

## INTELLECTUAL ACHIEVEMENT RESPONSIBILITY. A MANY-FACET RASCH MODEL ANALYSIS OF THE SCALE BY CRANDALL, KATKOVSKY AND CRANDALL

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The present study consists in the analysis of the responses of 485 high school Italian students to the items of the Intellectual Achievement Responsibility questionnaire (IAR; Crandall, Katkovsky, & Crandall, 1965) in view of the definition of a new form of the scale. The Italian version by Nigro and Galli (1988) was applied to the participants. The data were analyzed by means of the Many-Facet Rasch Model (MFRM; Linacre, 1989) approach. Within the frame of Rasch analyses, the MFRM allowed the parameterization of complex measurement situations in which different aspects might interfere between the ability of the person and the difficulty of the item, such as specific social, educational, or clinical attributes characterizing the persons, or different occasions in which the items are administered, or different methods applied to administer them, or different judges used to evaluate test performance, and so on. In this study, the MFRM allowed the definition of a psychometrically valid form of the IAR scale which consisted of 30 items, 15 for the I+ score and 15 for the I- score. Such items were not only well calibrated on the continuum of the latent trait characteristic of the intellectual achievement responsibility, but they were also free from biases such as those derived from the interaction with gender, type of school attended by the students, school grade, and parental cultural level.

Key words: Intellectual achievement responsibility; IAR questionnaire; Many-Facet Rasch Model; High school students; Validation analysis.

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### INTRODUCTION

Intellectual ability is no doubt a strong predictor of academic achievements, nevertheless, as is well known, it is demonstrated that it is not the only determinant / element to influence achievements in school. Learning achievements are related to multiple factors - cognitive, psychological, educational, and social (De Beni & Moé, 2000; Medin, 1997; Weiss 1997). Among the factors which predict academic achievements, particular attention is paid to the amount of responsibility students take for their own achievements (e.g., Autry & Langenbach, 1985; Tenenbaum, 1988).

As far as responsibility is concerned, persons differ in the degree to which they believe that they are responsible for the outcomes of situations. They may believe that their behavior causes the reinforcements which follow their actions or they may feel that their successes and failures depend on powerful others or are due to luck or fate. The same reinforcement in the same situation may be considered by one person as within his/her own control and by another person as outside his/her own influence. Rotter (1966) defined the tendency to attribute causes of events to internal factors "Internal Locus of Control" and the tendency to attribute causes to external fac-

tors “External Locus of Control”. Personal beliefs are important determinants of the reinforcing effects of many experiences. When a person believes that he/she has little control over the rewards or punishments he/she receives, then he/she has no reason to maintain or modify his/her behavior. Rewards and punishments have lost much of their reinforcement values (Rotter, Seeman, & Liverant, 1962).

Since the sixties of the past century, when the concept of locus of control was introduced by Rotter, many authors have shown interest for such concept and have been involved in developing and applying it in different research areas of psychology and, more in general, of the social sciences. The problem of assessing locus of control has also been often debated in the literature and numerous studies have been dedicated to the construction of scales for measuring it (e.g., Lefcourt, 1982; Nigro & Galli, 1988, 1998; Falco, 2007). Among the different scales devised for the assessment of the locus of control, the questionnaire by Crandall, Katkovsky and Crandall (1965) was considered, and still is, particularly valid for measuring young people’s beliefs in their own control of reinforcement in intellectual achievements situations at school. In past and recent years, many studies, some of the latest also at doctoral dissertation level, have applied the scale by Crandall et al. (1965), named Intellectual Achievement Responsibility (IAR), in different areas of psychology, such as: educational and school psychology (e.g., Coyer, 2005; Forzi, 1994; Henderson, 2005; O’Brien, 2001; Taylor & Michael 1991), developmental psychology (e.g., Width, 1997), social psychology (e.g., Miller, 2001; Styles, 2004), clinical psychology (e.g., Kistner, Osborne, & LeVerrier, 1988; Spencer, Head, Van-Dusen Pysh, & Chalfant, 1997).

The aim of this study was analysing the properties of the IAR questionnaire from a latent trait perspective, in view of the definition of a psychometrically valid instrument for Italian students. The novelty of this study is represented by the latent trait approach developed by means of the Many-Facet Rasch Model (Linacre, 1989). Such model, which belongs to the family of the Rasch models, allows not only the parameterization and the analysis of the fit of the model to the data of persons and items, but it also allows the parameterization of other variables, such as sex, age, school grades, parents’ cultural levels, judges, etc.. As it will be explained below, in this study the Italian translation of the IAR scale prepared by Nigro and Galli (1988) was applied to 485 Italian students. In the literature no Italian validation studies of the IAR questionnaire are found.

