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The GAI and CPI in the Italian standardization of the WAIS-IV and their clinical implications

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ABSTRACT. Accanto al QI totale della WAIS-IV in letteratura sono stati proposti due indici compositi: l'*Indice di Abilità Generale (IAG)* e *l'Indice di Competenza Cognitiva (ICC). L'IAG* è composto dai subtest di Comprensione Verbale e Ragionamento Visuo-percettivo, mentre l'ICC è composto dai subtest di Memoria di Lavoro e Velocità di Elaborazione. Nel presente lavoro di ampliamento della taratura italiana della WAIS-IV si forniscono le tabelle per l'individuazione dei due Indici per il campione di standardizzazione italiana e le tabelle relative al calcolo delle differenze tra QI e IAG e tra QI e ICC con le percentuali cumulate delle differenze per il campione totale e per 7 livelli di IAG e ICC. Inoltre, si riporta la tabella che mette a confronto i due indici IAG e ICC. Si spiega il metodo di calcolo della rarità tra i 4 indici di base per decidere se il QI è o no interpretabile. Si discute sull'uso di tali Indici in molti contesti clinici come ulteriori lenti attraverso cui poter focalizzare l'abilità dell'adulto con la WAIS-IV.

SUMMARY. The General Ability Index (GAI) and the Cognitive Proficiency Index (CPI) have been proposed along with the Full Scale IQ of the WAIS-IV. The GAI is formed by the scores of Verbal Comprehension and Perceptual Reasoning subtests, while the CPI is formed by Working Memory and Processing Speed subtests. This work provides tables to help identify the GAI and CPI for the Italian standardization sample, and also two tables for the calculation of differences between the FSIQ and the GAI and between the FSIQ and the CPI, with the cumulative percentages of differences for the total sample and for all seven levels of the GAI and CPI. Furthermore, the table also compares the GAI and CPI. The use of these indices in many clinical settings will also be discussed as an additional lens to focus on adult abilities using the WAIS-IV.

Keywords: *Intelligence, WAIS-IV, GAI, CPI, Unitary Ability, Italian standardization*

INTRODUCTION

The subtests of the Wechsler Adult Intelligence Scale - Fourth Edition (WAIS-IV, Wechsler, 2008a, 2013; Italian adaptation and adjustment by Orsini & Pezzuti, 2013, 2015) allow us to calculate following four composite scores, in addition to the Full Scale IQ: the Verbal Comprehension Index (VCI), which is a measure of abilities in forming verbal concepts, verbal reasoning and knowledge gained from the surrounding environment; the Perceptual Reasoning Index (PRI), which is a measure of fluid and visual-perceptual reasoning, spatial processing and the visual-motor integration process; the Working Memory Index (WMI) which involves the ability to temporarily hold information in the memory, to perform mental operations and to manipulate that information to produce results; and finally, the Processing Speed Index (PSI) which involves the ability to quickly and correctly analyse sequences or simple visual cues using short-term visual memory, attention and visual-motor coordination. These four indices come together to form a single Full Scale IQ (IQ) which, because of how it is composed, is therefore influenced by the working memory and processing speed; this is reflected in the research results and suggests that these are two key factors in overall intellectual functioning (Engle, Tirholski & Conway, 1999; Fry & Hale, 1996; Sub, Oberauer, Wittmann, Wilhelm & Schulzr, 2002; Vigil-Colet & Codorniu-Raga, 2002). However, it is possible for the composite score of the IQ to be affected by some variability of four underlying dimensions and this must always be taken into account by the clinician. So, two optional composite indices have been proposed alongside the Full Scale IQ and these are known as the General Ability Index (GAI) and the Cognitive Proficiency Index (CPI). The General Ability Index was introduced for the first time as part of the WISC-III (Wechsler, 1991) by Prifitera, Weiss & Saklofske (1998). It was created as an alternative measure of overall intellectual ability to the Full Scale IQ, having observed that students with learning disabilities showed deficits in working memory and processing speed, thus lowering their Full Scale IQ score. Furthermore, this reduced the amplitude of differences between the FSIQ and other measures of ability and academic performance, which leads to a higher likelihood that these subjects will not receive any kind of special education (Saklofske et al. 2005). As a result, Tulsky, Saklofske, Wilkins & Weiss (2001) established the GAI for the WAIS-III (Wechsler, 1997) and then the GAI for the WAIS-IV was finally presented in the WAIS-IV Technical & Interpretive Manual (Wechsler, 2008b). In particular, the sum of the age weighted scores of three Verbal Comprehension Index subtests (Similarities + Vocabulary + Information) and the three Perceptual Reasoning Index subtests (Block design + Matrix Reasoning + Visual Puzzles) is the basis for finding the General Ability Index (GAI) in the WAIS-IV. This index therefore makes it possible to obtain a general assessment of fluid and crystallized intelligence by excluding any subtests which, in relation to working memory and processing speed, are inadequate in many clinical contexts and may therefore give a distorted synthesis of the general intellectual level (Harrison, DeLisle, & Parker, 2008; Raiford, Weiss, Rolfhus & Coalson, 2005). This index was also created after having observed that while Verbal Comprehension and Perceptual Reasoning have high saturations of *g* factor intelligence in the WAIS-IV and all Wechsler intelligence tests, the saturations of *g* factor intelligence in the Working Memory and Processing Speed subtests are much lower. In fact, the GAI is a cognitive ability measure that highly correlates with the Full Scale IQ but is less sensitive to the basic cognitive processes measured by both the Working Memory and Processing Speed indices (Raiford et al., 2005; Tulsky et al., 2001; Weiss, Saklofske, Coalson & Raiford, 2010).

However, the latter two cognitive areas play an important role in overall intellectual functioning, such as the acquisition of new learning and the ability to use acquired knowledge (crystallized intelligence) to solve novel problems (fluid intelligence) (Weiss et al., 2010). So, it was proposed to investigate the General Ability Index counterpart as well: the Cognitive Processing Index (CPI). Specifically, the sum of the age weighted scores of two Working Memory subtests (Digit Span + Arithmetic) and two Processing Speed subtests (Coding + Symbol Search) form the basis for finding the Cognitive Processing Index (CPI) in the WAIS-IV. The CPI is therefore an index that summarises the outcomes of both the Working Memory and Processing Speed indices. This index was also first presented for the WISC-III by Dumont & Willis (2001) and then extended to the WISC-IV by Weiss, Saklofske, Prifitera and Holdnack (2006) and the WAIS-IV by Weiss et al. (2010). The CPI, represented by a quick visual speed, an efficient memory and good mental control, helps fluid reasoning and acquisition of new information, and reduces the cognitive load required by newer or more difficult tasks

(Weiss et al., 2006). It aids learning and problem solving, but excludes the effects of verbal comprehension and perceptual reasoning on intelligence. The CPI is a measure of how effectively a person is able to process cognitive information and could be considered an overall index of neurological efficiency (Weiss & Gabel, 2008).

