Testing for invariance in a structural model of academic achievement across underachieving and non-underachieving students

Abstract

This work aimed to test the invariance of a causal structural model of the determinants of academic achievement in underachieving and non-underachieving students. A theoretical model of the relationships between personal, social, and familial variables and academic performance was derived empirically using data from a large sample obtained in a previous study, prior to testing for invariance across the two student groups. Underachieving students were identified using the Rasch model procedure. The sample comprised 259 underachieving and 258 non-underachieving students. The latter were selected randomly from a large non-underachieving sample of Spanish secondary education students. For model comparisons between groups, multiple-group causal structural analyses were performed, following a sequence of nested models with increasing constraints. The results showed a good fit of the model in both groups, although about half of the parameters were not invariant across groups. Underachieving students were characterized by their lack of learning strategies, an academic self-concept that exerted less influence on achievement, and a positive effect of the parent-school relationship on academic performance/achievement. Non-underachieving students were characterized by their use of metacognitive strategies, which led to higher academic achievement, a greater effect of self-concept on their achievement, the perception of parental support leading to higher performance, and the positive effects of peer acceptance on academic achievement.

Keywords: Path analysis; underachieving/non-underachieving groups; causal structure; invariant and non-invariant path coefficients

1. Introduction

The term *underachievement* has emerged as an important construct in the field of education in recent decades. In the scientific literature, it has been applied to students who exhibit lower achievements in relation to their cognitive abilities (McCoach & Siegle, 2003; Phillipson, 2008). Traditionally, the detection of underachievement has been focused on gifted students to analyze the mean differences in cognitive and non-cognitive variables that may explain possible causes (Figg, Rogers, McCormick, & Low, 2012; Obergriesser & Stoeger, 2015), such as self-concept (Dixon, Craven, & Martin, 2006), motivation (Baker, Bridger, & Evans, 1998), parental involvement (Veas, Castejón, O'Reilly, & Ziegler, 2018), or stereotypes (Peixoto & Almeida, 2010), among others.

1.1.Theoretical model

In the last two decades, important theoretical and methodological advances have been made in underachievement. Within the theoretical context, the actiotope model of giftedness (Ziegler, 2005) constitutes a rationale that requires a comprehensive research strategy that tries to explain how external and internal variables relate to each other. As Ziegler and Baker (2013) suggested, academic achievement should be considered as the outcome of an educational system. Moreover, this integral conception allows us to justify and explore underachievement not only with gifted students, as explored in the United States (Obergriesser & Stoeger, 2015; Reis & McCoach, 2000), but also with students from all ranges of abilities (Dittrich, 2014), as studied in China (Phillipson, 2008, 2010).

According to Ziegler and Stoeger (2017), the actiotope of a student constitutes the unit of analysis. An actiotope can be defined as a dynamic and personal perspective in a specific environment. The influx of exogenous resources from the environment into the actiotope is of particular importance, because they build effective action repertoires that are conducive to success at school. When exogenous resources enter the actiotope, they are referred to as educational capital (Ziegler & Baker, 2013). In this sense, educational capital is defined as all the resources that can be used to promote learning. At the same time, five types of educational capital have been proposed: economic educational capital (wealth, possessions, money, or valuables that can be invested), cultural educational capital (value systems, thinking patterns, and models), social educational capital (people and social institutions), infrastructural educational capital (materials implemented in learning), and didactic educational capital (design and improvement of education and learning processes).

It is important to mention that these types of educational capital are not independent of each other. As a result, the number of exogenous resources that flow into an actiotope and the educational capital can vary considerably. Moreover, introducing exogenous resources to actiotopes to build up educational capital is not enough to understand students' learning processes, as endogenous resources also affect individual functioning, which is called learning capital. Again, these resources are organized into five types: organismic learning capital (a person's physiological and constitutional resources), telic learning capital (a person's anticipated goal states that satisfy their needs), actional learning capital (the totality of actions that a person is able to perform), episodic learning capital (the simultaneous goal- and situation-relevant action patterns that are accessible to a person), and attention learning capital (the quantitative and qualitative attentional resources that a person can apply to learning).

1.2.Factors involved in underachievement

Traditionally, most studies have focused more on learning capital resources to detect possible causes of underachievement. Therefore, the primary reasons identified were school- or family-adjustment-related problems (Baker, Bridger, & Evans, 1998; McCoach & Siegle, 2003), and personal attributes, such as low motivation or low self-concept (Dunlosky & Rawson, 2012; Peixoto & Almeida, 2010; Reis & McCoach, 2000). McCoach and Siegle (2003) attributed a part of the differences between underachieving and achieving students to students' *attitudes toward their school and teachers*. Miñano, Castejón, and Gilar (2014) showed that academically underachieving students had the lowest scores on academic self-perception, attitudes toward school, attitudes toward teachers, motivation/self-regulation, and goal valuation. Similar conclusions were reached in studies conducted in the US and China, with low levels of motivation associated with underachievement (Dunlosky & Rawson, 2012; Schick & Phillipson, 2009). The more consistent differences between underachieving and non-underachieving students have been found in motivation, irrespective of the measures of motivation that were used (Reis & McCoach, 2000; White, Graham, & Blass, 2018). In addition, underachieving students use less self-regulation, fewer learning strategies, and fewer study techniques (Dunlosky & Rawson, 2012). Moreover, in Europe, Castejón, Gilar, Veas, and Miñano (2016) concluded that overachieving students scored significantly higher than underachieving students in learning strategies and goals, academic self-concept, personal self-concept, relationships with parents, honesty, and personal stability.

However, what was not clear is the role of some important endogenous factors such as self-concept (Preckel & Brunner, 2015). Several studies reported a poorer academic self-concept in underachieving students (Rimm, 2003), and a poorer general self-concept but not a poorer academic self-concept in gifted underachieving students (McCoach & Siegle, 2003).

