.93 (2.28)
	Speech Rate or Sentence Questions (SR/SQ)	2-19	8.11 (4.00)

Table 2 – Observed minimum and maximum, mean, and standard deviation, percentage of borderline and clinical scores at CBCL

		Min_o-Max_o	Mean (SD)	% borderline scores	% clinical scores
CBCL	Withdrawn/Depressed (W/D)	50-82	59.89 (9.78)	.0%	21.4%
	Somatic Complaints (SC)	50-81	57.18 (8.84)	7.1%	10.7%
	Anxious/Depressed (A/D)	50-82	61.36 (9.13)	21.4%	14.3%
	Social Problem (SP)	50-80	60.82 (9.17)	10.7%	14.3%
	Thought Problems (TP)	50-70	54.96 (6.71)	3.6%	.0%
	Attention Problems (ATP)	50-86	65.29 (8.37)	14.3%	21.4%
	Rule-Breaking Behaviour (RBB)	50-67	54.71 (5.77)	3.6%	.0%
	Aggressive Behaviour (AB)	50-75	55.54 (7.91)	7.1%	7.1%
	Internalizing (InP)	33-74	60.68 (10.99)	43.9%	7.1%
	Externalizing (ExP)	30-69	52.32 (9.97)	25.0%	.0%
	Total	33-74	59.54 (9.64)	57.1%	3.6%

Table 3 – Correlation between scores of WISC-III and CAS scales

	TIQ	VIQ	PIQ	P	SI	A	SU	FS
TIQ	1	.37	.41**	.40*	.15	.07	−.03	.12
VIQ		1	−.66**	.25	.07	.16	−.12	.11
PIQ			1	.13	.14	−.10	.17	.06
P				1	.23	.26	.11	.53**
SI					1	.24	.42*	.63**
A						1	.29	.70**
SU							1	.71**
FS								1

* $p \leq .05$; ** $p \leq .01$

Table 4 – Correlation between scores of CBCL, WISC-III and CAS scales

	TIQ	VIQ	PIQ	P	SI	A	SU	FS
W/D	–.29	.28	–.03	–.13	.01	–.15	.14	–.10
SC	.19	–.48*	–.27	–.27	–.25	–.05	–.18	–.26
A/D	–.02	.01	.02	.01	–.29	.20	–.22	–.11
SP	.17	–.18	.09	–.13	–.28	–.28	–.55**	–.46*
TP	.01	–.11	–.05	–.36	–.24	–.08	.03	–.17
ATP	.12	.02	.18	–.05	.06	.28	.21	.21
RBB	.39**	–.46*	–.04	–.13	–.14	–.03	–.13	–.16
AB	.24	–.41*	–.15	–.39*	–.12	–.05	–.05	–.17
InP	–.14	.01	–.13	–.15	–.19	.08	–.11	–.15
ExP	.29	–.45*	–.15	–.26	–.16	–.00	–.04	–.12
Total	.11	–.24	–.10	–.23	–.24	.00	–.14	–.20