The GAI and CPI are therefore designed to provide two different views of a person's cognitive abilities, especially when there is a significant and rare variation between the VCI, WMI, PRI and PSI and therefore the Full Scale IQ may be difficult to interpret as a unitary index of intellectual ability. Both indices are able to provide the clinical and school psychologist with an indication of efficient information processing that facilitates reasoning and reduces the cognitive load required, for example, when learning new material or performing new tasks (Berninger, O'Donnell, & Holdnack, 2008; Johnson, Humphrey, Mellard, Woods, & Swanson, 2010; Weiss et al., 2006).

More specifically, the working memory would facilitate reasoning and problem solving skills, allowing the integration of new information with that learned in the past and helping the individual to decide what to do (Alloway, 2006; Swanson & Saez, 2003). A slow process always requires more time to solve a task, with greater mental fatigue and difficulty (Weiss, et al., 2010; Weiss, Saklofske & Prifitera, 2005). Thus, both the working memory and the processing speed interact with higher-order cognitive functions by influencing reasoning and learning (Fry & Hale, 2000; Weiss et al., 2010, 2005).

International literature on the GAI and CPI of the WAIS-IV is very scarce and mainly refers to a few standardizations in various countries of the world. On the contrary, there are several clinical studies using both indices on children who have been administered the WISC-III and WISC-IV. In particular, research has shown that where neuropsychological deficits are present, the outcome of the working memory and processing speed subtests, which contribute to the calculation of IQ, is more likely to be impaired in comparison to the outcome of the verbal comprehension and perceptual reasoning subtests. In these cases, the Full Scale IQ may mask any real differences between general cognitive abilities and other specific cognitive abilities, such as working memory and processing speed. Harrison and colleagues (2008) noted that when comparing the GAI and the Full Scale IQ scores of adults with neurocognitive disorders (e.g. Specific Learning Disabilities - SLD, attention deficit hyperactivity disorder - ADHD, head injuries) against the scores of adults with more psychological disorders (e.g. depression, anxiety), the former had a lower score in the CPI than in the GAI, and the latter was always equal to or higher than the Full Scale IQ. They concluded that using these indices properly can provide evidence of a deterioration in neural bases. These results are consistent with those of other studies showing how processing deficits tend to lower Full Scale IQ scores in children and adults with SLD and ADHD (Bremner et al., 2011; Calhoun & Mayes, 2005; Harrison et al., 2008; Longman, 2004; Schwean & McCrimmon, 2008; Weiss & Gable, 2008; Weiss et al., 2006) and that the GAI score is significantly higher than the CPI (Bremner et al., 2011). However, there is also research in which the discrepancy between the GAI and CPI shows a reduced accuracy in identifying children with ADHD (Devena & Watlkins, 2012).

There is some level of agreement in the literature comparing the GAI and CPI based on the Full Scale IQ level, where the GAI is higher than the CPI in subjects with a higher IQ (>110) and much lower than the CPI in subjects with a lower IQ (Bremner et al., 2011; Weiss et al., 2010).

In the WAIS-IV Technical and Interpretive Manual (Wechsler, 2008b), more than 65% of subjects in clinical groups (with varying degrees of intellectual disability, head injury, ADHD, Asperger's syndrome, probable Alzheimer's) show a lower Full Scale IQ in the GAI. Even in a recent work conducted in Italy by Cornoldi, Giofrè, Orsini & Pezzuti (2014), the GAI is higher than the Full Scale IQ in children with SLD as these individuals have specific deficits in the working memory and processing speed indices. It can reasonably be concluded that, in these cases, the reduction in IQ correlated to the difficulties in working memory and/or processing speed can complicate the interpretation of the performance of that subject in other tests such as memory, executive functions or performance. So when a clinician suspects he is faced with a neuropsychological case, the GAI and CPI may be useful when interpreting strengths and weaknesses.

This work is an extension of the Italian standardization of the WAIS-IV intended to put forward the most significant statistics (means, standard deviations, reliability and standard errors of measurement) of the GAI and CPI for the Italian standardization sample (16-90 years old). Additionally, it aims to propose the necessary tables for the transformation of the sum of the age weighted scores of the GAI and CPI subtests with a mean of 100 and standard deviation of 15 (with percentile ranks and confidence intervals of 90% and 95%). Additionally, there are tables for the identification of the

frequency percentage of differences between the FSIQ and GAI and between the FSIQ and CPI, both for the total sample and for the seven levels of GAI and CPI respectively. Lastly, this work aimed to produce a Table comparing the two indices.

METHODS

Sample

Italian standardization of the WAIS-IV was published on two successive dates for editorial reasons. First publication focused on standardizing subjects between 16 and 69 years of age (Orsini & Pezzuti, 2013) and second focused on those between 70 and 90 years of age (Orsini & Pezzuti, 2015): two normative samples representative of the Italian population according to level of education of subjects. All analyses of this study were carried out by unifying data of both normative samples: 1) first sample of 1424 subjects (697 males and 727 females) aged between 16 years, 0 months, 0 days and 69 years, 11 months and 30 days; 2) and second sample of 750 subjects (375 males and 375 females) aged between 70 years, 0 months, 0 days and 90 years, 11 months and 30 days. Both samples are representative of the population according to age, gender and level of education according to the latest ISTAT census of 2011. Specifically, number 5 of distinct subjects by gender in the following 13 age groups are: 16-17 years (N = 139: 69F and 70M); 18-19 years (N = 137: 71F and 66M); 20-24 years (N = 174: 83F and 91M); 25-29 years (N = 187: 93F and 94M); 30-34 years (N = 150: 78F and 72M); 35-44 years (N = 178: 87F and 91M); 45-54 years (N = 173: 74F and 99M); 55-64 years (N = 168: 81F and 87M); 65-69 years (N = 118: 61F and 57M); 70-74 years (N = 200: 100F and 100M); 75-79 years (N = 200: 100F and 100M); 80-84 years (N = 200: 100F and 100M); 85-90 years (N = 150: 75F and 75M).

Procedure

In summary, sum of three Verbal Comprehension subtests and three Perceptual Reasoning subtests form the basis for calculating the General Ability Index (GAI = Similarities + Vocabulary + Information + Block Design + Matrix Reasoning + Visual Puzzles); the two Working Memory subtests and two Processing Speed subtests form the basis for identifying the Cognitive Proficiency Index (CPI = Digit Span + Arithmetic + Coding + Symbol Search).