Although less consideration was initially given to the role of educational capital constructs in underachievement, studies since the turn of the century have reported the important influence of educational capital or exogenous constructs. Reis and McCoach's (2000) review of family factors in gifted students showed that most studies of underachieving students focus on family structures and environments. Certain types of domestic environments and familial features may be related to underachievement (Baker et al., 1998; Rimm & Lowe, 1988). Where parents' interest in their children's achievement tends to lead to higher academic results for their children, underachieving students' parents might exhibit an uninterested attitude toward education. Social factors, such as peer acceptance, may also contribute to achievement and underachievement (Reis & McCoach, 2000), as negative peer attitudes or behavior can often account for underachievement. Underachieving students frequently report peer influence as the strongest force impeding their achievements (Clasen & Clasen, 1995). However, research on parental involvement in the education of underachieving students across the range of intellectual capacities is lacking (Jeynes, 2005, 2012).

1.3.Statistical methods for estimating underachievement

Regarding the identification of underachieving students, the traditional statistical methods used are the *absolute split*, *simple difference*, and *regression methods* (Lau & Chan, 2001). The absolute split method uses an arbitrary limit for the highest mental ability (e.g., top 5%) and the lowest academic performance (e.g., bottom 5%). The simple difference score is based on the discrepancy between the standardized performance score and the standardized ability score, usually one standard deviation. The regression method is based on the deviation of the students' score from the regression line of the achievement measure based on the ability measure. Students are underachieving if this deviation of the obtained to predicted scores is negative and greater than one standard deviation. Thus, students with standardized residuals greater than -1 are considered as underachieving. As these measures are assumed to have a standard normal distribution, the consideration of errors implies a possible under- or overestimation. Moreover, the calculation of underachievement expressed as the standard deviation of the perceived discrepancy between potential and achievement would create an arbitrarily consistent value for the number of those for whom this discrepancy is greater than one. This number can be determined from a standard normal distribution table by using the typical scores of an IQ test and school grades, and generating a consistent percentage of underachievement, which would vary depending on the standard deviation cut-off criteria (Plewis, 1991; Ziegler, Ziegler & Stoeger, 2012).

To improve the objective use of the interval scale, the latest method employed in identifying underachieving students is the Rasch model (Phillipson, 2008; Phillipson & Tse, 2007). This model assumes that the probability of a given person/item interaction is only governed by the difficulty of the item and the ability of the person, which are determined by the item locations of the presumed latent variables along the same scale structure (Bond & Fox, 2007; Rasch, 1980; Wright & Stone, 1979). Therefore, using the same measurement scale establishes homogeneous intervals, which means that the same difference between the difficulty parameter of an item and the ability of the subject involves the same probability of success (or failure) along the entire scale (Preece, 2010).

As our own results have shown (Veas, Gilar, Castejón & Miñano, 2016), there are statistically significant differences in the percentage of underachieving students in compulsory secondary education, identified with different methods, with the obtained percentages of underachieving students varying from 14.55% (simple standardized difference) to 15.39% (regression method) or 30.37% (Rasch model).

According to Phillipson and Tse (2007), the application of the Rasch model can be considered the most objective method because the results are based on measurement scales that are invariant between persons.

1.4. The present study

Previous studies have revealed differences between underachieving and non-underachieving students *in the means* (Castejón et al., 2016; Siegle & McCoach, 2018; White et al., 2018) of the considered personal, social, and family variables. However, there have been almost no studies (Kim, Ham, & Hwang, 2017) on the differences *in the strengths* of the relationship between these variables and academic performance in underachieving and non-underachieving students. Moreover, a separate analysis of each of these variables does not provide insight into the complex relationships that hold between them in predicting and/or explaining academic performance. Structural models are needed to capture both the interrelationship of these variables and their relationships with achievement, while comparing the similarities and differences of these models in groups of underachieving and non-underachieving students.

From a methodological point of view, these structural models make use of techniques such as path analysis and structural equations with latent variables. From a conceptual point of view, they integrate the main variables related to performance and the variables that differentiate between underachieving and non-underachieving students. These variables are situated within the personal scope of learning capital, mostly the cognitive type, such as general intelligence, intellectual skills (or learning strategies), and motivation. Although educational capital resources received minor attention during the 90s, and the social and family context were considered in recent studies, this included only a small number of variables (Fenollar, Román, & Cuestas, 2007; Miñano & Castejón, 2011; Miñano, Castejón, & Gilar, 2012; Spinath, Spinath, Harlaar, & Plomin, 2006; Veas, Castejón, Gilar, & Miñano, 2015; Zuffianò, Alessandri, Gerbino, & Luengo, 2013). In previous studies on academic performance, the structural models showed a good fit to the data and established a set of relationships that were stable in different groups of subjects and educational levels (Fenollar, et al., 2007; Veas, et al., 2015).

The results of a previous study (Veas et al., 2015), which were obtained using a sample of 1,398 Spanish secondary school students, were in line with other works in terms of the contributions of the factors of intellectual ability, self-concept, learning strategies, goal orientation, popularity, and parental involvement in academic achievement. The study's path analysis showed a satisfactory data fit, explaining 56% of the academic achievement variance.

Within the actiotope model of underachievement, the *main objective* of this study was to compare a structural model of the relationships of educational capital and learning capital resources, using indicators based on personal, social, and contextual variables, with academic performance. The necessary data for this were acquired from the study of Veas et al. (2015), using non-underachieving and underachieving students who were identified through the Rasch model. The model of Veas et al. (2015), which includes most of the variables that are related to academic performance, is based on the review of 12 previous structural models of the factors that affect performance. In addition, the variables in this model are those that appear systematically in the reviews on the characteristics of underachieving students (Siegle & McCoach, 2018; White et al., 2018).

There is hardly any previous research on the issue of the strength of the relationships between these variables in underachieving students (Kim, et al., 2017), since the vast majority of studies deal with differences in means (Castejón et al., 2016; Siegle & McCoach, 2018; White et al., 2018). However, it *can be hypothesized* that the paths that would be different between the two groups *in terms of the strength of the relationships* between variables, will be those connecting the variables of academic self-concept, motivational orientation towards learning, metacognition, and the expectations of parents, which are variables in which greater differences between groups are found.