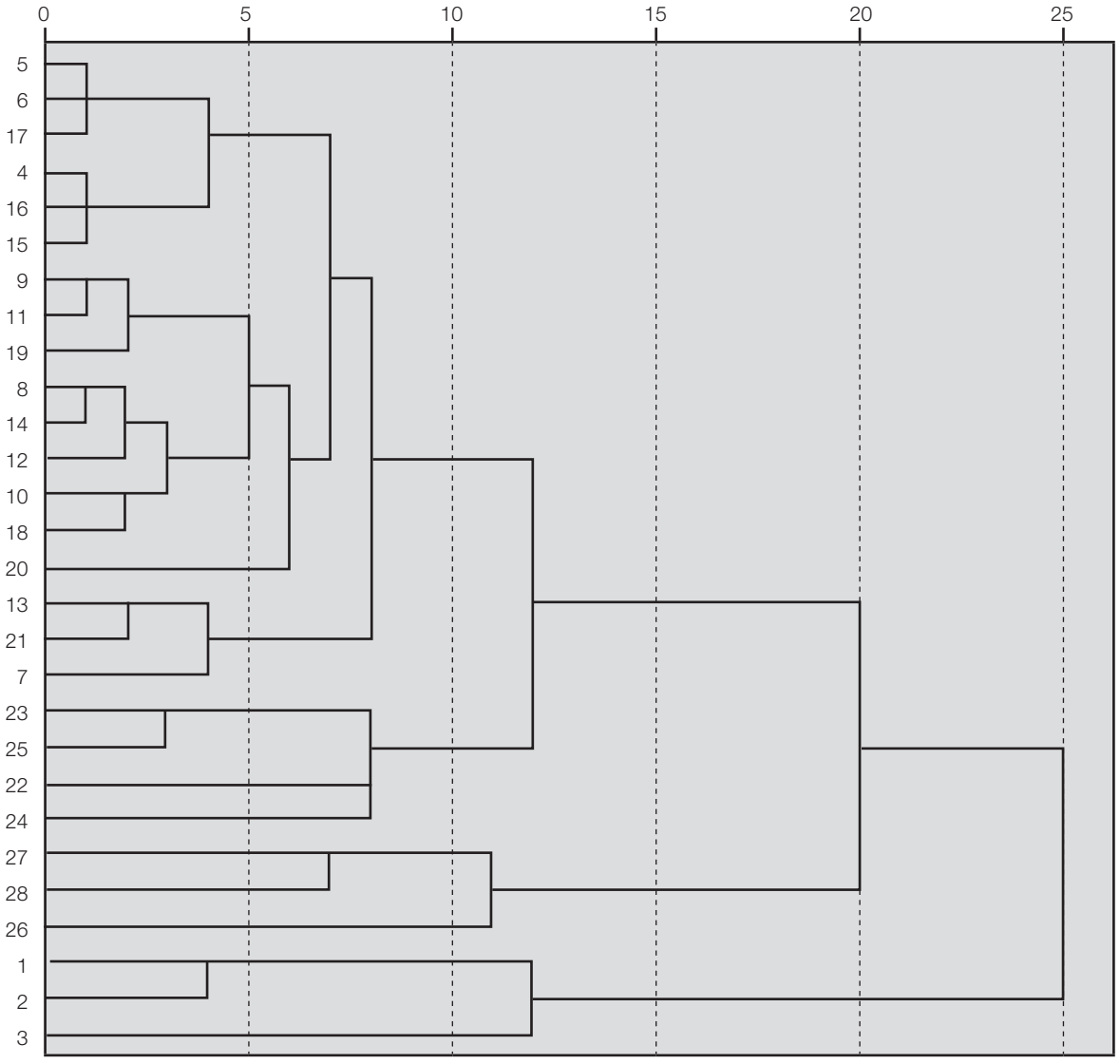
* $p \leq .05$; ** $p \leq .01$

shows that the ability to solve practical problems and operate with data and images to understand the sequential order of stimuli influences the social competence of these subjects, ameliorating their capability to understand and respect social rules. This datum is particularly interesting because can address the intervention programs suggesting to operate with the Successive process. The enhancement of Successive can produce a direct effect on the behavioral problems of these subjects, influencing their social competencies.

The analysis of cognitive profiles suggests the presence of three BIF groups, the first group has higher Attention and the second has higher Successive than the third, which is characterized instead by lower cognitive profiles. It is the first group, with its strength in Attention, to show the better social functioning. The second group collects the largest number of subjects highlighting the relevance of identifying these children in order to help them in the learning process and foster better social adjustment, even in adult life, according to Schuchardt et al. (2010). These results confirm the presence of BIF category and even the measure of cognitive processes seems to highlight the existence of a border functioning, according to the IQ assessment. Therefore, for what concern the first hypothesis, the presence of a specific profile for BIF seems to refer to a weakness in Planning and Attention processes but some considerations seem to be essential. In fact, the ability to plan seems to be, generically, compromised, as hypothesized, but a different reasoning is necessary for Attention. The functioning of this process seems to be generally low but, in some profiles, it seems to be a strength, contrary to our hypothesis, and it could be a way to improve the general functioning. So, the possibility to identify the cognitive functioning of BIF seems to allow a best clinical understanding of the children with this clinical condition.