#### THE INTELLECTUAL ACHIEVEMENT RESPONSIBILITY (IAR) QUESTIONNAIRE

The IAR questionnaire (Crandall et al. 1965) intended to measure beliefs in internal versus external responsibility and was developed within a larger research program dealing with children’s achievement development. In particular, the IAR aimed to assess children’s beliefs in reinforcement responsibility exclusively in intellectual-academic achievement situations and restricted the source of external control to those persons that more often came into contact with a child, such as parents, teachers, and peers. This limit was mainly due to the consideration that children may attribute different quantity of control to adults, to luck or fate (Rotter et al, 1962).

The IAR scale was composed of 34 forced-choice items. A total responsibility score I (internal or self) was considered; in addition, two partial scores could be obtained for beliefs in internal responsibility for success (I+ score) and in internal responsibility for failure (I- score).

Each item described either a positive (success) or a negative (failure) achievement experience which usually occurred in children's lives. The item was followed by one alternative stating that the event was caused by the child and another stating that the event occurred because of somebody else's behavior. A I+ score was obtained by summing all positive events for which the child assumed responsibility and a I- score was the sum of all negative events for which the child felt responsible. The general total score I was the sum of the scores of the two subscales I+ and I-. Crandall et al. (1965) applied the questionnaire to 923 elementary and high school students. The socio-economic status of the students' families was based on the occupation and education level of the head of the family. It was decided that individual oral presentation of the scale was desirable for children at elementary school level. The instructions presented in both the oral and the written administration requested the subject to choose the answer "that best describes what happens to you or how you feel." Descriptive statistics were computed for both I+ and I- scores and also for the I total score. The reliability of the three scores was analyzed and different studies were conducted in order to compare school grades, age levels, genders, social classes, and family life conditions. The low correlation between the I+ and the I- scores raised some doubt about the use of the I total score alone. Since the total score combined self-responsibility for success and failure, it may mask important differences between the two in the individual person. General tendencies were noticed for I+, I- scores and also for the I total score to increase slightly with age, and for girls' scores to be a little higher than boys'. The difference between genders increased from age 12 on. Concerning social classes and family life conditions, no significant effects of such variables on the I+, I- and I total scores were noticed. The test-retest reliability of the three scores computed separately was quite satisfactory (Crandall et al., 1965).

#### MANY-FACET RASCH MODEL

As is known, the Rasch Simple Logistic Model (RSLM; Rasch, 1960/1980) focused on two aspects of the measurement situation, namely on two facets of the underlying dimension being measured: the level of ability or attitude expressed by a person, and the difficulty or endorsability of an item. The testing situation was just an opportunity to collect data which were an observable evidence of the interaction between the person and the test items. Such interaction was empirical evidence of the existence of a latent trait (Bond & Fox, 2001). However, more complex measurement situations existed in which other aspects interfered between the ability of the person and the difficulty of the item, such as specific social, educational, or clinical attributes which characterized the persons, or different occasions in which the items were administered, or different methods applied to administer the items, or different judges used to evaluate the performances, and so on. Within the unidimensionality of Rasch modeling, Linacre (1989) developed the Many-Facet Rasch Model (MFRM) which took these more complex situations into account.

The original RSLM with two facets, where the probability of any answer was a function of the ability (facet 1) of the person and the difficulty (facet 2) of the item, took the form of Equation 1:

$$P(X_{vi} = x) = \frac{e^{(\beta_v - \delta_i)}}{1 + e^{(\beta_v - \delta_i)}} \quad (1)$$

where

$P(X_{vi} = x)$  is the probability of response  $x$  of person  $v$  to item  $i$ ;

$\beta_v$  is the parameter denoting the ability of person  $v$ ;

$\delta_i$  is the parameter denoting the difficulty of item  $i$ .

Equation (1) can be formulated also in logit form by means of Equation (2):

$$\ln\left(\frac{P(X_{vi} = x)}{1 - P(X_{vi} = x)}\right) = \beta_v - \delta_i \quad (2)$$

The MFRM, where the probability of any answer was a function not only of the ability of the person and of the difficulty of the item, but also of other variables that might systematically influence the persons' scores, took the form of Equation 3. In the example equation, besides ability (facet 1) and difficulty (facet 2), the following extra factors were introduced: gender (facet 3), age (facet 4), cultural level (facet 5), and time of test administration (facet 6):

$$P(X_{vijlmq} = x) = \frac{e^{(\beta_v - \delta_i - \sigma_j - \alpha_l - c_m - \tau_q)}}{1 + e^{(\beta_v - \delta_i - \sigma_j - \alpha_l - c_m - \tau_q)}} \quad (3)$$

where

$P(X_{vijlmq} = x)$  is the probability of the response  $x$  of person  $v$  to item  $i$ , where the effects of sex, age, cultural level, and time are also considered;

$\beta_v$  is the parameter denoting the ability of person  $v$ ;

$\delta_i$  is the parameter denoting the difficulty of item  $i$ ;

$\sigma_j$  is the parameter denoting gender  $j$ ;

$\alpha_l$  is the parameter denoting age level  $l$ ;

$c_m$  is the parameter denoting cultural level  $m$ ;

$\tau_q$  is the parameter denoting the time of administration  $q$ .