2. Materials and methods

2.1. Participants

This study used random cluster sampling with the school as the sampling unit, focusing on southeastern Spain. A total of 1,398 students in their first and second year of compulsory secondary education in the province of Alicante (Spain) were selected. Of them, 216 were excluded from the final sample because of having an insufficient command of the language, not having completed the tests in their entirety, or because they did not have parental consent. Thus, in total, 1,182 compulsory secondary education students participated. Of them, 962 participants (81.4%) were enrolled in a public school, and 220 (18.6%) were enrolled in a private school. In our sample, 619 students were enrolled in the first course and 563 were enrolled in the second. In Spain, compulsory secondary education comprises four courses, with students aged from 12 to

16 years. Childhood socioeconomic status (SES) was established on the basis of parents' occupations, family income, and educational histories. There was a wide range of SESs; middle-class children made up the majority.

We used a chi-square test to determine any differences in the gender makeup of the sample (51.2% were boys and 48.8% were girls) compared to that of the national student population (51.3% boys and 48.7% girls); there were no gender differences (χ^2 = 0.006, $df = 1$, $p > .05$).

From the total sample, 359 underachieving students were identified using the Rasch model. Of the 823 non-underachieving students, a similar number of students (358) were selected randomly.

2.2. Measures

2.2.1. Measurement of general intellectual ability.

General intellectual ability was estimated using the Battery of Differential and General Abilities (BADyG) (Yuste, Martínez, & Gálvez, 2005), which measures students' capacities and academic abilities using 192 items with five response options (only one option is correct), and provides a general intelligence quotient (IQ). The composite reliability for total IQ was .84.

2.2.2. Measurement of self-concept.

Marsh's (1990) Self-Description Questionnaire (SDQ-II), which was adapted into Spanish (the Self-Concept Evaluation Scale for Adolescents [ESEA-2]) by González-Pienda et al. (2002), was used to evaluate self-concept. This instrument comprises 70 items grouped into 11 self-concept dimensions. The answers were given on a six-point Likert scale (1 = totally disagree, 6 = totally agree), indicating the degree of agreement or disagreement with each statement. In this study, we used only the academic self-concept factor (*ac_selfconc*), with a composite reliability value of .90.

2.2.3. Measurement of goal orientation.

García et al.'s (1998) Academic Goal Questionnaire (CMA), which is a Spanish adaptation of the Achievement Goal Tendencies Questionnaire of Hayamizu and Weiner (1991), was used to evaluate goal orientation. This instrument comprises 20 items grouped into three goals: learning, performance, and reinforcement. The answers are given on a five-point Likert scale (1 = never, 5 = always), depending on the frequency with which the subject feels the statement to be true. In this study, we used only two factors, namely, the learning (*learn_goals*) and performance goals (*perf_goals*), with composite reliability values of .74 and .89, respectively.

2.2.4. Measurement of learning strategies.

Learning strategies were measured using the Learning Strategies Questionnaire (CEA), which evaluates four large scales, produced by Beltrán, Pérez, and Ortega (2006). We used only the elaboration of information (*elaboration*), personalization (creative and critical thinking, *personali*), and meta-cognition (*metacogni*) scales. To evaluate these three scales, students answered fifty items on a five-point Likert scale (1 = completely false, 5 = totally true), indicating the degree to which each strategy is applicable to their own learning. The composite reliability values for the study sample were .82 (information scale), .74 (personalization scale), and .74 (meta-cognition scale).

2.2.5. Measurement of popularity.

The Bull-S questionnaire (version A) by Cerezo (2000) was used to measure the variable of popularity (*popularity*). This instrument comprises 15 items. In this study, we used only the first four (“Who would you choose as a classmate?,” “Who would you not choose as a classmate?," "Who do you think has chosen you?," "Who do you think has not chosen you?") to extract an index of peer acceptance, namely, *popularity*.

2.2.6. Measurement of parental involvement.

The Parental Involvement Questionnaire (CIF) was used to evaluate the participation of parents. This questionnaire was created by our research group. Through this questionnaire, the students assessed their perception of parental participation and monitoring, and the importance that their parents give to the educational process. The instrument comprises of 20 items grouped into four factors: a) perception of support, organization, and interest in the educational process ("I believe that my parents help me with my studies as much as they can") (*per_support*); b) parental expectations ("My parents believe I can continue on to pursue post-compulsory education, i.e., high school or intermediate vocational training") (*expectations*); c) school relations ("My parents regularly attend parent-tutor meetings") (*school_relat*); and d) support with homework ("My parents assist me with questions, homework, internet research, etc.") (*time_support*). Students answered the questionnaire on a five-point Likert scale (1 = never or hardly ever, 5 = always or mostly), indicating the frequency that each statement is true. The composite reliability values for the study sample were .70 (*per_support*), .79 (*expectations*), .63 (*school_relat*), and .76 (*time_support*).

2.2.7. Measurement of academic achievement.

To measure academic achievement (*achievement*), the mean of seven numerical course GPAs was used: Spanish language and literature, natural sciences, Catalan language, social sciences, mathematics, English, and technology. Grades from art education and physical education were discarded because they lacked unidimensionality, which is an important assumption when differential item functioning is present among the students’ gender in this sample (Veas, Gilar, Miñano, & Castejón, 2017). The student scores presented a Cronbach’s alpha value of .94.

2.3. Procedure

The necessary consent was first obtained from the administrative staff and school boards of the schools, and then the parents or legal guardians of the students provided written informed consent. Data collection occurred at the schools during the second trimester of the school year and on two consecutive days. Normal school hours were employed, including two sessions of two hours each per day, with a twenty minute break between the sessions.

The four-hour sessions were close in time, and were held mid-term. All the variables were evaluated within the same time interval, with the exception of academic performance, which was obtained at the end of the course.

2.4. Data analysis

The identification of underachieving students was conducted using the Rasch method by analyzing logit scores from the IQ on the BADyG and school grades with Winsteps software version 3.81 (Linacre, 2011), based on the joint maximum likelihood (Linacre, 2012). Once fit indices from both measures were observed, the Rasch model allowed for testing the hypothesis that two tests measure the same underlying construct (Bond & Fox, 2007). A scatterplot of students was made to compare the Rasch responses and observe whether the points lay within the 95% confidence intervals (Phillipson, 2008). To make this calculation, a *t* test was used, dividing the difference between a person’s achievement measure and their intelligence measure by the squared difference between their achievement standard error and their intelligence standard error. Those points outside the confidence intervals indicated that the achievement level was not as expected (Veas, Gilar, Miñano, & Castejón, 2016; Veas, Gilar, Castejón, & Miñano 2016).