For what concern the relationship between PASS profile and IQ is possible to notice only a weak relationship, as hypothesized but even the relationship between PASS profile

Figure 1 – Dendrogram of cluster analysis

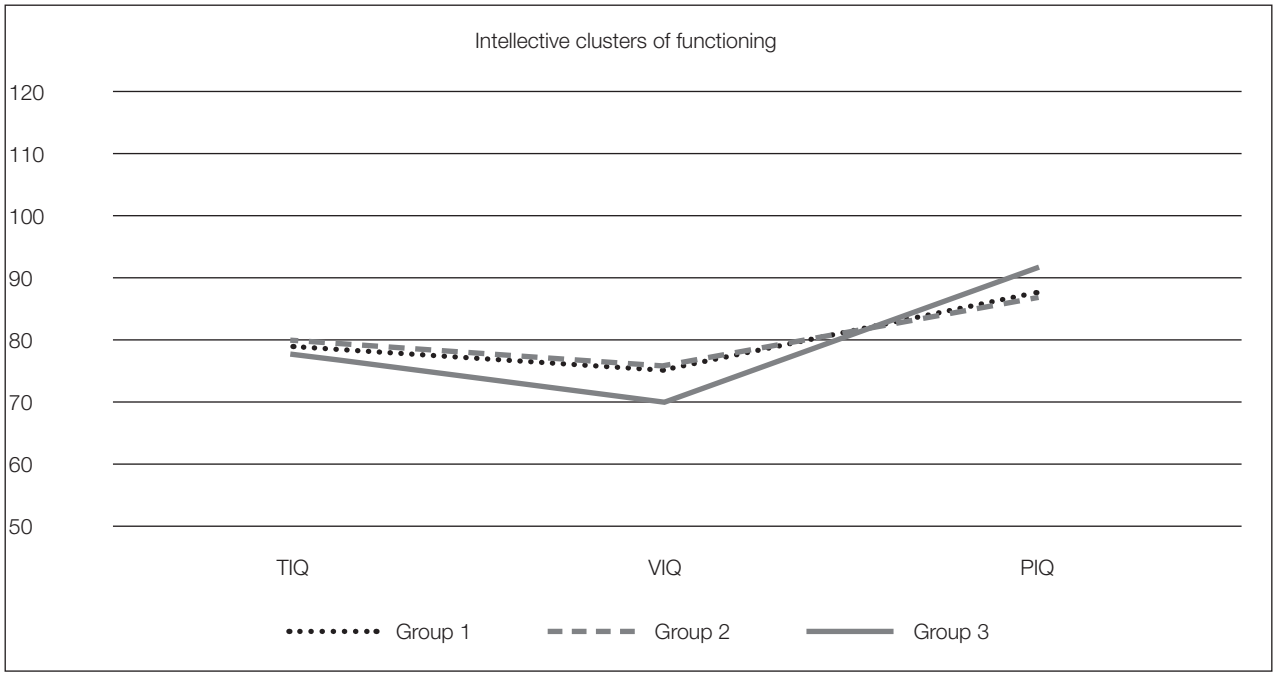


Note. In the X axis rescaled distance; in the Y axis subjects' codes.

and behavioral problems does not appear so strong, contrary to our hypothesis. Obviously, these results concern only data collected about children with BIF; these relationships could be different in children with typical development.