The procedure used to create the GAI and CPI norms is the same as that used in the US standardization of the WAIS-IV. In the first step, the sum of the age weighted scores of six subtests in the General Ability scale (GA - three Verbal Comprehension subtests and three Perceptual Reasoning subtests) and four subtests in the Cognitive Proficiency scale (CP - two Working Memory subtests and two Processing Speed subtests) and mean and standard deviations were calculated for each age group. ANOVA and Bartlett's test for homogeneity of variances were then carried out, from which no statistically significant differences due to age were shown between means and variances (see Table 1).

In the light of the results of this methodological step, the subjects of both samples were unified into a single data file. Two distributions of the sums of the age weighted scores for the GAI and CPI were transformed linearly into IQs with a mean of 100 and standard deviation of 15. Conversion tables of the sums of weighted scores for the GAI and CPI were then created.

For both the GAI and CPI, reliability coefficients were calculated for each age group using Mosier's formula (1943), and using the average rtt calculated with Fisher's z-transformation for the overall sample. The Mosier formula allows us to calculate the reliability of a composite score, such as the GAI, starting with the reliability of the individual subtests involved.

So, the cumulative percentages of differences between the FSIQ and GAI and between the FSIQ and CPI were calculated on both samples, both for the total sample and for all seven different levels of GAI and CPI in order to identify the "rarity" of the FSIQ-GAI and FSIQ-CPI differences. Lastly, a Table was created to compare the GAI and CPI.

RESULTS

Table 2 shows reliability and standard errors of measurement by age group and the overall sample for both the GAI and CPI. There are no statistic norms to interpret the reliability coefficient but it generally follows a rule of thumb (see Nunnally & Bernstein, 1994) as follows: values less than .60 are considered inadequate; values between .60 and .70 are considered adequate; values between .70 and .80 are considered reasonable; values between .80 and .90 are considered good.

Table 1 - Means and standard deviations of the sums of age weighted scores forming General Abilities (AG) and Cognitive Proficiency (CP) scales: Anova and Bartlett's test results from 13 age groups

Age group	GA sum of age weighted scores		CP sum of age weighted scores	
	Mean	SD	Mean	SD
16-17	59.8	12.8	39.9	9.00
18-19	60.4	13.3	39.9	8.24
20-24	60.1	12.3	40.1	9.21
25-29	59.9	12.2	40.1	8.19
30-34	60.3	13.6	40.0	7.82
35-44	60.1	13.7	40.0	8.71
45-54	60.0	13.5	40.0	8.95
55-64	60.0	13.4	39.7	8.97
65-69	60.0	12.4	39.9	9.42
70-74	60.9	14.2	39.8	9.88
75-79	59.0	13.0	40.2	9.47
80-84	58.8	13.6	40.4	9.99
85-90	61.0	14.9	39.4	8.90
$F_{(12, 2161)}$	.40	—	.13	
Bartlett's Test $\chi^2_{(12)}$	13.20		20.55	

With regard to the GAI, the reliability of the various age groups ranges from .95 (16-17, 20-24 and 25-29 years) to .98 (85-90 years). With regard to the reliability of the CPI, the ranges are .90 (25-29 years) to .96 (65-69, 70-74, 75-79, 80-84 and 85-89 years). The average reliability for the GAI and CPI are .96 and .94, respectively. It is reasonable to conclude that all the reliability coefficients are good to high.

Tables 3 and 4 show data for the conversion of the sums of weighted scores that form the General Abilities in the GAI, and the Cognitive Proficiencies in the CPI. In addition, each index has its own percentile rank and two confidence intervals of 90% and 95%.

As an example of the applicability of these tables, let us assume that a person has achieved the following sums of weighted scores in indices: 40 in Verbal Comprehension, 35 in Perceptual Reasoning, 20 in Working Memory and 25 in Processing Speed. To find the GAI, we need to find out the sum of the weighted score in the GA scale, taken from Verbal Comprehension and Perceptual Reasoning: this sum would be 75. In Table 3, we look for 75 in the first column titled "Sum of WS", which has a GAI of 117 (above average, see Table 2-5, page 20, Orsini & Pezzuti, 2013), a percentile rank of 88, which indicates that 88% of subjects from the Italian population scored a GAI up to 117, and two confidence intervals within which the true score of the subject would fall according to two levels of probability, 90% and 95%. The CPI can be calculated in the same way and in this case it would be 108.

Both the GAI and the CPI can be compared to the Full

Table 2 - Reliability indices and standard errors of measurement by age group and for the total sample

Age group	GAI		CPI	
	Reliability	SEM	Reliability	SEM
16-17	.95	3.27	.91	4.14
18-19	.96	3.16	.94	3.93
20-24	.95	3.29	.92	3.85
25-29	.95	3.30	.90	4.27
30-34	.97	2.82	.92	4.11
35-44	.96	3.14	.94	3.84
45-54	.96	3.03	.95	3.58
55-64	.96	2.96	.94	4.01
65-69	.96	2.83	.96	3.37
70-74	.97	2.45	.96	3.05
75-79	.97	2.31	.96	2.75
80-84	.97	2.53	.96	3.03
85-90	.98	2.45	.96	3.08
16-90 years sample	.96*	2.91	.94*	3.65

*r_{tt} mean calculated with Fisher's Z-transformation

Scale IQ of the subjects: the comparison between the GAI and IQ shows an assessment of the effects of working memory and processing speed on the general expression of cognitive ability; on the contrary, the comparison between the CPI and IQ shows an assessment of the effects of crystallized and fluid intelligence on IQ. When the difference between these pairs of indices is not rare among the normal population (therefore, with a healthy neuropsychological functioning), according to Saklofske et al. (2005) and Tulsky et al. (2001), the GAI provides a good approximate measure of overall intellectual ability. This also applies to the Full Scale IQ.