Equation (3) in *logit* took the form of Equation (4):

$$\ln\left(\frac{P(X_{vijlmq} = x)}{1 - P(X_{vijlmq} = x)}\right) = \beta_v - \delta_i - \sigma_j - \alpha_l - c_m - \tau_q \quad (4)$$

All the parameters could be estimated separately. Linacre (1989) interpreted the MFRM as an extension of the SLRM, that is, when the extra facets were not required to model the complexity of the measurement situation, the MFRM became the SLRM.

The parameter estimation procedure adopted in the Many-Facet Program (Linacre 2005) was designed to handle the more complex applications of unidimensional Rasch measurement and perform the parameter estimation by means of the Joint Maximum Likelihood Estimation (JMLE) procedure.

Concerning the control fit evaluation of the parameters, as is known, the fit statistics must

determine how well any set of empirical data meets the requirements of the model. In the output of the Many-Facet Program two fit statistics were reported, the mean square outfit statistic and the mean square infit statistic. The outfit statistic placed more emphasis on unexpected responses far from a person measure or an item measure, whereas the infit statistic emphasized more the unexpected responses near the person measure or the item measure (Wright & Masters, 1982). More precisely, the outfit information was simply based on the sum of squared standardized residuals for each person on each item. The sum was then divided by the number of items for each person and by the number of persons for each item, hence the mean square. The infit was an information-weighted sum. As is known, the statistical information in a Rasch observation is its variance, that is the squared standard deviation of the estimate. The variance was larger for observations close to an item or a person and smaller for extreme observations. To obtain an infit measure, each squared standardized residual, say for one person through all items, was weighted by its variance and then summed. Dividing that total by the sum of the variances produced a fit statistic which was influenced by the weighting effect (Bond & Fox, 2001). The outfit and the infit statistics had a scale form with an expected value of +1 and a range from 0 to positive infinity. An outfit or infit statistic in the range 0.70-1.30 indicated a satisfactory fit of the empirical data to the model. The explanation is that an infit or outfit mean square value of  $1 + x$  indicates 100  $x\%$  more variation between the observed and the model predicted response patterns than would be expected if the data and the model were perfectly compatible. Thus an infit statistic for instance of 1.30 indicates 30% more variation in the observed data than the model predicted. The value 0.70 indicates 30% less variation in the observed data than the model predicted (Bond & Fox, 2001).

After estimating the parameters, the Many-Facets Program can also check for biases in a given model. A bias can be due to any kind of interaction, such as differential item functioning, differential person functioning, or differential functioning of any other facet, and is estimated from the residuals left over after estimating the parameters in the main analysis (Linacre, 2005). Detecting a bias serves many purposes in the research, and is of particular importance when, in the frame of a Rasch analysis, possible differences between specific elements of facets might influence the interpretation of the results. To make an example, considering a bias associated to a specific item and the gender of persons, this means that a residual remains after estimating the item parameter from which two new parameters, one for males and one for females, can be estimated (target measures). Such parameters can be compared (contrast measure) by means of the  $t$  statistic. If the  $t$  statistic is significant ( $p \leq .05$ ), then, against the Rasch model principle, the gender of persons affects the item or, similarly, the item has a differential functioning in relation to gender. When the purpose is the analysis of the validity of a test, detecting a bias helps in verifying its functioning. Items showing significant biases should be taken into particular consideration in view of the final version of a test.

#### PARTICIPANTS AND ANALYSES

Participants were 485 students in two Northern Italian provinces, aged 14-19; 53.20% females and 46.80 % males. They attended three grades of high school: first (41%), third (32%), and fifth (27%) grades of four types of schools: the Classical studies School (Liceo Classico) (13%), the Scientific studies School (Liceo Scientifico) (15%), the Art School (Liceo Artistico) (14%), the School of Education, Psychology and Social Sciences (Liceo scocio-psico-peda-

gogico) (13%) and the Industrial Technical Institute (Istituto Tecnico Industriale) (45%). The cultural level of the students' families, defined on the basis of both parents' school levels, was divided in low (31%), medium (49%), and high (20%).

Considering the difference which might exist between self-responsibility for success and self-responsibility for failure in a person (Crandall et al., 1965), the analyses were performed separately for the two parts of the IAR questionnaire, the I+ score and the I- score. In the frame of Rasch analyses, the following aspects were taken into consideration: a) the definition of the location parameters of persons and items on the two IAR latent traits by means of the MFRM program estimate procedure; b) the control of the fit to the model of the item parameters by means of the infit and outfit statistics; c) the definition of the location parameters of genders, types of school, school grades, and parents' cultural levels on the two IAR latent traits by means of the MFRM program estimate procedure; d) the control of the fit of the model of the parameters; e) the control of the existence of bias/interactions of the items in relation to the facet-variables: gender, type of school, school grade, and parent cultural level.