To compare a model of the determinants of academic achievement across groups (underachieving and non-underachieving students), we tested for the invariance of a causal structure across groups, following a strategy for testing replicability (Byrne, 2008). This approach is a straightforward way to test whether a model that has been specified in one sample is replicated in other independent samples from the same population. In our case, the structural paths described in the work of Veas et al. (2015), as shown in a simplified manner in Figure 1, were invariant across each group of underachieving (n = 359) and non-underachieving (n = 358) students. First, we established a theoretical reference model, which was derived empirically using a large sample (Veas et al., 2015), prior to testing for invariance across groups. The theoretical reference model was the model with the best fit to the data in the Veas et al. (2015) study. This model (Figure 1) was the model tested in two subsamples—underachieving and non-underachieving students—selected from the sample of 1,182 students used in Veas et al. (2015). All the variables in this model were defined by a single measure; that is, they were treated as observed, and none were considered latent.

The rationale was that the objective here was to determine the extent to which this final model presented similarities (invariant) and differences (not invariant) across two independent groups: underachieving and non-underachieving students. Consistent with this rationale, model specifications were identical in both groups (Byrne, 2008). Multi-group causal structure analyses were performed using EQS 6.2 (Bentler, 2005). The maximum likelihood (ML) method was used for the estimation of parameters.

[Put Figure 1 near here]

To test the invariance of causal structures, or measurement, across groups, we followed the sequence of nested models proposed by Vandenberg and Lance (2000) and Byrne (2008), increasing the constraints from one model to the next.

The configural model (1) was the first step in establishing invariance; the estimation of the parameters of the configural model involved testing whether there was a similar path structure across groups without imposing between-group constraints. This test was passed if a similar model structure with simultaneous parameter estimations in both groups fit the data. The configural model served as a baseline model to test the subsequent models.

The full path coefficients invariance model (2) was established by adding cross-group constraints to the path coefficients. If applying these constraints produced a fit increase that was statistically significant, this indicated that not all path coefficients were invariant across groups. To determine which parameters were non-invariant across groups, EQS provided a cumulative multivariate Lagrange Multiplier (LM) test for releasing constraints; the probabilities associated with the incremental univariate values ($\Delta\chi^2$) were $< .05$.

If the condition of full path coefficients was not satisfied, it was possible to test the partial path coefficient invariance model (Model 2a) (Byrne, Shavelson, & Muthén, 1989), relaxing those constraints that had been shown to be non-invariant in the previous step. When the comparison with the configural model yielded a non-significant difference in χ^2, this suggested that the specified equality constraints were tenable. Tests for the equivalence of error variances-covariances (Model 3) were considered excessively stringent (Byrne, 2008; Byrne et al., 1989).

To compare the models whose analyses were based on ML estimation, we used the likelihood ratio test (i.e., $\Delta\chi^2$ to Δdf). Supplementary fit indices were employed to evaluate model fit. This included the comparative fit index (CFI), the increment in CFI (ΔCFI), the goodness-of-fit index (GFI), the standardized root mean square residual (SRMR), and the root mean square error of approximation (RMSEA). This procedure allowed us to determine which parameters were invariant and which differed across groups.

3. Results

Table 1 contains separate descriptive statistics, correlations between variables, and skewness and kurtosis values for the two groups of non-underachieving (n_1 = 358) and underachieving (n_2 = 359) students. The skewness and kurtosis values of most variables fell inside the range of −1 to +1, and only certain values departed from normality. The maximum likelihood method was used for parameter estimation because it is robust and stands up to minor changes and moderate departures from normality; the higher absolute value of univariate skewness approached two, and kurtosis was less than seven (Curran, West, & Finch, 1996).

Although the pattern of correlations was similar, differences between groups were observed, namely, the correlation between achievement and metacognition was greater in the non-underachieving group (r = .35) than in the underachieving group (r = .23). Additionally, the correlation between achievement and time support was negative and significant in the non-underachieving group (r = −.17), and not significant (r = −0.05) in the underachieving group. Likewise, performance goals had a negative correlation with achievement (r = −.13) in the non-underachieving group, but it was neither negative nor significant (r = .01) in the underachieving group.

Likewise, the mean scores for all variables except time support and performance goals were higher in the non-underachieving group than in the underachieving group.

(Please put Table 1 near here)

Table 2 summarizes the sequence of models that tested the invariance of the path coefficients across the groups. The theoretical reference model was the model that best fit the data in the Veas et al. (2015) study; this model was the one tested in two subsamples—underachieving and non-underachieving students—selected from the sample of 1,182 students used in Veas et al. (2015). The fit of our reference model was satisfactory (χ^2 = 317.73, RMSEA = .076, SMRM = .089), with CFI and GFI values of .953 and .963, respectively, which fit the criteria established by Hu and Bentler (1999). It is considered that a model has a satisfactory fit if the value of the CFI is equal to or greater than .95.

Multi-group structural equation modeling started with the configural baseline model: this model tested whether the causal structure shown in Figure 1 fit both groups. The fit indices simultaneously supported the fit of this causal structure for both groups. As seen in Table 2, the configural model provided a very good fit to the data (CFI = .956, GFI = .957, χ^2 = 226.09, RMSEA = .070, SMRM = .087), indicating that the causal structure was equal across groups.

(Please put Table 2 near here)

However, the multivariate LM test for adding parameters indicated a significant increment in fit when adding the path coefficient for *popularity → IQ*, in the non-underachieving group. The free estimation of this parameter in a subsequent re-specification of the configural model produced an increase in the global fit that became significant (decrement in χ^2 = 9.77, df = 1, p < .01, CFI = .959, GFI = .959, RMSEA =.068, SMRM = .097). In this way, the modified configural model became the baseline model against which to compare more restrictive models. Although this model still did not show a total adjustment to the data (p > .05), the value of χ^2/df (216.32/81 = 2.67) was satisfactory.