Tables 5 and 6 show the cumulative percentages of the differences between the two Italian standardization samples according to the following seven levels of ability of the GAI (GAI <70; GAI 70-79; GAI 80-89; GAI 90-109; GAI 110 -119; GAI 120-129; GAI >129) and CPI (CPI <70; CPI 70-79, CPI 80-89; CPI 90-109, CPI 110-119; CPI 120-129, CPI >129). These allow the identification of any rarities. To use these tables, the Full Scale IQ is calculated first, then the GAI and the CPI, then the GAI is subtracted from the Full Scale IQ. We then search for the value of difference in Tables 5 and 6 in either the columns for the group total or the columns for the level of GAI and CPI achieved by the subject without taking the sign into account. We then scroll across the row to the cumulative percentage in the column, where the sign is then taken into account. In this way, we can see if the differences can be considered rare and thus worthy of clinical study. Defining whether a difference is rare or not is tricky. Indeed, Sattler (2008) believes that a difference occurring in less than 15% of subjects can be considered rare, while Weiss et al. (2010) say 10%. The cut-off

Table 3 – Conversion of the sums of age weighted scores for the GAI for 16-90 years sample

			Confidence interval					Confidence interval					Confidence interval	
Sum of WS	**GAI**	**Rp**	**90%**	**95%**	**Sum of WS**	**GAI**	**Rp**	**90%**	**95%**	**Sum of WS**	**GAI**	**Rp**	**90%**	**95%**
6	39	<.1	37-46	36-47	24	59	<.1	56-65	55-66	42	80	9	76-85	75-86
7	40	<.1	38-47	37-48	25	61	<.1	58-67	57-68	43	81	10	77-86	76-87
8	41	<.1	39-48	38-49	26	62	<.1	59-68	58-69	44	82	11	78-87	77-88
9	43	<.1	40-50	40-51	27	63	1	60-69	59-70	45	83	13	79-88	78-89
10	44	<.1	41-51	41-52	28	64	1	61-70	60-71	46	84	15	80-89	79-90
11	45	<.1	42-52	42-52	29	65	1	62-71	61-72	47	85	17	81-90	80-91
12	46	<.1	43-53	42-53	30	66	1	63-72	62-73	48	86	19	82-91	81-92
13	47	<.1	44-54	43-54	31	67	1	64-73	63-74	49	88	21	84-93	83-94
14	48	<.1	45-55	44-55	32	68	2	65-74	64-75	50	89	24	85-94	84-95
15	49	<.1	46-55	45-56	33	70	2	66-76	66-77	51	90	26	86-95	85-96
16	50	<.1	47-56	46-57	34	71	2	67-77	67-78	52	91	28	87-96	86-97
17	52	<.1	49-58	48-59	35	72	3	68-78	68-79	53	92	31	88-97	87-98
18	53	<.1	50-59	49-60	36	73	4	69-79	68-79	54	93	34	89-98	88-99
19	54	<.1	51-60	50-61	37	74	4	70-80	69-80	55	94	38	90-99	89-100
20	55	<.1	52-61	51-62	38	75	5	71-81	70-81	56	96	41	92-101	91-102
21	56	<.1	53-62	52-63	39	76	6	72-81	71-82	57	97	45	92-102	92-103
22	57	<.1	54-63	53-64	40	77	7	73-82	72-83	58	98	48	93-103	93-104
23	58	<.1	55-64	54-65	41	79	7	75-84	74-85	59	99	50	94-104	94-105

continued on next page

continued

			Confidence interval					Confidence interval					Confidence interval	
Sum of WS	**GAI**	**Rp**	**90%**	**95%**	**Sum of WS**	**GAI**	**Rp**	**90%**	**95%**	**Sum of WS**	**GAI**	**Rp**	**90%**	**95%**
60	100	53	95-105	95-105	79	121	93	116-125	115-126	98	143	>99.9	137-146	136-147
61	101	57	96-106	95-106	80	123	93	118-127	117-128	99	144	>99.9	138-147	137-148
62	102	59	97-107	96-107	81	124	94	119-128	118-129	100	145	>99.9	139-148	138-149
63	103	62	98-108	97-108	82	125	95	119-129	119-130	101	146	>99.9	140-149	139-150
64	105	64	100-109	99-110	83	126	96	120-130	120-131	102	147	>99.9	141-150	140-151
65	106	67	101-110	100-111	84	127	96	121-131	121-132	103	148	>99.9	142-151	141-152
66	107	70	102-111	101-112	85	128	97	122-132	121-132	104	150	>99.9	144-153	143-154
67	108	72	103-112	102-113	86	129	97	123-133	122-133	105	151	>99.9	145-154	144-155
68	109	75	104-113	103-114	87	130	98	124-134	123-134	106	152	>99.9	145-155	145-156
69	110	78	105-114	104-115	88	132	98	126-135	125-136	107	153	>99.9	146-156	146-157
70	111	79	106-115	105-116	89	133	98	127-136	126-137	108	154	>99.9	147-157	147-158
71	112	81	107-116	106-117	90	134	98	128-137	127-138	109	155	>99.9	148-158	148-158
72	114	83	109-118	108-119	91	135	98	129-138	128-139	110	156	>99.9	149-159	148-159
73	115	85	110-119	109-120	92	136	99	130-139	129-140	111	157	>99.9	150-160	149-160
74	116	86	111-120	110-121	93	137	99	131-140	130-141	112	159	>99.9	152-161	151-162
75	117	88	112-121	111-122	94	138	99	132-141	131-142	113	160	>99.9	153-162	152-163
76	118	89	113-122	112-123	95	139	99	133-142	132-143	114	161	>99.9	154-163	153-164
77	119	90	114-123	113-124	96	141	99	135-144	134-145					
78	120	92	115-124	114-125	97	142	99	136-145	135-146					

Note. Sum of WS = sum of age weighted scores of the subtests: Similarities + Vocabulary + Information + Block Design + Matrix Reasoning + Visual Puzzles.

Table 4 – Conversion of the sums of age weighted scores for the CPI for 16-90 years sample

			Confidence interval					Confidence interval	
Sum of WS	**CPI**	**Rp**	**90%**	**95%**	**Sum of WS**	**CPI**	**Rp**	**90%**	**95%**
4	40	<.1	38-49	37-50	29	82	12	77-89	76-90
5	42	<.1	40-51	39-52	30	83	15	78-90	77-91
6	43	<.1	41-52	39-53	31	85	18	80-92	79-93
7	45	<.1	42-54	41-55	32	87	21	82-93	81-94
8	47	<.1	44-56	43-57	33	88	24	83-94	82-95
9	48	<.1	45-57	44-58	34	90	28	85-96	84-97
10	50	<.1	47-59	46-60	35	92	32	87-98	86-99
11	52	<.1	49-60	48-61	36	93	36	88-99	87-100
12	53	<.1	50-61	49-62	37	95	41	90-101	89-102
13	55	<.1	52-63	51-64	38	97	46	91-103	90-104
14	57	<.1	54-65	53-66	39	98	50	92-104	91-105
15	58	<.1	55-66	54-67	40	100	54	94-106	93-107
16	60	<.1	57-68	56-69	41	102	58	96-108	95-109
17	62	<.1	58-70	57-71	42	103	63	97-109	96-110
18	63	<.1	59-71	58-72	43	105	67	99-110	98-111
19	65	1	61-73	60-74	44	107	71	101-112	100-113
20	67	1	63-75	62-76	45	108	74	102-113	101-114
21	68	1	64-75	63-77	46	110	78	104-115	103-116
22	70	2	66-77	65-78	47	112	81	106-117	105-118
23	72	2	68-79	67-80	48	113	83	107-118	106-119
24	73	3	69-80	68-81	49	115	86	108-120	107-121
25	75	4	71-82	70-83	50	117	88	110-122	109-123
26	77	6	73-84	72-85	51	118	90	111-123	110-124
27	78	7	74-85	72-86	52	120	91	113-125	112-126
28	80	10	75-87	74-88	53	122	93	115-126	114-127