The Many-Facet model applied for the analyses corresponded to Equation 5:

$$\ln \left( \frac{P(X_{vijlqm} = x)}{1 - P(X_{vijlqm} = x)} \right) = \beta_v - \delta_i - \sigma_j - \omega_l - \lambda_q - \gamma_m \quad (5)$$

where

$P(X_{vijlqm} = x)$  is the probability of the response  $x$  of person  $v$  to item  $i$ , where the effects of gender, type of school, school grade, and parents cultural level are taken into consideration;

$\beta_v$  is the parameter denoting the achievement responsibility of person  $v$ ;

$\delta_i$  is the parameter denoting the IAR item  $i$ ;

$\sigma_j$  is the parameter denoting gender  $j$ ;

$\omega_l$  is the parameter denoting type of school  $l$ ;

$\lambda_q$  is the parameter denoting school grade  $q$ ;

$\gamma_m$  is the parameter denoting parents' cultural level  $m$ .

After detecting the items which showed a good fit to the model and did not manifest relevant bias/interactions, such items formed a new version of the IAR questionnaire.

## RESULTS

*Facet location parameters.* Considering the I+ scale, the data showed a mean of 1.65 and a standard error of .74 for the person parameters ( $\beta_v$ ). The infit and the outfit statistics for such result were very satisfactory, being respectively 1.00 and .97. As far as the I- scale is concerned, the person parameters mean was 1.35 and the standard error 1.67. The infit and the outfit statistics were respectively 1.00 and .94.

In Table 1 the item location parameters ( $\delta_i$ ), the parameter standard errors, and the infit and outfit statistics were presented for both I+ and I-.

TABLE 1  
 Item location parameters, parameter standard errors (*SE*), infit and outfit statistics for I+ and I- scales

Item	I+ scale				I- scale			
	Location parameter	<i>SE</i>	Infit statistic	Outfit Statistic	Location parameter	<i>SE</i>	Infit statistic	Outfit statistic
1	-1.12	.17	0.94	0.89	0.77	.10	1.02	1.01
2	-0.68	.15	0.93	0.85	-1.71	.19	1.00	1.01
3	-1.01	.16	0.89	0.71	2.09	.10	1.16	1.29
4	-0.54	.14	0.95	0.91	0.41	.11	1.11	1.19
5	1.96	.10	1.05	1.13	1.72	.10	1.06	1.08
6	0.84	.10	1.10	1.12	-0.88	.14	0.96	0.85
7	-0.54	.14	0.96	0.95	0.76	.10	0.96	0.95
8	0.57	.11	1.09	1.14	-0.09	.12	0.96	0.88
9	-1.33	.18	1.05	1.11	-1.36	.17	0.90	0.57
10	1.07	.10	1.07	1.08	-0.30	.12	0.99	0.88
11	-0.31	.13	0.87	0.76	-0.27	.12	0.87	0.74
12	0.24	.11	0.92	0.89	0.13	.11	1.05	1.10
13	-0.31	.13	0.96	0.88	-1.86	.20	0.90	0.58
14	0.38	.11	0.94	0.95	0.77	.10	0.99	0.93
15	1.33	.10	1.06	1.07	-0.29	.12	0.97	1.00
16	-1.12	.17	0.97	0.81	-0.11	.12	1.00	0.94
17	0.66	.11	1.11	1.16	0.22	.11	1.02	1.01

All the item parameters in Table 1 showed a good fit to the model. The reliability indexes, in terms of separation (subject facets), were .84 for I+ and .97 for I-.

Concerning the location parameters and the infit and outfit statistics for gender ( $\sigma_j$ ), type of school ( $\alpha_l$ ), school grade ( $c_m$ ), and parents' cultural level ( $\tau_q$ ) for both I+ and I-, males seemed to assume more credit for positive events and seemed to feel less responsible for failures than girls. Such result represented a tendency and was not statistically demonstrated. Other tendencies were found in relation to type of school in which the students of classical studies and of scientific studies schools seemed to feel more responsible for both their successes and their failures than their school mates of the art school who showed the opposite tendency. Art students seemed to assume less credit and less blame for positive and negative events, respectively. Students of the school of education felt less responsible for their successes than for their failures; whereas technical school students showed the opposite tendency. As far as school grades are concerned, younger students seemed to feel more responsible than older students for both successful and unsuccessful events, whereas older students seemed to distinguish positive events from negative ones in terms of responsibility. Considering the parents' cultural level, students coming from families where the parents had a high cultural level, showed a tendency to feel more responsible than their school mates for both successful and unsuccessful events.

