

PREDICTING INTRA-INDIVIDUAL ACADEMIC ACHIEVEMENT TRAJECTORIES OF ADOLESCENTS NESTED IN CLASS ENVIRONMENT: INFLUENCE OF MOTIVATION, IMPLICIT THEORY OF INTELLIGENCE, SELF-ESTEEM AND PARENTING

Isabelle ROSKAM & Frederic NILS
Université Catholique de Louvain

In a longitudinal study conducted on 1130 adolescents (557 male and 573 female) in the 1st-6th grades from Belgian secondary schools, we tested the influence of individual factors (motivational constructs, implicit theory of intelligence and self-esteem) and environmental determinants (parenting and class environment) of academic achievement (grades in mathematics, language arts and GPA at three points in time). Using hierarchical linear models, we observed a decrease of grade over the course of the study, reciprocal relations between motivational constructs, self-esteem and academic achievement, a strong positive impact of supportive parenting and a moderate influence of class environment.

Introduction

Many studies have been devoted to adolescents' academic achievement, which is often considered as a measure of their social adjustment and positive functioning (Chen, Rubin, & Li, 1997; Schmidt & Padilla, 2003). Occidental cultures are concerned with competitive environments where highly-educated and highly-functioning individuals generally hold the best social positions because of increased income, job security and job satisfaction. In such a context, academic achievement is also considered as an important predictor of many facets of adolescents' well being such as mental health and happiness (de Bruyn, Dekovic, & Meijnen, 2003; Marchant, Paulson, & Rothlisberg, 2001).

Among variables that contribute to adolescents' academic achievement, existing studies stress individual predictors such as motivation, implicit theory of intelligence and self-esteem, or environmental predictors like parenting and, less frequently, class environment. Most of these studies are cross-

Isabelle Roskam is Professor of Psychology at the Laboratory for Educational and Developmental Psychology at the Université Catholique de Louvain. Frederic Nils is Associate Professor at the Laboratory for Educational and Developmental Psychology at the Université Catholique de Louvain.

Correspondence regarding this article can be sent to Isabelle Roskam, Laboratory for Educational and Developmental Psychology, Place Cardinal Mercier, 10, 1348 Louvain-la-Neuve. E-mail: isabelle.roskam@uclouvain.be

sectional, implying correlational analyses between academic achievement and only one individual or environmental factor. This kind of design does not allow the establishment of causal relations among individual or environmental predictors and adolescents' academic achievement. Furthermore, cross-sectional studies do not consider the adolescent as subject-in-development. Finally, by considering a given individual or environmental factor in isolation, it does not allow to assess the contribution of each variable compared to the other ones.

In reply to the limits noted above, the present study is based on longitudinal data. Growth curves are drawn for the adolescents' academic achievement in a one-year and three-times design. It considers several individual and environmental variables as possible causal predictors for the adolescents' growth curve. The contributions of each of these variables are analysed compared in relationship to the others. Using hierarchical linear models, the adolescents are viewed as subject-in-development who (1) display cognitive characteristics (motivation, implicit theory of intelligence and self-esteem), (2) are influenced by their parents' childrearing behaviour (parenting) and (3) are nested in class environment. Hypotheses are based on the existing literature that allows to bring out the expected contribution of individual and environmental predictors on the adolescents' academic achievement.

Academic achievement

Several measures of adolescents' academic achievement have been used in previous studies: standardised achievement tests, official school reports or grades reported by the teachers or by the adolescents themselves. The authors having used two or more of these measures report high correlations between them (.76 to .90) and observe similar relations with criterion variables like motivation and self-esteem (Marsh & Yeung, 1997; Pelegrina, Garcia-Linares, & Casanova, 2003; Skaalvik & Valas, 1999; Wolters, 2004). The measure of the adolescents' academic achievement however challenges the longitudinal collection of data. Indeed, to study growth in academic achievement, the scores at different moments have to be comparable. Using grades reported by school, teachers or adolescents is questionable because they are obtained from tests with different forms and difficulty across sessions (Hong & Ho, 2005; Jimerson, Egeland, & Teo, 1999). Nevertheless, according to realistic concern and evidence of high correlations between standardised achievement tests and grades, several longitudinal studies are based on grades (Juang & Silbereisen, 2002; Marsh & Yeung, 1997; Pintrich, 2000).

Longitudinal studies focused on growth of the adolescents' academic achievement have consistently displayed a decline in grade during the course of adolescence in mathematics, reading and courses related to language and

language arts. Such results have been observed in a number of different countries (Jimerson et al., 1999; Peetsma, Hascher, van der Veen, & Roede, 2005; Pintrich, 2000). In line with these studies, adolescents' academic achievement is expected to decline over the course of the time considered in the present study.