The next model tested was one with full invariance of path coefficients: that is, a model with all path coefficients, minus *popularity* → *IQ*, constrained to be invariant across groups. Testing for the equivalence of path coefficients entails the specification of equality constraints for all freely estimated coefficients that are specified similarly in both groups. By employing these constraints, a decrease in fit was obtained from the baseline model that was statistically significant ($\Delta\chi^2$ = 75.66, Δdf = 30, p <.01), showing that the path coefficients were not invariant across the two groups. By examining other fit indices (CFI = .945, GFI = .943, RMSEA = .068, SMRM = .097), model degradation was shown, ΔCFI = .014 > .01, which exceeded the value of .01 proposed by Cheung and Rensvold (2002).

The next test involved a model with partial invariance of path coefficients. In this model, we released the equality constraints of the path coefficients whose values were non-significant as per the Wald Test, which ascertains whether a single parameter or a set of parameters, specified as free in the model, can be set to zero without significant degradation of model fit (Byrne, 2008). The seven non-significant coefficients in the non-underachieving group and the nine path coefficients in the underachieving group are shown in Table 3 and Figure 2. Two of these coefficients were non-significant in both groups; thus, we relaxed 14 equality constraints across groups.

This partial invariance model resulted in fit index improvements (χ^2/df = 2.58, CFI = .953, GFI = .952, RMSEA = .067, SMRM = .091). Nevertheless, this improvement was not enough to achieve a model that did not differ significantly from the baseline model ($\Delta\chi^2$ = 34.39, Δdf = 16, p <.05). To determine which parameters were not equivalent across non-underachieving and underachieving students, we used the LM test for releasing constraints (Bentler, 2005). Associated with each constraint is a cumulative multivariate LM test (χ^2) and an incremental univariate χ^2 value, along with their probabilities. To find non-invariant parameters across groups, we checked the probability associated with the incremental univariate χ^2 values that were < .05 (Byrne, 2008).

On the basis of the results of the LM test of equality constraints, only two path coefficients (*achievement → ac_selconc* and *ac_selconc → expectations*) and one error covariance (*perf_goals* <-> *learn_goals*) were determined to be non-invariant across the two student groups.

Subsequently, the constraints on the two non-invariant path coefficients were relaxed. The statistics for the overall fit of the final model of partial invariance are shown in Table 2. Regarding the chi-square value, the fit of this model was not significantly worse than that of the modified configural invariance model ($\Delta\chi^2$ = 15.15, Δdf = 14, p > .05); CFI was the same, whereas RMSEA (.063) and SMRM (.086) were improved. Thus, partial invariance, with 18 constraints relaxed (of which two were common to both groups), was supported. This indicated both similarities and differences between the causal structures in the two student groups.

Table 3 shows the standardized and unstandardized values of the regression coefficients and the covariance of errors for the non-underachieving and underachieving groups, and summarizes the parameters that were invariant and non-invariant across groups.

(Please put Table 3 near here)

As seen in Table 3, the IQ → *popularity* coefficient was estimated only for the non-underachieving group. Fourteen path coefficients and six covariance errors were invariant across groups. Another fourteen path coefficients were non-invariant. Of these, five were non-significant in the non-underachieving group, but significant in the underachieving group; seven were non-significant in the underachieving group but significant in the non-underachieving group. The coefficients, *ac_selfconc* → *achievement* and *expectations* → *ac_selfconc*, indicated that the strengths of the relations were different across groups. The path coefficient *ac_selfconc* → *achievement* was higher in the non-underachieving group (β = .34), whereas the path coefficient *expectations* → *ac_selfconc* was higher in the underachieving group (β = .32). Two path coefficients, *elaboration* → *achievement* and *personali* → *achievement*, were not significant in either group.

The error covariances were invariant across groups, with the exception of *perf_goals* ↔ *learn_goals*, which had a stronger relationship in the non-underachieving group compared with the underachieving group.

The similarities and differences of the paths across groups are represented graphically in Figure 2. As for the similarities between the groups, the important points are the high coefficient value of the relationship between IQ and achievement, which is similar in both groups, and the direct influence of academic self-concept on achievement, which also has an indirect relationship through learning strategies. There is a direct path from learning goal orientation to learning strategies. In both groups, goal orientations were directly related to learning strategies but not to performance. Similarly, in both groups, expectations had notable relationships with self-concept (as in the perception of support), school relations, and the amount of support.

As for the differences, the positive influence of academic self-concept on achievement was greater in the non-underachieving group than in the underachieving group, whereas the influence of expectations on academic self-concept was greater in the underachieving group than in the non-underachieving group.

Performance goals maintained more negative relationships in the non-underachieving group than in the underachieving group, for example, with the strategies of elaboration, personalization, and metacognition. Academic self-concept did not have a significant relationship with performance goals in the non-underachieving group, but had a positive relationship in the underachieving group.

The strategy of metacognition maintained a significant relation with achievement in the non-underachieving group, whereas this relation was not significant in the underachieving group.

(Please put Figure 2 near here)

Perception of support, school relations, and the amount of support maintained different relations with academic achievement in both groups. The relation of the perception of support with achievement was positive and significant in the non-underachieving group, and non-significant in the underachieving group. On the other hand, the coefficient of the relationship between school relations and achievement was not significant in the non-underachieving group, but significant in the underachieving group. The negative relationship between the amount of support and achievement was significant only in the non-underachieving group. Meanwhile, the error covariance between performance goals and learning goals was higher in the non-underachieving group than in the underachieving group. Although performance goals and learning goals were positively correlated in both groups, the relations of these variables with the others were different across groups.

4. Discussion

The complex nature of the variables involved in underachievement implies the need to analyze their different interaction levels. During the last few decades, scientific literature has highlighted the phenomenon of underachievement, mostly focusing on gifted students (McCoach & Siegle, 2011; Peterson & Colangelo, 1996; Reis & McCoach, 2000). In this context, the actiotope model of giftedness tries to answer the question of how components of underachievement form an integrated whole, looking at how educational capital can be transformed into learning capital. These relations, however, can also be explored at all ranges of ability to provide a deeper comprehension of the underachievement phenomena. In line with the main objective of this work, analyzing the similarities and differences of a causal structure of the predictors of academic achievement across non-underachieving and underachieving students, the results showed both similarities and differences. Although about half of the path coefficients remained invariant, the other half revealed significant differences between the two groups.