*Bias/interaction analysis.* Considering the I+ scale, no bias was detected in 53% of the items; bias information was rather irrelevant in 35% of the items, whereas significant bias/ interaction information was found in 12% of the items, that is, item 2 and item 10 interacted significantly with three of the facets: school grade, parents' cultural level, and type of school attended

by the students. In Table 2 such results were shown: besides item location parameters, also bias/interaction parameter measures (target measure) and contrast measures (target contrast) were displayed; error probability values of the contrast measures were also presented.

TABLE 2  
 Item bias/interaction information for the I+ scale. Item location parameter, target measure, contrast measure, *t*-test, and *df* concerning type of school, school grade, and parent cultural level

I+								
Variable	Item	Location parameter	Target measure	Target measure	Target contrast	<i>t</i> -test	<i>df</i>	Error probability
Type of school	2	-0.68	-0.05 (A)	-1.39 (E)	1.34	2.15	121	0.0332
	2	-0.68	-3.10 (C)	-0.63 (S)	-2.47	-2.28	127	0.0244
	2	-0.68	-3.10 (C)	-0.45 (T)	-2.65	-2.55	270	0.0112
	2	-0.68	-3.10 (C)	-0.05 (A)	-3.05	-2.86	127	0.0049
	10	1.07	1.63 (C)	0.65 (S)	0.98	2.44	127	0.0161
	10	1.07	1.63 (C)	0.73 (A)	0.89	2.29	127	0.0237
	10	1.07	1.63 (C)	1.02 (T)	0.61	1.94	270	0.0528
	10	1.07	0.65 (S)	1.48 (E)	-0.83	-2.02	121	0.0460
School grade	2	-0.68	-0.31 (3°)	-1.22 (5°)	0.91	2.29	273	0.0230
	10	1.07	0.71 (1°)	1.22 (3°)	-0.52	-2.09	329	0.0378
	10	1.07	0.71 (1°)	1.38 (5°)	-0.67	-2.66	316	0.0082
Parents' cultural level	10	1.07	0.71 (L)	1.31 (M)	-0.67	-2.49	361	0.0132

Note (1°) = First school grade; (3°) = Third school grade; (5°) = Fifth school grade; (L) = Low social class; (M) = Medium social class; (A) = Art School; (C) = Classical studies School; (E) = School of Education, Psychology, and Social Sciences; (S) = Scientific studies School; (I) = Technical Industrial Institute.

The data in Table 2 showed that item 2 (When you do well on a test at school, it is more likely to be because you studied for it) location parameter (-.68 in Table 1) changed when the bias/interaction with school grades was considered. The parameter measure became higher when the interaction with the third grade (-.31) was analyzed and it became lower when the interaction was related to the fifth grade (-1.22). The contrast between the two interaction parameters was significant ( $p = .023$ ). Item 2 showed a differential functioning also in relation to the type of high school attended by the students. The classical studies school had a much lower target measure (-3.10) than the item parameter measure (-.68), whereas other types of school, such as the scientific studies one (-.63), the technical school (-.45), and the art school (-.05) showed higher target measures. The school of education showed a lower target measure (-1.39). Target contrast measures for types of school were all statistically significant. Considering item 10 (When you win at a game of cards or checkers it happens because you play real well) with location parameter 1.07 in Table 1, the bias/interaction information showed a lower target measure for the first grade (.71) and higher parameters for the third and the fifth grades, respectively 1.22 and 1.38. All the contrast measures were significant. Item 10 showed a differential functioning also in relation to the



parents' cultural level, with the low one showing a lower target measure (.71) and the medium having a higher measure (1.31). The contrast was significant ( $p = .0132$ ). Types of school attended also affected the functioning of item 10; the classical studies school had associated a higher measure (1.63) and all the other types of school showed lower measures. All contrasts were statistically significant.

Considering the I- scale, no bias or quite irrelevant bias/interaction information was detected in 88% of the items, whereas item 1 and item 17 showed a rather relevant number of significant bias/interactions. All the interactions were related only to the types of school attended by the students. In Table 3 besides the item location parameters, the bias/interaction parameter measures (target measure) and the contrast measures (target contrast) were shown as well; error probability values of the contrast measures were also presented.

TABLE 3  
 Item bias/interaction information for the I- scale. Item location parameter, target measure, contrast measure,  $t$ -test, and  $df$  concerning type of school

		I-						
Variable	Item	Location parameter	Target measure	Target measure	Target contrast	$t$ -test	$df$	Error probability
Type of school	1	0.77	1.13 (S)	-0.02 (A)	1.14	2.88	140	0.0046
	1	0.77	0.19 (C)	0.90 (I)	-0.71	-2.07	277	0.0397
	1	0.77	-0.02 (A)	0.90 (I)	-0.92	-2.72	283	0.0070
	1	0.77	0.19 (C)	1.13 (S)	-0.94	-2.33	134	0.0214
	1	0.77	-0.02 (A)	1.25 (E)	-1.27	-3.07	125	0.0027
	1	0.77	0.19 (C)	1.25 (E)	-1.07	-2.54	119	0.0125
	17	0.22	0.87 (C)	-0.85 (E)	1.72	3.52	119	0.0006
	17	0.22	0.40 (A)	-0.85 (E)	1.25	2.56	125	0.0117
	17	0.22	0.30 (S)	-0.85 (E)	1.15	2.37	129	0.0191
	17	0.22	0.87 (C)	0.17 (T)	0.71	2.17	277	0.0312
	17	0.22	-0.85 (E)	0.17 (T)	-1.02	-2.35	272	0.0193