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			Confidence interval					Confidence interval	
Sum of WS	CPI	Rp	90%	95%	Sum of WS	CPI	Rp	90%	95%
54	123	94	116-127	115-128	66	143	>99.9	135-146	134-147
55	125	95	118-129	117-130	67	145	>99.9	137-148	136-149
56	127	96	120-131	119-132	68	147	>99.9	139-150	138-151
57	128	97	121-132	120-133	69	148	>99.9	140-151	139-152
58	130	97	123-134	122-135	70	150	>99.9	141-153	140-154
59	132	98	124-136	123-137	71	152	>99.9	143-155	142-156
60	133	98	125-137	124-138	72	153	>99.9	144-156	143-157
61	135	99	127-139	126-140	73	155	>99.9	146-158	145-159
62	137	99	129-141	128-142	74	157	>99.9	148-159	147-161
63	138	99	130-142	129-143	75	158	>99.9	149-160	148-161
64	140	>99.9	132-143	131-144	76	160	>99.9	151-162	150-163
65	142	>99.9	134-145	133-146					

Note. Sum of WS = sum of age weighted scores of the subtests: Digit Span + Arithmetic + Symbol Search + Coding

may be determined by the clinician, while remaining below 15%. So if, for example, differences obtained by less than 10% of the sample are considered rare, we can see that there are few differences equal to or greater than 7 and 10 for the GAI and CPI respectively of the total sample (see Table 5 and 6).

Lastly, Table 7 shows the occurrence frequency of differences between the GAI and CPI both for the total sample and for varying levels of the FSIQ.

Once again, if we are using 10% as a criterion of rarity, Table 7 shows that a difference of 15 points between the GAI and CPI can be considered rare and worthy of clinical investigation where it is negative (i.e. GAI < CPI) and 16 points where it is positive (i.e. GAI > CPI).

A confirmed result in existing literature (Weiss et al., 2010) is that the frequencies of the differences between GAI and CPI may vary depending on general ability level (IQ). With an IQ below 90, it seems more likely for the GAI to be lower than the CPI, and inversely, with an IQ above 90, the GAI is higher than the CPI.

CONCLUSION AND DISCUSSION

In general, the Full Scale IQ should be considered the most valid measure of global cognitive ability; working memory and processing speed are essential for a full assessment of cognitive ability, and excluding these two measures from the overall score of the IQ reduces the amplitude of the construct. This is important to bear in mind because, when Prifitera, Saklofke & Weiss (2005) suggested for the first time that clinicians use the GAI as an alternative way to sum up general intellectual ability, the suggestion led many clinicians to prefer it over the Full Scale IQ and to consider it as the best index for summarising intellectual ability. Thus, subsequently Weiss et al. (2010) have since specified that the GAI must only be used alone when there are important clinical reasons that require the exclusion of the weight of the working memory and processing speed in an intellectual evaluation. Indeed, when faced with neuropsychological deficits (e.g.

Table 5 – Cumulative percentages of the FSIQ-GAI differences for the total sample and for various levels of the GAI

	16-90 years sample (N=2174)		GAI <70 (N=33)		GAI 70-79 (N=130)		GAI 80-89 (N=348)		GAI 90-109 (N=1114)		GAI 110-119 (N=336)		GAI 120-129 (N=151)		GAI >129 (N=62)		
	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	
Diff.	(–)	(+)	(–)	(+)	(-)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	**Diff.**
22																	22
21																	21
20											.3						20
19											.3						19
18											.3						18
17										.1	.3						17
16	.1	.1						.3	.1	.1	.3						16
15	.2	.1						.3	.2	.1	.3	.3	.7				15
14	.2	.3						.6	.3	.4	.3	.3	.7				14
13	.4	.5						1.1	.5	.5	.3	.3	1.3				13
12	.9	.8	3.0				.3	1.4	.8	.9	1.2	.6	2.6		1.6		12
11	1.4	1.2	3.0			.8	.9	1.7	1.3	1.4	1.8	1.2	3.3		1.6		11
10	2.2	2.3	3.0			3.8	.9	2.3	2.3	2.6	2.7	2.1	5.3	.7	1.6		10
9	3.4	3.3	6.1		.8	3.8	1.4	3.7	3.3	3.8	4.2	3.0	9.3	.7	1.6		9
8	5.4	5.2	6.1		3.1	5.4	1.4	5.7	5.7	6.2	6.0	4.2	13.2	2.0	6.5		8
7	8.2	8.2	9.1	6.1	4.6	10.8	2.6	8.6	8.3	9.2	10.1	7.1	17.9	4.6	11.3		7

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	16-90 years sample (N=2174)		**GAI <70 (N=33)**		**GAI 70-79 (N=130)**		**GAI 80-89 (N=348)**		**GAI 90-109 (N=1114)**		**GAI 110-119 (N=336)**		**GAI 120-129 (N=151)**		**GAI >129 (N=62)**		
	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	IQ<GAI	IQ>GAI	
Diff.	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	**Diff.**
6	12.1	11.5	12.1	6.1	6.9	12.3	6.6	12.9	11.3	11.9	15.5	10.1	22.5	9.9	24.2	4.8	6
5	15.9	16.4	12.1	12.1	10.0	18.5	9.5	19.5	14.9	17.0	21.4	11.7	25.8	14.6	29.0	6.5	5
4	22.7	22.3	12.1	18.2	16.9	26.9	15.5	25.3	21.3	23.8	30.4	17.6	33.8	18.5	37.1	6.5	4
3	28.8	29.7	18.2	33.3	20.8	34.6	21.8	33.6	27.6	31.1	37.5	24.1	37.7	23.8	45.2	16.1	3
2	36.8	36.5	21.2	48.5	26.9	43.1	30.5	40.5	35.6	38.4	45.8	28.3	45.0	29.8	54.8	19.4	2
1	46.3	45.3	42.4	54.5	36.9	57.7	37.6	51.7	44.8	46.7	56.8	35.1	55.6	37.7	64.5	25.8	1
Mean	4.0	4.0	3.5	3.2	3.4	3.7	3.4	4.0	4.0	4.2	4.1	4.4	4.9	3.8	4.3	3.1	Mean
SD	2.8	2.8	3.6	1.8	2.3	2.7	2.2	2.9	2.8	2.8	2.9	2.8	3.4	2.3	2.5	1.8	SD
Mdn	3.0	3.0	1.5	3.0	3.0	3.0	3.0	3.0	3.0	4.0	4.0	3.5	4.0	3.0	4.0	3.0	Mdn
Mean	–.02		.30		.91		.80		.16		–.88		–1.32		–2.00		Mean
SD	4.7		4.3		4.2		4.3		4.7		4.8		5.1		3.9		SD