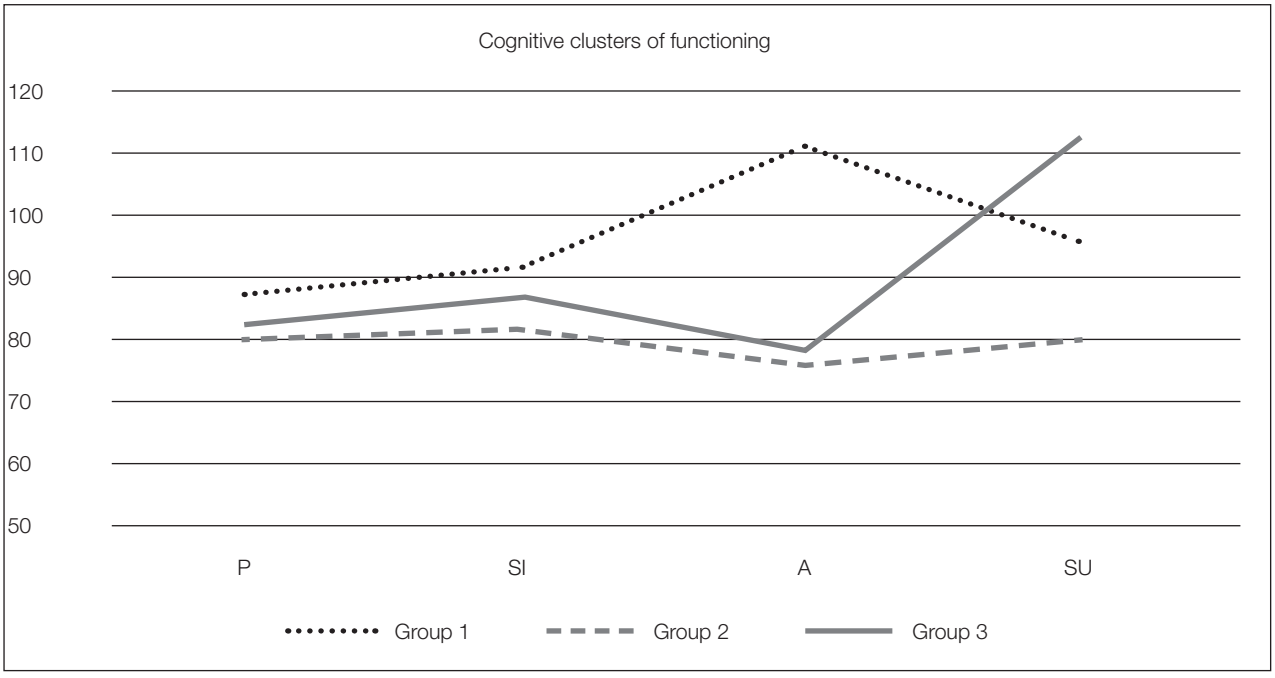
All these results must be interpreted with caution. The exploratory character of this study suggests the possibility of concentrating future analyses on the comparison between BIF and other neurodevelopmental disorders to better understand the cognitive specificities of this condition but it is important to highlight some important limitations of this study. First of all this study analyzed the medical record of subjects with BIF and for the authors an in-depth analysis of the cases was impossible. Furthermore the number of enrolled cases is very limited. These two factors don't allow generalization of results and they suggest to be very careful in their interpretation. Future studies, enrolling subjects with BIF, can compare their cognitive functioning with that of subjects with typical development or intellectual disabilities.

Figure 2 – Intellective profiles of the three groups



Note. In the X axis TIQ (Total IQ), VIQ (Verbal IQ) and PIQ (Performance IQ).

Figure 3 – Cognitive profiles of the three groups



Note. In the X axis the PASS scales.

References

ACHENBACH, T.M. & RESCORLA, L. (2001). *ASEBA School-Age Forms & Profiles*. Aseba: Burlington.

ALLOWAY, T.P. (2010). Working memory and executive function profiles of individuals with borderline intellectual functioning. *Journal of Intellectual Disability Research*, *54*(5), 448-456. DOI:10.1111/j.1365-2788.2010.01281.x.