Note (A) = Art school; (C) = Classical studies school; (E) = School of Education, Psychology, and Social Sciences; (S) = Scientific studies school; (T) = Technical Industrial Institute.

The data in Table 3 show that item 1 (When you have troubles understanding something in school, it is usually because you did not listen carefully) location parameter (.77 in Table 1) became higher when the bias/interaction was represented by the scientific school (1.13), the school of education (1.25), and the technical school (.90); the location parameter decreased if the bias/interaction was related to the classical studies school (.19) and the art school (-.02). All contrasts were significant. Item 17 (If a teacher says to you "Try to do better," it is because your work wasn't as good as usual) showed a differential functioning in which its location parameter (.22 in Table 1) increased in relation to the classical studies school (.87), the scientific studies school (.30) and the art school (.40), it decreased in relation to the school of education (-.85) and the technical school (.17).

In conclusion, although all the item location parameters of both I+ and I- showed a good fit to the model (see Table 1), the results of the bias/interaction analyses would suggest not to

consider item 2 and item 10 for I+ and item 1 and item 17 for I–, in the final version of the IAR questionnaire.

Against the principle of the Rasch model, the parameters of such items were significantly affected by specific characteristics of the persons. The final form of the IAR questionnaire should then consist of 30 items, 15 for the I+ scale and 15 for the I– scale.

#### FINAL REMARKS

In this study the application of the Many-Facet Rasch Model (MFRM; Linacre, 1989) to the responses of 485 high school Italian students collected by means of the Intellectual Achievement Responsibility questionnaire (IAR; Crandall et al., 1965) offers the opportunity to define a new version of the IAR scale according to the principles of the Latent Trait Theory. The MFRM is an extension of the Simple Logistic Rasch Model (SLRM; Rasch, 1960/1980). The mathematical properties of the latter are maintained in the MFRM, but one or more extra components of the measurement situation are introduced, such as person gender, cultural level, etc.. As in the dichotomous model, the raw scores are the sufficient statistics for the person parameter, the item parameter, and any other component which is introduced. The Many-Facet Model also supports powerful quality-control fit statistics, such as infit and outfit statistics (Linacre 2005). A further feature of the model is its capability in detecting bias/interactions which might affect the item (or person) functioning. As is known, when validating the items of a test the main purpose consists in obtaining items which are free from biases, such as gender, age, cultural level, etc., in such a way that the items are not only well calibrated on the continuum of a measurable trait, but can also function free from distortions in any situation. In this study the MFRM analyses applied to the data collected by means of the IAR questionnaire in the Italian translation by Nigro and Galli (1988), allow the definition of a new Italian version of the scale, where the items are not only well calibrated on the latent trait devised to measure the intellectual achievement responsibility of students who attend high school, but can also function without distortions, due to bias/interactions with gender, type of school, school grade, and parents' cultural level. The Italian version reported in the Appendix consists of thirty items (IAR total score). Just like in the original questionnaire, the items are divided into two subscale: 15 items for the assessment of the responsibility for success (I+ score) and the remaining 15 items for the assessment of responsibility for failure (I– score). In such version item 2 and item 10 of the original form of the I+ scale and items 1 and 17 of the I– scale have been eliminated as they are not acceptable according to the property of the MFRM. A total I score, combining the I+ and I– scores, can be computed. As already mentioned above, such total score should not be interpreted alone since it combines self-responsibilities for success and failure which might mask the difference between the two in a person. More studies are suggested in view of a new version of the IAR questionnaire valid for elementary school students.

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APPENDIX

Questionario IAR [The IAR scale]