Table 6 - Cumulative percentages of the FSIQ-CPI differences for the total sample and for various levels of the CPI

	16-90 years sample (N=2174)		CPI <70 (N=29)		CPI 70-79 (N=133)		CPI 80-89 (N=351)		CPI 90-109 (N=1104)		CPI 110-119 (N=332)		CPI 120-129 (N=149)		CPI >129 (N=76)		
	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	
Diff.	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	**Diff.**
22	.0	.1						.6					.7				22
21	.1	.2						.9		.2			.7		1.3		21
20	.2	.3		3.4				.9	.1	.2			1.3		1.3		20
19	.4	.5		6.9				1.1	.3	.4		.3	2.7		2.6		19
18	.7	.7		10.3		.8		1.4	.6	.5	.3	.3	3.4		2.6		18
17	1.0	1.4		13.8		2.3		2.0	.9	1.4	.6	.6	4.7	.7	3.9		17
16	1.3	1.9		13.8		3.0	.3	2.3	1.0	1.8	1.2	1.5	6.0	.7	5.3		16
15	2.3	2.8		13.8		3.0	1.4	3.7	1.8	3.1	1.8	1.8	7.4	.7	10.5		15
14	2.8	3.2		13.8	1.5	3.8	1.4	3.7	2.1	3.6	3.0	2.1	7.4	.7	11.8		14
13	3.6	4.1		20.7	1.5	4.5	2.3	6.6	2.6	4.3	4.5	2.7	10.1	.7	11.8		13
12	4.6	5.2		20.7	3.8	4.5	3.1	9.1	3.3	5.4	5.7	3.0	11.4	1.3	11.8		12
11	6.7	6.7		20.7	5.3	7.5	4.8	12.0	4.4	6.3	10.2	4.8	17.4	2.7	15.8		11
10	8.8	9.3		20.7	8.3	11.3	5.7	15.4	6.3	8.7	13.6	6.9	20.8	4.7	19.7	1.3	10
9	10.9	11.2	3.4	24.1	9.0	12.8	6.6	17.9	8.2	10.8	15.4	9.0	24.2	4.7	28.9	2.6	9
8	13.4	13.9	3.4	24.1	11.3	16.5	7.4	21.4	11.1	13.7	18.4	11.1	28.9	4.7	31.6	3.9	8
7	17.5	17.4	6.9	37.9	14.3	20.3	9.4	24.8	15.6	17.1	23.2	14.8	32.9	6.0	36.8	7.9	7

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	16-90 years sample (N=2174)		**CPI <70 (N=29)**		**CPI 70-79 (N=133)**		**CPI 80-89 (N=351)**		**CPI 90-109 (N=1104)**		**CPI 110-119 (N=332)**		**CPI 120-129 (N=149)**		**CPI >129 (N=76)**		
	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	IQ<CPI	IQ>CPI	**Diff.**
Diff.	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	
6	20.4	20.9	10.3	41.4	15.8	24.1	11.4	30.2	18.3	20.9	26.8	16.9	38.3	7.4	42.1	9.2	6
5	24.8	25.7	10.3	51.7	17.3	28.6	14.0	35.3	23.4	25.6	32.2	21.1	44.3	12.8	44.7	13.2	5
4	29.3	31.2	10.3	58.6	21.1	35.3	17.9	42.2	27.6	30.9	38.3	26.8	49.7	16.8	47.4	14.5	4
3	34.6	36.6	17.2	65.5	26.3	42.9	21.4	46.2	33.9	37.0	43.7	30.1	53.7	22.8	50.0	18.4	3
2	40.8	41.9	20.7	69.0	33.8	51.1	28.2	52.1	39.9	42.8	49.7	32.8	59.1	27.5	56.6	25.0	2
1	46.1	47.8	27.6	69.0	36.1	55.6	34.2	59.5	45.5	48.6	55.1	38.3	62.4	33.6	62.3	30.3	1
Mean	5.9	5.9	4.0	8.6	5.7	5.9	5.0	6.5	5.4	5.0	6.2	5.9	7.8	4.4	8.0	4.2	Mean
SD	4.2	4.2	3.0	6.6	3.8	4.2	4.0	4.6	3.8	4.2	4.0	4.0	4.9	3.4	5.2	2.8	SD
Mdn	5.0	5.0	3.0	7.0	4.0	5.0	4.0	6.0	5.0	5.0	5.0	5.0	7.0	3.5	7.5	3.0	Mdn
Mean	.10		4.79		1.22		2.20		.37		–1.19		–3.39		–3.76		Mean
SD	7.0		8.0		6.7		6.8		6.7		6.9		7.2		7.1		SD

Table 7 – Cumulative percentages of the GAI-CPI differences for the total sample and for various levels of the FSIQ