AMERICAN PSYCHIATRIC ASSOCIATION (APA) (2013). *Diagnostic and Statistical Manual of Mental Disorders* (5th ed.). Arlington, VA: American Psychiatric Publishing.

ARDILA, A., PINEDA, D. & ROSSELLI, M. (2000). Correlation between intelligence test scores and executive function measures. *Archives of Clinical Neuropsychology, 15*(1), 31-36. DOI:10.1016/S0887-6177(98)00159-0.

ASONITOU, K., KOUTSOUKI, D., KOURTESSIS, T. & CHARITOU, S. (2012). Motor and cognitive performance differences between children with and without developmental coordination disorder (DCD). *Research in Developmental Disabilities*, *33*(4), 996-1005. DOI:10.1016/j.ridd.2012.01.008.

BARKL, S., PORTER, A. & GINNS, P. (2012). Cognitive training for children: Effects on inductive reasoning, deductive reasoning, and mathematics achievement in an Australian school setting. *Psychology in the Schools*, *49*(9), 828-842. DOI:10.1002/pits.21638.

BARTOCCI, A., STRIANO, P., MANCARDI, M.M., FICHERA, M., CASTIGLIA, L., GALESI, O., MICHELUCCI, R. & ELIA, M. (2008). Partial monosomy Xq (Xq23→ qter) and trisomy 4p (4p15. 33→ pter) in a woman with intractable focal epilepsy, borderline intellectual functioning, and dysmorphic features. *Brain and Development*, *30*(6), 425-429. DOI:10.1016/j.braindev.2007.11.004.

BEN-YIZHAK, N., YIRMIYA, N., SEIDMAN, I., ALON, R., LORD, C. & SIGMAN, M. (2011). Pragmatic language and school related linguistic abilities in siblings of children with autism. *Journal of Autism and Developmental Disorders*, *41*(6), 750-760. DOI: 10.1007/s10803-010-1096-6.

BONIFACCI, P. & SNOWLING, M.J. (2008). Speed of processing and reading disability: A cross-linguistic investigation of dyslexia and borderline intellectual functioning. *Cognition*, *107*(3), 999-1017. DOI:10.1016/j.cognition.2007.12.006.

CHAN, R.C., SHUM, D., TOULOPOULOU, T. & CHEN, E.Y. (2008). Assessment of executive functions: Review of instruments and identification of critical issues. *Archives of Clinical Neuropsychology*, *23*(2), 201-216. DOI:10.1016/j.acn.2007.08.010.

DAS, J.P. & NAGLIERI, J.A. (1996). Mental retardation and assessment of cognitive processes. In: J.W. Jacobson & J.A. Mulick, (Eds.), *Manual of Diagnosis and Professional Practice in Mental Retardation*. Washington, DC: American Psychological Association.

DAS, J.P., NAGLIERI, J.A. & KIRBY, J.R. (1994). *Assessment of Cognitive Processes: The PASS Theory of Intelligence*. Boston: Allyn & Bacon.

DENNIS, M., FRANCIS, D.J., CIRINO, P.T., SCHACHAR, R., BARNES, M.A. & FLETCHER, J. M. (2009). Why IQ is not a covariate in cognitive studies of neurodevelopmental disorders. *Journal of the International Neuropsychological Society*, *15*(03), 331-343. DOI:10.1017/S1355617709090481.

EK, U., NORRELGEN, F., WESTERLUND, J., DAHLMAN, A., HULTBY, E. & FERNELL, E. (2012). Teenage outcomes after speech and language impairment at preschool age. *Neuropsychiatric Disease and Treatment*, *8*, 221-227. DOI:10.2147/NDT.S30106.

EMBREGTS, P.J.C.M. & VAN NIEUWENHUIJZEN, M. (2009). Social information processing in boys with autistic spectrum disorder and mild to borderline intellectual disabilities. *Journal of Intellectual Disability Research*, *53*(11), 922-931. DOI:10.1111/j.1365-2788.2009.01204.x.