	Italian version	English version
I+	01 Se l'insegnante ti promuovesse, ciò accadrebbe probabilmente a) perché gli eri simpatico/a, o b) perché avevi studiato molto?	If a teacher passes you to the next grade, would it probably be a) because she liked you, or b) because of the work you did?
I-	02 Quando leggi un racconto e non riesci a ricordare molto di quello che hai letto, ciò accade generalmente a) perché il racconto non era scritto bene, o b) perché non eri interessato/a al racconto?	When you read a story and can't remember much of it, is it usually a) because the story wasn't well written, or b) because you weren't interested in the story?
I+	03 Immagina che i tuoi genitori ti dicano che stai andando bene a scuola. È probabile che ciò accada a) perché i tuoi risultati scolastici sono buoni, o b) perché loro sono di buonumore?	Suppose your parents say you are doing well in school. Is this likely to happen a) because your school work is good, or b) because they are in a good mood?
I+	04 Immagina di svolgere meglio del solito un compito in classe. Ciò accade probabilmente a) perché ti sei impegnato/a molto, o b) perché qualcuno ti ha aiutato/a?	Suppose you did better than usual in a subject at school. Would it probably happen a) because you tried harder, or b) because someone helped you?
I-	05 Quando perdi giocando a carte o a dama ciò di solito accade a) perché l'altro giocatore è bravo, o b) perché tu non giochi bene?	When you lose at a game of cards or checkers, does it usually happen a) because the other player is good at the game, or b) because you don't play well?
I-	06 Immagina che una persona non ti ritenga intelligente o capace a) se ti impegni sei capace di fargli cambiare idea, o b) c'è gente che pensa che non sei molto intelligente, qualunque cosa tu faccia?	Suppose a person doesn't think you are very bright or clever a) can you make him change his mind if you try to, or b) are there some people who will think you're not very bright no matter what you do?
I+	07 Se risolvi un puzzle rapidamente, ciò accade a) perché non era un puzzle molto difficile, o b) perché ti sei impegnato/a molto per risolverlo?	If you solve a puzzle quickly, is it a) because it wasn't a very hard puzzle, or b) because you worked on it carefully?
I-	08 Se un ragazzo o una ragazza ti dice che sei stupido/a, è molto probabile che lo dica a) perché ce l'ha con te, o b) perché quello che hai fatto non era intelligente?	If a boy or girl tells you that you are dumb, is it more likely that they say that a) because they are mad at you, or b) because what you did really wasn't very bright?
I-	09 Immagina di studiare per diventare insegnante, scienziato o medico, e che tu non ci riesca. Pensi che questo accadrebbe a) perché non ti stai impegnando abbastanza, o b) perché avevi bisogno di aiuto e le altre persone non te lo hanno dato?	Suppose you study to become a teacher, scientist, or doctor and you fail. Do you think this would happen a) because you didn't work hard enough, or b) because you needed some help, and other people didn't give it to you?

(appendix continues)

Appendix (continued)

	Italian version	English version
I+	10 Quando a scuola apprendi rapidamente, ciò accade generalmente a) perché hai ascoltato molto attentamente, o b) perché l'insegnante ha spiegato molto chiaramente?	When you learn something quickly in school, is it usually a) because you paid close attention, or b) because the teacher explained it clearly?
I+	11 Se l'insegnante ti dice: "Il tuo compito è buono", ciò accade perché a) questo è ciò che gli insegnanti generalmente dicono per incoraggiare gli studenti, o b) perché hai fatto un buon lavoro?	If a teacher says to you, "Your work is fine," is it a) because it is something teachers usually say to encourage pupils, or b) because you did a good job?
I-	12 Quando trovi difficoltà nel risolvere problemi di aritmetica o di matematica in classe, ciò accade a) perché non hai studiato abbastanza prima del compito, o b) perché l'insegnante ha dato dei problemi troppo difficili?	When you find it hard to work arithmetic or math problems at school, is it a) because you didn't study well enough before you tried them, or b) because the teacher gave problems that were too hard?
I-	13 Quando dimentichi qualcosa che hai ascoltato in classe, ciò accade a) perché l'insegnante non l'ha spiegata molto bene, o b) perché non ti sei sforzato/a di ricordare?	When you forget something you heard in class, is it a) because the teacher didn't explain it very well, or b) because you didn't try very hard to remember?
I+	14 Immagina di non essere stato/a sicuro/a circa la risposta da dare ad una domanda dell'insegnante, ma che la tua risposta sia risultata esatta. È probabile che ciò sia accaduto a) perché l'insegnante non si è mostrata esigente come al solito, o b) perché avevi dato la migliore risposta possibile?	Suppose you weren't sure about the answer to a question your teacher asked you, but your answer turned out to be right. Is it likely to happen a) because she wasn't as particular as usual, or b) because you gave the best answer you could think of?
I+	15 Quando leggi un racconto e lo ricordi bene, ciò accade generalmente a) perché eri interessato/a al racconto, o b) perché il racconto era ben scritto?	When you read a story and remember most of it, is it usually a) because you were interested in the story, or b) because the story was well written?
I-	16 Se i tuoi genitori ti dicono che ti stai comportando da sciocco/a e che non rifletti sulle cose, è più probabile che ciò accada a) a causa di qualcosa che hai fatto, o b) perché è capitato che loro fossero di cattivo umore?	If your parents tell you you're acting silly and not thinking clearly, is it more likely to be a) because of something you did, or b) because they happen to be feeling cranky?
I-	17 Quando non fai bene un compito in classe, ciò accade probabilmente a) perché il compito era particolarmente difficile, o b) perché non ti eri preparato/a?	When you don't do well on a test at school, is it a) because the test was especially hard, or b) because you didn't study for it?