	16-90 years sample (N=2174)		IQ <70 (N=39)		IQ 70-79 (N=130)		IQ 80-89 (N=355)		IQ 90-109 (N=1087)		IQ 110-119 (N=338)		IQ 120-129 (N=161)		IQ >129 (N=64)		
	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	
Diff.	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	**Diff.**
25	1.5	1.8			1.5		1.7	1.1	1.2	1.7	2.7	3.6	1.9	2.5		1.6	25
24	1.9	2.3			1.5		2.0	1.4	1.7	2.3	3.3	3.8	1.9	4.3		1.6	24
23	2.1	2.8			2.3		2.3	1.4	1.9	2.7	3.3	5.6	1.9	4.3		1.6	23
22	2.7	3.4			2.3	.8	3.7	1.4	2.2	3.3	4.1	6.2	2.5	5.6		1.6	22
21	3.2	4.0			3.1	1.5	3.7	2.3	2.8	3.6	5.0	7.1	3.7	6.2		4.7	21
20	4.0	4.7			4.6	1.5	3.9	2.8	3.7	4.3	5.9	8.6	4.3	6.8	1.6	6.3	20
19	5.2	5.8	2.6		6.9	2.3	4.2	3.1	4.9	6.0	7.7	8.6	5.0	8.1	1.6	7.8	19
18	6.1	6.6	5.1		6.9	2.3	4.5	4.2	6.2	6.8	7.7	9.5	7.5	8.7	1.6	9.4	18
17	7.1	7.5	7.7		7.7	2.3	5.4	4.2	7.4	8.0	8.9	10.1	7.5	10.6	1.6	9.4	17
16	8.0	8.6	12.8	2.6	9.2	3.1	6.5	5.1	8.1	9.1	9.5	11.2	7.5	12.4	3.1	10.9	16
15	9.6	10.3	15.4	7.7	11.5	3.1	7.3	6.8	9.6	10.9	10.9	13.0	10.6	15.5	6.3	10.9	15
14	11.2	11.4	23.1	7.7	12.3	4.6	8.7	7.3	11.1	12.3	12.7	13.6	11.8	16.8	6.3	10.9	14
13	12.9	12.9	25.6	7.7	13.8	4.6	11.5	9.6	12.8	13.7	14.2	15.7	12.4	18.0	6.3	12.5	13
12	15.3	15.4	28.2	7.7	17.7	6.2	13.5	11.8	15.5	15.9	15.7	18.6	14.9	21.1	7.8	17.2	12
11	17.3	17.3	28.2	10.3	20.0	7.7	16.1	13.8	17.4	17.7	18.0	21.3	15.5	23.0	10.9	20.3	11
10	19.5	19.6	33.3	10.3	21.5	10.0	18.0	16.6	19.2	19.7	21.0	24.0	19.3	25.5	15.6	25.0	10

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	16-90 years sample (N=2174)		**IQ <70 (N=39)**		**IQ 70-79 (N=130)**		**IQ 80-89 (N=355)**		**IQ 90-109 (N=1087)**		**IQ 110-119 (N=338)**		**IQ 120-129 (N=161)**		**IQ >129 (N=64)**		
	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	GAI< CPI	GAI> CPI	
Diff.	(-)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	(–)	(+)	**Diff.**
9	21.6	22.2	41.0	10.3	23.1	12.3	19.7	18.3	21.7	22.8	21.9	26.0	21.1	28.6	15.6	25.0	9
8	24.5	24.9	43.6	17.9	25.4	16.2	21.4	21.1	25.1	25.5	24.9	28.1	23.0	32.3	18.8	28.1	8
7	27.5	27.6	48.7	17.9	30.0	20.0	25.1	23.1	27.5	28.2	28.4	32.0	25.5	34.8	23.4	28.1	7
6	31.2	31.3	56.4	17.9	36.2	20.8	29.0	27.6	31.3	31.8	31.4	35.5	26.7	37.9	26.6	32.8	6
5	33.9	34.4	59.0	20.5	43.1	24.6	32.4	31.8	33.3	34.9	34.6	38.2	29.2	39.8	28.1	34.4	5
4	37.1	38.5	61.5	23.1	44.6	29.2	36.6	34.9	36.9	38.5	37.6	42.6	30.4	47.2	32.8	40.6	4
3	40.4	41.6	64.1	25.6	49.2	30.8	38.9	38.9	40.8	42.0	40.5	45.3	32.3	49.1	39.1	43.8	3
2	44.0	45.3	33.3	30.8	52.3	37.7	44.5	40.6	44.2	45.8	42.3	48.5	36.0	54.7	43.8	50.0	2
1	47.4	49.1	41.0	30.8	56.9	41.5	49.0	45.9	47.0	49.8	45.3	50.6	40.4	57.8	15.6	53.1	1
Mean	9.3	9.3	10.6	6.8	8.9	6.8	8.5	8.3	9.3	9.4	10.4	10.6	9.9	10.0	7.1	9.2	Mean
SD	6.7	7.0	4.9	4.7	6.3	5.1	6.6	6.3	6.7	7.1	7.5	7.6	7.2	7.2	5.1	6.7	SD
Mdn	8.0	8.0	10.0	6.0	7.0	5.5	7.0	7.0	8.0	8.0	8.0	9.0	9.0	8.0	7.0	8.0	Mdn
Mean	.2		–7.0		–3.0		–1.2		.2		1.5		2.9		2.9		Mean
SD	11.4		5.6		6.2		6.2		6.8		7.5		7.4		6.5		SD

dementia, head trauma, ADHD, etc.) or physical or sensory deficits, performance in working memory and processing speed tasks are more likely to be impaired than in verbal comprehension and perceptual reasoning tasks. In these cases, a reduced performance in working memory and/or processing speed tasks may conceal differences between general cognitive ability (represented by Full Scale IQ) and other cognitive functions (e.g. memory). There are also works showing that using the GAI alone for those diagnosed with an intellectual disability is of limited value (Koriakin et al., 2013). It is therefore reasonable to think that the General Ability Index together with the Cognitive Proficiency Index should be considered additional indices to help the clinician identify strengths and weaknesses based on comparisons between general abilities and other cognitive functions. These indices can provide the basis for an additional layer of interpretation, allowing the clinician to investigate any differences among reasoning abilities (crystallized and fluid) and processing abilities (working memory and processing speed).

Hence, the GAI is not made to replace the Full Scale IQ but, as stated in the Technical and Interpretative Manual of the WAIS-IV (Wechsler, 2008), it should be reported and interpreted just like the Full Scale IQ and Four Basic Indices (VCI, PRI, WMI and PSI), bearing in mind that the GAI is still not considered the best estimate of general intellectual ability over the Full Scale IQ (Weiss, et al. 2010). However, one could say that the GAI may be used as a measure of general cognitive abilities when working memory and processing speed are not significantly different from verbal and non-cognitive abilities.