EMERSON, E., EINFELD, S. & STANCLIFFE, R.J. (2010). The mental health of young children with intellectual disabilities or borderline intellectual functioning. *Social Psychiatry and Psychiatric Epidemiology*, *45*(5), 579-587. DOI:10.1007/s00127-009-0100-y.

EMERSON, E. & ROBERTSON, J. (2010). Obesity in young children with intellectual disabilities or borderline intellectual functioning. *International Journal of Pediatric Obesity*, *5*(4), 320-326. DOI: 10.3109/17477160903473713.

FERNELL, E. & EK, U. (2010). Borderline intellectual functioning in children and adolescents insufficiently recognized difficulties. *Acta Paediatrica*, *99*(5), 748-753. DOI:10.1111/j.1651-2227.2010.01707.x.

FERRARI, M. (2009). Borderline intellectual functioning and the intellectual disability construct. *Journal Information*, *47*(5), 386-389. DOI:10.1352/1934-9556-47.5.386.

FIORELLO, C.A., HALE, J.B., HOLDNACK, J.A., KAVANAGH, J.A., TERRELL, J. & LONG, L. (2007). Interpreting intelligence test results for children with disabilities: Is global intelligence relevant? *Applied Neuropsychology*, *14*(1), 2-12. DOI: 10.1080/09084280701280338.

FLANAGAN, D.P., FIORELLO, C.A. & ORTIZ, S.O. (2010). Enhancing practice through application of Cattell-Horn-Carroll theory and research: A "third method" approach to specific learning disability identification. *Psychology in the Schools*, *47*(7), 739-760. DOI:10.1002/pits.20501.

FRIGERIO, A., CATTANEO, C., CATALDO, M., SCHIATTI, A., MOLTENI, M. & BATTAGLIA, M. (2004). Behavioral and emotional problems among Italian children and adolescents aged 4 to 18 years as reported by parents and teachers. *European Journal of Psychological Assessment*, *20*(2), 124-133. DOI: 10.1027/1015-5759.20.2.124.

GOLDSTEIN, S. & NAGLIERI, J.A. (2009). The changing face of autism: New data on attention impairments. *The ADHD Report*, *17*(3), 1-3. DOI:10.1521/adhd.2009.17.3.1.

GRÉGOIRE, J. (2013). Measuring components of intelligence mission impossible? *Journal of Psychoeducational Assessment*, *31*(2), 138-147. DOI:10.1177/0734282913478034.

IBM CORP. (2012). *IBM SPSS statistics for Windows, version 21.0*. Armonk, NY: IBM Corp.

ISEMAN, J.S. (Ed.). (2012). School success and cognitive instruction for students with ADHD. *The ADHD Report*, *20*(1), 1-6.

LÓPEZ-VILLALOBOS, J.A., LLANO, A.D., SÁNCHEZ-AZÓN, M. I., SANGUINO-ANDRÉS, R. & ALBEROLA-LÓPEZ, S. (2012). Disruptive behavior disorders: Multidimensional analysis. *International Journal of Clinical Health & Psychology*, *12*(3), 405-417.

MASI, G. (1998). Adolescents with borderline intellectual functioning: Psychopathological risk. *Adolescence*, *33*(130), 416.

NAGLIERI, J.A. (1999). *Essentials of CAS Assessment* (Vol. 2). New York: Wiley.

NAGLIERI, J.A. & DAS, J.P. (1997). *Cognitive Assessment System*. Itasca, IL: Riverside Publishing.

NAJAFI, S., SADEGHI, V., MOLAZADE, J., GOODARZI, M.A. & TAGHAVI, M.R. (2010). Brain cognitive functions in normal, ADHD and RD (Reading disable) children (A comparative study). *Procedia Social and Behavioral Sciences*, *5*, 1849-1853. DOI:10.1016/j.sbspro.2010.07.376.