First, the causal structure of the determinants/predictors of academic achievement, initially validated in a previous study conducted with a larger group of students (Veas et al., 2015), was retained when both groups were examined in the configural model. However, the statistical significance and/or strength of many of the relationships between the variables, represented by the values of the path coefficients and error covariances, differed significantly across groups.

As mentioned in the Results section, fourteen path coefficients and six covariance errors were invariant across groups, and a similar number of path coefficients were non-invariant across non-underachieving and underachieving students.

As one might theoretically expect (Deary, Strand, Smith, & Fernandes, 2007), intellectual capacity, expressed as IQ, remained the most important predictor of the academic achievement of both non-underachieving and underachieving students. The differences between the groups occurred in the personal and familial variables considered in the structural model; in fact, the intellectual levels of the groups were similar.

5.1. Academic self-concept

Academic self-concept was another variable that impacted achievement in both groups, although the positive effect of academic self-concept on achievement was greater for non-underachieving students. Among underachieving students, academic self-concept had a weaker effect on academic achievement. Although results for the differences between underachieving and non-underachieving students in terms of the level of academic self-concept have not been entirely consistent in previous studies (McCoach & Siegle, 2003; Preckel & Brunner, 2015), related studies have generally revealed a weaker academic self-concept for underachieving students (Castejón et al., 2016; Rimm, 2003). Thus, it appears that underachieving students show both a lower level of academic self-concept and a weaker relationship between this and performance.

Academic self-concept also had indirect effects on achievement through learning goals and strategies. These relationships manifested differently in the groups. The non-underachieving students' academic self-concept influenced performance through metacognitive strategies, whereas the underachieving students' self-concept affected goal orientations, which in turn led to different strategies. In both cases, academic self-concept seemed to initiate a chain of influence (Marsh & Craven, 2016; Seaton, Parker, Marsh, Craven, & Seeshing-Yeung, 2014).

5.2. Goal orientations

Motivational orientations, learning, and performance goals did not influence achievement directly, but the learning strategies of both groups did. Learning goals directly influenced the learning strategies of elaboration, personalization, and metacognition for both groups. On the other hand, performance goals showed a negative influence on the three learning strategies of non-underachieving students. In addition, learning goals indirectly influenced academic achievement through metacognitive strategies, but only for non-underachieving students. Although both learning and performance goals showed positive relationships with learning strategies in the validation study of the structural model (Veas et al., 2015), in our study the relationships were not significant for the underachieving group, but were negative and significant for the non-underachieving group. This negative relationship has also been found in other studies (Middleton & Midgley, 1997; Pintrich, 2000). These results appear to be less consistent with the theory of multiple goals (Harackiewicz, Barron, Pintrich, Elliot, & Thrash, 2002; Liu, Wang, Tan, Ee, & Koh, 2009), which could be explained by the poor academic self-concept of underachieving students, as other studies have shown that students with a positive self-concept can be performance-goal oriented (e.g., Bandalos, Finney, & Geske, 2003). The results of our study also indicated that academic self-concept did not have a significant relationship with performance goals for non-underachieving students, but did have a positive relationship for underachieving ones.

5.3. Metacognition

These results revealed the key role of metacognitive strategies in academic performance. The multiple relationships between learning goals, performance goals, and learning strategies influenced academic performance only through metacognitive strategies, and only for non-underachieving students. Moreover, the relation between learning goal orientation and achievement was mediated with the use of metacognition strategies (Valle et al., 2003) for non-underachieving students. Metacognition, which is key to the selection and regulation of strategies and learning techniques, is a general strategy that can be applied to different domains (Callan, Finch, Marchant, & German, 2016; Nisbet & Shucksmith, 1986). Metacognition also played a key role in the differentiation of underachieving and non-underachieving students in other studies (Castejón et al., 2016; Stoeger & Ziegler, 2005; Yip, 2007).

5.4. Parental involvement

Parental expectations, which are in turn influenced by general intelligence, proved to be the most important indicator of parental involvement in the educational process, showing a direct path to self-concept, perception of support, school relations, and the amount of support in both underachieving and non-underachieving students, and an indirect influence on achievement through those variables. Expectations seem to be the best predictor of parental involvement and student achievement, as stated in some meta-analyses (Hattie, 2009; Jeynes, 2005; Wilder, 2014). On the basis of the actiotope model, this factor may be the main reason that explains the differences in self-concept between underachieving and non-underachieving students. Within the non-underachieving group, if social educational capital is mainly constructed by positive parent-adolescent interactions, students' good ideas about self are linked with a consistent telic learning capital, which activates the appropriate actional learning capital through didactic resources within the episodic and attentional learning capital (metacognition strategies). On the contrary, negative influences from social educational capital provokes negative ideas about self and increases the activation of performance goals (telic learning capital), which in turn avoid the use of metacognitive strategies (episodic and attentional learning capital)

These results are congruent with a study by Stern (2006), who found that although parents' expectations were significantly related to reading achievement, parents' expectations and students' perceptions in the risk group were not related to reading achievement. Parents' higher expectations led to a stronger perception of support, better school relationships, and more support for students. In addition, parental expectations had a greater impact on academic performance through these variables; however, the impact was different between groups. The perception of support had a positive effect on achievement for non-underachieving students, but not for underachieving ones. On the contrary, school relations were related to achievement for the underachieving group; better parent-school relationships led to higher achievement by underachieving students. Meanwhile, more support (in terms of time) was associated with lower academic performance for non-underachieving students, as in other studies (Gonida & Cortina, 2014; Niggli, Trautwein, Schnyder, Luedtke, & Neumann, 2007), but it had no relation to the performance of underachieving students. These results have clear implications for the improvement of academic performance, as evidenced by studies on the effectiveness of parental involvement programs in education (Jeynes, 2012).

5.5. Popularity

The path of general intelligence, popularity, and academic achievement only occurred in non-underachieving students, where a significant increment in model fit was obtained when this path was added; sociometric popularity, a measure of acceptance used in this work, seems to be more related to academic performance than perceived popularity (Meijs, Cillessen, Scholte, Segers, & Spijkerman, 2010; Schonert-Reichl, 2013). Popularity promotes a sense of belonging in school, increasing performance and motivation, which contributes to participation in school, academic success, emotional balance, and teacher-student relationships (Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008).