(appendix continues)

Appendix (continued)

	Italian version	English version
I+	18 Se la gente pensa che tu sia intelligente o capace, ciò accade a) perché hanno simpatia per te, o b) perché generalmente ti comporti in modo intelligente o capace?	If people think you're bright or clever, is it a) because they happen to like you, or b) because you usually act that way?
I-	19 Se l'insegnante ti bocciasse, ciò accadrebbe probabilmente a) perché ce l'aveva con te, o b) perché il tuo rendimento non era sufficientemente buono?	If a teacher didn't pass you to the next grade, would it probably a) because she "had it in for you," or b) because your school work wasn't good enough?
I-	20 Immagina di non andare bene come al solito in una materia. Ciò accadrebbe probabilmente a) perché non sei stato/a preciso/a come al solito, o b) perché qualcuno ti ha infastidito o ti ha distratto dallo studio?	Suppose you don't do as well as usual in a subject at school. Would this probably happen: a) because you weren't as careful as usual, or b) because somebody bothered you and kept you from working?
I+	21 Se un ragazzo o una ragazza ti dice che sei intelligente, è molto probabile che lo dica a) perché mostri di avere idee brillanti, o b) perché ha simpatia per te?	If a boy or girl tells you that you are bright, is it usually a) because you thought up a good idea, or b) because they like you?
I+	22 Immagina di diventare un/a famoso/a insegnante, scienziato o medico. Pensi che questo accadrebbe a) perché delle persone ti hanno aiutato quando ne avevi bisogno, o b) perché ti sei impegnato/a a fondo?	Suppose you became a famous teacher, scientist or doctor. Do you think this would happen a) because other people helped you when you needed it, or b) because you worked very hard?
I-	23 Immagina che i tuoi genitori ti dicano che non stai andando bene a scuola. È più probabile che ciò accada a) perché i tuoi risultati scolastici non sono molto buoni, o b) perché loro sono di cattivo umore?	Suppose your parents say you aren't doing well in your school work. Is this likely to happen more a) because your work isn't very good, or b) because they are feeling cranky?
I-	24 Immagina di spiegare ad un amico/a le regole di un gioco e che lui/lei abbia delle difficoltà. Ciò accadrebbe a) perché non è in grado di comprendere come si gioca, o b) perché non sei stato/a capace di spiegare bene il gioco?	Suppose you are showing a friend how to play a game and he has trouble with it. Would that happen a) because he wasn't able to understand how to play, or b) because you couldn't explain it well?
I+	25 Quando trovi facile svolgere problemi di aritmetica o matematica in classe, ciò accade di solito a) perché l'insegnante ha dato problemi particolarmente facili, o b) perché hai studiato bene il libro prima del compito?	When you find it easy to work arithmetic or math problems at school, is it usually a) because the teacher gave you especially easy problems, or b) because you studied your book well before you tried them?

(appendix continues)

Appendix (continued)

	Italian version	English version
I+	26 Quando ricordi bene qualcosa che hai ascoltato in classe, ciò accade generalmente a) perché ti sei sforzato/a di ricordare, o b) perché l'insegnante lo ha spiegato bene?	When you remember something you heard in class, is it usually a) because you tried hard to remember, or b) because the teacher explained it well?
I-	27 Se non sai risolvere un puzzle, è più probabile che ciò accada a) perché non sei particolarmente bravo/a a fare i puzzle, o b) perché le istruzioni non erano scritte molto chiaramente?	If you can't work a puzzle, is it more likely to happen a) because you are not especially good at working puzzles, or b) because the instructions weren't written clearly enough?
I+	28 Se i tuoi genitori ti dicono che sei intelligente o capace, è più probabile che ciò accada a) perché sono di buonumore, o b) a causa di qualcosa che hai fatto?	If your parents tell you that you are bright or clever, is it more likely a) because they are feeling good, or b) because of something you did?
I+	29 Immagina di spiegare ad un amico/a le regole di un gioco e che lui/lei apprenda rapidamente. Ciò accadrebbe più spesso a) perché sei stato/a capace di spiegargliela bene, o b) perché è stato in grado di comprendere?	Suppose you are explaining how to play a game to a friend and he learns quickly. Would that happen more often a) because you explained it well, or b) because he was able to understand it?
I-	30 Immagina di non essere sicuro/a circa la risposta da dare ad una domanda che ti ha fatto l'insegnante, e che la risposta che dai risulti sbagliata. È probabile che ciò accada a) perché l'insegnante si è mostrato più esigente del solito, o b) perché hai risposto troppo in fretta?	Suppose you're not sure about the answer to a question your teacher asks you and the answer you give turns out to be wrong. It is likely to happen a) because she was more particular than usual, or b) because you answered too quickly?