ORSINI, A. & PICONE, L. (2006). *WISC-III: Contributo alla taratura italiana*. Firenze: Giunti O.S. Organizzazioni Speciali.

SCHUCHARDT, K., GEBHARDT, M. & MÄEHLER, C. (2010). Working memory functions in children with different degrees of intellectual disability. *Journal of Intellectual Disability Research*, *54*(4), 346-353. DOI: 10.1111/j.1365-2788.2010.01265.x.

SHAW, S.R. (2008). An educational programming framework for a subset of students with diverse learning needs borderline intellectual functioning. *Intervention in School and Clinic*, *43*(5), 291-299. DOI: 10.1177/1053451208314735.

SPARROW, E.P. & HUNTER, S.J. (2012). Reflections on executive functioning. In S.J. Hunter & E.P. Sparrow (Eds.), *Executive Function and Dysfunction. Identification, Assessment and Treatment*. New York: Cambridge University Press.

TADDEI, S. & CONTENA, B. (2013a). Brief report: Cognitive performance in autism and Asperger's syndrome: What are the differences? *Journal of Autism and Developmental Disorders*, *43*(12), 2977-2983. DOI:10.1007/s10803-013-1828-5.

TADDEI, S. & CONTENA, B. (2013b). Cognitive processes in ADHD and Asperger's disorder: Overlaps and differences in PASS profiles. *Journal of Attention Disorders*, advance online publication. DOI:1087054713510350.

TADDEI, S., CONTENA, B., CARIA, M., VENTURINI, E. & VENDITTI, F. (2011). Evaluation of children with Attention Deficit Hyperactivity Disorder and Specific Learning Disability on the WISC and Cognitive Assessment System (CAS). *Procedia Social and Behavioral Science*, 29, 574-582. DOI:10.1016/j.sbspro.2011.11.278.

TADDEI, S. & NAGLIERI, J.A. (2005). L'adattamento italiano del Das-Naglieri Cognitive Assessment System. In J.A. Naglieri & J.P. Das (Eds.), *Cognitive Assessment System*. Firenze: Giunti O.S. Organizzazioni Speciali.

VAN DER MEER, D.J. & VAN DER MEERE, J.J. (2004). Response inhibition in children with conduct disorder and borderline intellectual functioning. *Child Neuropsychology*, *10*(3), 189-194. DOI:10.1080/09297040409609809.

VAN DER MEERE, J.J., VAN DER MEER, D.J., KUNERT, H.J., BORGER, N. & PIRILA, S. (2008). Impulsive responses in children with conduct disorder and borderline intellectual functioning. *Child Neuropsychology*, *14*(2), 187-194. DOI:10.1080/09297040701660283.

VAN NIEUWENHUIJZEN, M., CASTRO, B., AKEN, M. & MATTHYS, W. (2009). Impulse control and aggressive response generation as predictors of aggressive behaviour in children with mild intellectual disabilities and borderline intelligence. *Journal of Intellectual Disability Research*, *53*(3), 233-242. doi:10.1111/j.1365-2788.2008.01112.x.

VAN NIEUWENHUIJZEN, M. & VRIENS, A. (2011). (Social) Cognitive skills and social information processing in children with mild to borderline intellectual disabilities. *Research in developmental disabilities*, *33*(2), 426-34. doi:10.1016/j.ridd.2011.09.025.

VUIJK, P.J., HARTMAN, E., SCHERDER, E. & VISSCHER, C. (2010). Motor performance of children with mild intellectual disability and borderline intellectual functioning. *Journal of Intellectual Disability Research*, 54(11), 955-965. DOI:10.1111/j.1365-2788.2010.01318.x.

WECHSLER, D. (1991). *The Wechsler intelligence scale for children – third edition*. San Antonio, TX: The Psychological Corporation.

WILLIS, J., DUMONT, R. & KAUFMAN, A. (2011). Assessment of intellectual functioning in children. In K. Geisinger (Ed.), *APA Handbook on Testing and Assessment*. Washington, DC: American Psychological Association.