In the underachieving group, this factor constitutes the key element within social educational capital, as these students can compensate for negative interactions with parents. However, peers' influences could also account for underachievement (Reis & McCoach, 2000), especially if they affect endogenous factors in terms of classroom structures. In this sense, previous studies reported the high impact of classroom goal structures on determining individual goals (Muyarama & Elliot, 2009).

5.6. Limitations

As a limitation of the study, it is necessary to note that, in the proposed model, only observed variables are considered, for which the metric invariance cannot be tested.

Moreover, one of the dimensions of CIF, *school relations*, did not have an appropriate composed reliability value (Hair et al., 2008), which may affect the reliance of this measure.

More specifically, although the causal relationships are theoretically based in our causal model, (i.e., CI preceding motivational orientation and self-concept or performance), the cross-sectional nature of our study is a limitation to infer causality in the relationships proposed in the model.

5. Conclusions

Overall, underachieving students were characterized primarily by their lack of learning strategies systematically related to academic performance, such as metacognition, the fact that their academic self-concepts exerted less influence on achievement, the greater influence of parental expectations on their academic self-concepts, and better parent-school relationships, which led to higher achievement.

On the other hand, non-underachieving students were characterized mainly by their use of metacognitive strategies that led to higher academic achievement, the stronger influence of self-concept on their performance, the perception of parental support leading to higher performance, and the positive effects of social and peer acceptance on academic achievement. Knowledge of these characteristics will assist with the design and implementation of programs aimed at reversing the poor academic performance of underachieving students (Chan, 1999, 2005; Renzulli & Reis, 1997). In addition, any educational intervention trying to reverse underachievement must concurrently focus on the personal, familial, and social factors that define underachievement (Baum, Renzulli, & Hébert, 1995).

Deepening our knowledge of the actiotope model of underachievement has allowed us to explore the differences between underachieving and non-underachieving students in terms of the variables that were included here and which display reciprocal relations and effects on academic achievement. We must also establish whether underachieving students constitute a homogeneous or heterogeneous group. In addition, the results should be cross-validated with data from another sample.

Another possibility for future research is to analyze in depth the sample of underachieving students, to establish if students identified as underachieving have any exogenous cultural or socioeconomic variables in common—for example, low socioeconomic level, membership of a minority cultural group, or immigrant status—

that could explain the differences in the relationships between variables across under- and non-underachieving students.

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Figure captions

Fig. 1. Simplified initial model (from Veas et al., 2015).

Fig. 2. Final model with each path color representing an effect (orange = invariant coefficient, green = non-invariant coefficient, blue = significant coefficient only in the underachieving group, red = significant coefficient only in the non-underachieving group, grey = no significant coefficient).

Fig. 2. Final model with each path color representing an effect (- = invariant coefficient, += non-invariant coefficient, *= significant coefficient only in the underachieving group, .= significant coefficient only in the non-underachieving group, = = no significant coefficient).

Table 1

Correlations, Descriptive Statistics, Skewness and Kurtosis between Variables in No-under (Lower Left) and Under Achieving Groups (Upper Right)

Variables	1	2	3	4	5	6	7	8	9	10	11	12	13
1.IQ	1	.10	.10	.09	.12*	.04	.18**	-.01	-.19**	.32**	.01	-.03	.66**
2.popularity	.18**	1	.03	.01	.03	.02	.01	.03	.06	.09	.00	.01	.14**
3.elaboration	.21**	-.05	1	.84**	.64**	.21**	.28**	.29**	.25**	.35**	.30**	.14**	.20**
4.personali	.20**	-.07	.82**	1	.56**	.20**	.29**	.33**	.26**	.37**	.34**	.16**	.16**
5.metacogni	.28**	.04	.62**	.55**	1	.22**	.23**	.27**	.19**	.29**	.23**	.05	.23**
6.per_support	.13*	.09	.22**	.17**	.26**	1	.45**	.43**	.49**	.23**	.19**	.07	.14**
7.expectations	.32**	.08	.30**	.32**	.25**	.45**	1	.40**	.28**	.37**	.21**	.13*	.19**
8.school_relat	.07	.09	.36**	.34**	.25**	.40**	.34**	1	.57**	.13**	.19**	.16**	.13
9.time_support	-.14**	-.03	.21**	.18**	.07	.40**	.15**	.43**	1	.13**	.31**	.13**	-.05
10.ac_selfconc	.43**	.07	.26**	.29**	.35**	.21**	.28**	.15**	-.02	1	.32**	.20**	.49**
11.lear_goals	.04	-.04	.12*	.11*	.07	.07	.03	.06	.14**	.11*	1	.38**	.09
12.perf_goals	-.13*	.02	-.11	-.06	-.08	-.02	-.01	-.08	.04	.01	.53**	1	.01
13.achievement	.73**	.22**	.23**	.21**	.35**	.24**	.34**	.14**	-.17**	.61**	.05	-.13*	1
N	No-under n_1 = 358						Under n_2 = 359						
Mean group 1	101.21	6.14	59.47	72.55	38.64	21.62	21.61	19.50	16.21	4.81	26.41	25.19	6.99

Stand. Dev. 1	17.23	4.16	10.57	13.31	6.45	3.03	3.20	3.70	4.70	.99	11.17	8.86	1.55
Skewness 1	0.05	0.98	-0.01	0.01	-0.01	-0.80	-1.43	-0.61	-0.28	-1.03	-0.67	-2.06	-0.08
Kurtosis 1	-0.51	1.94	-0.57	-0.45	-0.09	0.01	2.40	-0.14	-0.72	0.99	-0.30	2.94	-0.67
Mean group 2	98.73	5.09	54.32	68.57	35.18	20.25	19.56	18.38	16.55	3.69	23.83	25.80	4.61
Stand. Dev. 2	13.75	3.66	10.73	13.51	6.19	3.53	4.05	3.86	4.80	1.13	11.30	7.10	1.09
Skewness 2	0.22	0.90	0.11	0.21	-0.01	-1.04	-0.68	-0.36	-0.32	-0.21	-0.34	-2.32	0.15
Kurtosis 2	-0.41	1.08	-0.03	0.16	-0.04	1.18	-0.07	-0.40	-0.57	-0.35	-0.63	5.20	0.15