So, the GAI and CPI should always be used together, especially when there is a statistically significant and rare difference between the highest and the lowest of the four indices: VCI, PRI, WMI and PSI. In the latter case, the Full Scale IQ cannot be defined as a unitary expression of intellectual ability (Lichtenberger & Kaufman, 2009) and the GAI may provide a measure of crystallized and fluid intellectual efficiency while the CPI provides a separate processing measure of working memory and processing speed. Since there are many misunderstandings and doubts among Italian professionals using the Wechsler scales with regard to the correct threshold for deciding whether a Full Scale IQ may be defined as unitary, this work aims to make the most of the opportunity in order to provide a little clarification on this topic in the hopes of resolving such doubts. In order to define the unitary nature of the Full Scale IQ of all the Wechsler scales, Lichtenberger & Kaufman (2009) refer to using a rarity threshold of 23 IQ points difference between the highest score (Max) and the lowest score (Min) of the four indices (VCI, PRI, WMI and PSI) that any one person can achieve. This threshold value of 23 was calculated using the formula 1.5**SD*, where: 1.5 is the z value associated with a proportion of the area under the normal distribution curve, a value chosen to identify 6.7% of cases (expression of rarity) on the tail of the curve; and *SD* is the standard deviation to be used. Lichtenberger and Kaufman use the standard deviation for the distribution of IQ or the Indices, which have a mean of 100 and standard deviation of 15. Thus the formula becomes: 1.5*15 = 22.5 which was rounded to 23. This threshold has been considered, and is still considered by many, as the rarity threshold for all the latest editions of the Wechsler scales (WISC-IV, WAIS-IV) to determine whether the difference between the four indices is believed to be rare. This rarity threshold applies to all standardizations for every country in the world.

However, in two recent works on the unitary nature of the Full Scale IQ of the WISC-IV (Orsini, Pezzuti & Hulbert, 2014) and WAIS-IV (Orsini, Pezzuti & Hulbert, 2015), it has been shown that the identification of 23 arises from the incorrect use of the standard deviation which depends on the distribution used by Lichtenberger and Kaufman, specifically the distribution of IQ, and not the Max-Min distribution of the differences between the four indices. In fact, if we go into the distribution of IQ, we are somewhat "trapped" and the only conclusions we can draw using the parameters of this distribution (mean and *SD*), and the results of the formula (Mean + z**SD* = 100 + 1.5*15 = 122.5, rounded to 123) concern the IQ score of 123 with a percentile rank of 93.3%, and that 6.7% of the population obtained an IQ score of over 123. No other conclusion can be made, and nothing can be said with respect to the distribution of Max-Min differences of the four indices. In fact, if we are interested in finding out the percentage of subjects that achieve a certain Max-Min difference between the four indices in a standardized test sample, we need to use the Max-Min distribution, and not the IQ distribution. Therefore, the first distribution will have a different mean and standard deviation than the second. This means that for each standardization subject, we need to know the highest score (Max) and the lowest score (Min) of the indices, so we need to calculate the difference between the maximum

score minus the minimum score for each subject, and thus we obtain a new distribution of scores which will have its own mean and standard deviation. The latter is the one that should be used (along with the mean Max-Min distribution) to calculate the threshold value. Furthermore, a distribution frequency of all the Max-Min differences for all subjects in the standardization sample will provide confirmation of the threshold value based on the rarity percentage chosen (for example 6.7%). This means that there will be as many threshold values as there are samples on which the test is standardized, and not just a single threshold value for all samples and for all versions of the Wechsler scales.

In particular, the threshold value that isolates 6.7% of Italian subjects who achieve a Max-Min difference between the four indices aged between 16 and 69 and who took part in the standardization of the WAIS-IV is 38 ($Mean_{(Max-Min)} + z^*SD_{(Max-Min)} = 22.62 + 1.5^*10.01 = 37.6$ rounded to 38), for those aged between 70 and 90 years, the threshold value is 31 ($Mean_{(Max-Min)} + z^*SD_{(Max-Min)} = 17.54 + 1.5^*8.83 = 30.8$ rounded to 31). This means that if, for example, a 45-year-old achieves the following scores in the WAIS-IV: CVI = 100, PRI = 126, WMI = 85, PSI = 98, the difference can be calculated between the highest and the lowest, namely: 126-85 = 41. This difference exceeds the threshold of 38, and is therefore considered very rare (less than 6.7% of the population have a difference of 41 IQ points among the four indices). This tells us that there is too much variability among the four indices and it would not be justified to consider the Full Scale IQ as an expression of unitary ability. Consequently, we could calculate the two alternative indices, the GAI and CPI. However, the clinician who wishes to use the GAI and CPI must make sure that there is no significant or rare difference between the VCI and PRI and the WMI and PSI, respectively (using the appropriate tables for both Italian standardizations), to avoid masking more specific deficits. If there is a statistically significant and rare difference between the VCI and PRI, use of the GAI is not justified, and equally if the difference between the WMI and PSI is rare, use of the CPI is not justified. The individual indices must be analysed separately.

Of course, more research is needed on the clinical usefulness of these two indices for the adult population, as well as an empirical verification of the intelligence structure of the Italian population involved in these two indices and the other four (VCI, PRI, WMI and PSI).

Be careful, however, because although the GAI is usable, it is also important that there are no rare differences (frequently less than 6.7%) between the VCI and PRI (which form the GAI). The same applies to the CPI, that is, it is important that there are no rare differences between the WMI and PSI in order to use the CPI correctly. The rarity thresholds of differences between the VCI and PRI for two separate samples of 16-69 years and 70-90 years are 24 and 20, respectively, while the rarity thresholds of differences between the WMI and PSI for two separate samples of 16-69 years and 70-90 years were 26 and 21, respectively. So, if the difference between the VCI and PRI is 27 points in a 20-year-old (in absolute value, that is, without taking the sign into account), we are not able to use the GAI because 27 is greater than the threshold value of 24. This is because there is too broad and rare a difference between the VCI and PRI of the General Ability Index in the Italian population between 16 and 69 years of age. This difference means the GAI cannot be defined as a unitary and cohesive expression of General Ability.

In conclusion, this article is an extension of the Italian Standardization of the WAIS-IV and also shows the normative tables for the calculation of the General Ability Index and the Cognitive Proficiency Index of the WAIS-IV carried out on the Italian population, as well as the tables for the assessment of any rarity in the differences between IQ and the GAI and CPI of a subject. Once again, when used as part of a psychological evaluation, it is always best to use both the GAI and the CPI rather than just the GAI on its own, as it is often done so by clinicians when the ability framework is diversified. Using both indices would provide a framework of strengths and weaknesses of an individual, without any distortion as a result of combining a set of different abilities into a single overall score. It is important to emphasise that, as reported by Flanagan & Kaufman for the WISC-IV, and Lichtenberg & Kaufman for the WAIS-IV, the Full Scale IQ obtained by a child in the WISC-IV (Flanagan & Kaufman, 2009, p. 143) and by an adult in the WAIS-IV (Lichtenberg & Kaufman, 2009, p. 155) must always be interpreted, especially when it is essential for diagnosis (e.g. of an intellectual disability) or for intervention (e.g. inclusion in a program for gifted children). Even when both the IQ, and the GAI and CPI are not interpretable based on empirical criteria (i.e. statistics), the index (or indices) which provide the most sensible overview of intelligence of the child or adult should be selected in the diagnostic process and / or intervention scheduling.

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