Note. * $p<0.05$; ** $p< 0.01$

Table 2

Tests for Invariance of Structural Parameters across No-under and Under-achieving Groups

	Model	χ^2	*df*	χ^2/df	$\Delta\ \chi^2$	$\Delta\ df$	CFI	ΔCFI	GFI	SRMR	RMSEA
1	Theoretical-Reference Model$^{(1)}$	317.73	41	7.74	-		.953	-	.963	.089	.076
2	Configural Model	226.09	82	2.75	-	-	.956	.003	.957	.087	.070
3	Configural modified (with IQ, Popularity in Group 1)-Baseline	216.32	81	2.67	(- 9.77*)	(-1)	.959	.003	.959	.087	.068
4	Full Invariance of common path coefficients	291.98	111	2.63	75.66*	30	.945	.014	.943	.097	.068
5	Partial invariance, without non-significant (*ns*) path coefficients)	250.71	97	2.58	34.39 *	16	.953	.008	.952	.091	.067
6	Partial invariance, without *ns* coefficients and non- invariant constraints	231.47	95	2.43	15.15	14	.959	.006	.955	.086	.063

(1) n= 1180; Non-underachieving n_1= 358; Underachieving n_2= 359. * $\chi^2_{(30)} = 43.77$; * $\chi^2_{(16)} = 26.29$; * $\chi^2_{(14)} = 23.68$; * $\chi^2_{(1)} = 3.84$; α= .05

Table 3

Values of regression coefficients and covariance of errors for the non-underachieving and underachieving groups

	Non-underachieving group		Underachieving group	
Parameter	Standardized	No standardized (SD)	Standardized	No standardized (SD)
Regression coefficients				
IQ -> popularity *(non-under)*	.18*	0.04* (.01)	-	-
ac_selfconc -> popularity *(under)*	-.01	- 0.01^{NS} (.24)	.09*	0.31* (.17)
ac_selfconc -> elaboration *(=)*	.25*	2.66* (.35)	.28*	2.66* (.35)
lear_goals -> elaboration *(=)*	.21*	0.20* (.03)	.21*	0.20* (.03)
perf_goals -> elaboration *(non-under)*	-.23*	- 0.28* (.06)	.01	0.01^{ns} (.07)
ac_selfconc -> personali *(=)*	.26*	3.56* (.44)	.30*	3.58* (.44)
lear_goals -> personali *(=)*	.21*	0.25* (.04)	.21*	0.25* (.04)
perf_goals -> personali *(non-under)*	-.17*	- 0.26* (.08)	.02	0.04^{ns} (.09)
ac_selfconc -> metacogni *(=)*	.27*	1.74* (.21)	.31*	1.74* (.21)
lear_goals -> metacogni *(=)*	.14*	0.08* (.02)	.14*	0.08* (.02)
perf_goals -> metacogni *(non-under)*	-.17*	- 0.12* (.03)	-.06	- 0.05^{ns} (.04)
expectations -> per_support *(=)*	.44*	0.41* (.03)	.47*	0.41* (.03)
IQ -> expectations *(=)*	.31*	0.05* (.01)	.19*	0.05* (.01)

expectations-> school_relat *(=)*	.33*	0.39* (.03)	.41*	0.39* (.03)
expectations -> time_support *(=)*	.24*	0.36* (.04)	.31*	0.36* (.04)
IQ -> time_support *(=)*	-.22*	- 0.06* (.01)	-.18*	- 0.06* (.01)
IQ -> ac_selfconc *(=)*	.37*	0.02* (.01)	.26*	0.02* (.01)
expectations -> ac_selfconc *(≠)*	.16*	0.05* (.01)	.32*	0.09* (.01)
IQ -> lear_goals *(under)*	.01	0.01^{NS} (.03)	-.11*	- 0.09* (.04)
ac_selfconc -> lear_goals *(under)*	.11	1.24^{ns} (.64)	.36*	3.63* (.52)
IQ -> perf_goals *(=)*	-.13*	- 0.07* (.02)	-.13*	- 0.07* (.02)
ac_selfconc -> perf_goals *(under)*	.07	0.64^{ns} (.48)	.25*	1.58* (.33)
IQ -> achievement *(=)*	.51*	0.04* (.01)	.55*	0.04* (.01)
popularity -> achievement *(non-under)*	.09*	0.03* (.02)	.05	0.01^{ns} (.04)
elaboration -> achievement *(ns)*	.05	0.01^{ns} (.01)	.09	0.01^{ns} (.01)
personali -> achievement *(ns)*	-.06	$- 0.01^{ns}$ (.01)	-.12	$- 0.01^{ns}$ (.01)
metacogni-> achievement *(non-under)*	.08*	0.02* (.01)	.07	0.01^{ns} (.01)
per_support-> achievement *(non-under)*	.12*	0.06* (.01)	.03	0.01^{ns} (.01)
school_relat-> achievement *(under)*	.05	0.02^{ns} (.01)	.12*	0.03* (.01)
time_support-> achievement *(no-under)*	-.18*	- 0.06* (.01)	-.08	$- 0.20^{ns}$ (.01)
ac_selfconc-> achievement *(≠)*	.34*	0.53* (.05)	.28*	0.28* (.04)
Covariance of errors				

elaboration <-> personali *(=)*	.80*	100.86* (8.49)	.80*	96.41* (8.10)
elaboration <-> metacogni *(=)*	.56*	33.52* (3.61)	.59*	33.89* (3.52)
personali <-> metacogni *(=)*	.49*	37.17* (4.45)	.49*	35.45* (4.20)
per_support <-> school_relat *(=)*	.29*	2.78* (0.51)	.31*	3.45* (0.61)
per_support <-> time_support *(=)*	.38*	4.78* (0.69)	.42*	5.98* (0.81)
school_relat <->time_support *(=)*	.40*	6.40* (0.90)	.51*	8.15* (0.93)
lear_goals <-> perf_goals *(≠)*	.54*	52.81* (5.86)	.33*	24.70* (4.09)