Achievement in mathematics is probably the most often studied amongst academic disciplines (see for example Ding & Davison, 2005; Ma & Xu, 2004; Pintrich, 2000, Stevens, Olivarez, Lan, & Tallent-Runnels, 2004). It has been considered among the most important and challenging disciplines. Abu-Hilal (2000) hypothesised that students may develop a stronger sense of self-efficacy beliefs in mathematics than in any other domain. Several other studies also include mathematics plus science, language arts or reading (see for example Jimerson et al., 1999; Marsh & Yeung, 1997; Newbegin & Owens, 1996; Peetsma et al., 2005). Others measure academic achievement with grades averaged from several disciplines (Grade Point Average – GPA) despite moderate correlations between them (see for example de Bruyn et al., 2003; Gagné & St Père, 2001; Hair & Graziano, 2003). Those studies provide evidence that the results obtained for one discipline are not relevant for another one. Furthermore, several authors suggest that the more specifically the outcome variable is defined and measured, the more likely it is to provide significant results and causal relations (Fan, 2001). Following such assumption, specific grades would be preferable than averaged grades from several disciplines.

Individual predictors

Three sets of individual predictors are considered in the present study as potential determinants of later adolescents' academic growth: motivational constructs, implicit theory of intelligence and self-esteem. Relatively few studies have attempted to combine these cognitive constructs and academic achievement in one single model (Leondari & Gialamas, 2002). Little is thus known about how these constructs are related to each other and how they are related to achievement when the others are controlled.

Several *motivational constructs* have been studied, in particular self-efficacy beliefs related to specific disciplines, attitude towards school, school anxiety, goal orientation, and causal attributions regarding achievement. Numerous studies focus on self-efficacy beliefs defined as individual's judgments about ones competence to perform in specific tasks in specific situations (Bandura, 1997). They show that adolescents' beliefs about their competence affect achievement. These beliefs have even been considered as better predictors than real competence regarding achievement, especially for adolescents (Schunk & Pajares, 2005), but this assumption is nevertheless

contested as soon as IQ is controlled (Gagné & St Père, 2001). When other motivational variables and previous achievement were controlled, Pajares and Graham (1999) however revealed that self-efficacy beliefs was the only motivational variable predicting later achievement. Correlations between self-efficacy beliefs and achievement range from .40 to .70 across samples and cultures (Juang & Silbereisen, 2002; Schunk & Pajares, 2005; Wolters, 2004). Also, despite correlations between self-efficacy beliefs and other motivational constructs, direct pathways between self-efficacy beliefs and academic achievement have been displayed in many path analysis (Greene, Miller, Crowson, Duke, & Akey, 2004; Leondari & Giliamas, 2002; Peetsma et al., 2005; Stevens et al., 2004). However, although the relation between self-efficacy beliefs and achievement is well established by previous studies, there is no agreement about their causal ordering. Skaalvik and Valas (1999) report four possible models: the self-efficacy beliefs predict achievement (self-enhancement model) or achievement predicts self-efficacy beliefs (skill-development model) or the influence is reciprocal between the two variables (reciprocal model) or they are correlated and influenced by common external variables. According to a developmental perspective, the skill-development model seems to be supported in elementary school years while the reciprocal model is widely supported in high school years (Marsh & Yeung, 1997). Reciprocal causal relations between self-efficacy beliefs and academic achievement are then expected in the present study.

Among the motivational constructs potentially linked to achievement, attitude towards school relies on school value, school appeal and willingness for learning. Relatively few studies encompass attitude towards school while trying to predict academic achievement. And yet Abu-Hilal (2000) stated that adolescents who perceive a discipline as important or useful should display more effort to it and therefore have better achievement. A direct pathway has been reported between school value and achievement. Positive relationships with achievement have been shown by Alves-Martins, Peixoto, Gouveia-Pereira, Amaral, and Pedro (2002) but with achievement predicting attitude towards school. Also relatively few recent studies consider school anxiety as potential predictor of achievement. An average correlation of $-.34$ was reported in a meta analysis (Hembree, 1990 in Ma & Xu, 2004) and coefficients ranging from $-.28$ to $-.15$ were reported by Newbegin and Owens (1996). Furthermore, Ma and Xu (2004) displayed reciprocal negative relations between anxiety and achievement in a longitudinal study, with prior achievement predicting anxiety in each of the five negative pathways but anxiety predicting later achievement only in two of the five negative pathways (i.e., from grade 7 to 8 and 8 to 9, not later). A direct negative pathway also appears in Abu-Hilal (2000) between achievement in mathematics and anxiety. In the present study, school value, school appeal and willingness for

learning are expected to predict high level or growth of achievement while school anxiety is expected to predict low level or decline of achievement.

In line with the distinction between intrinsic and extrinsic motivation, the goal orientation theory proposes three kinds of goals: mastery goals (to develop and improve ability), performance approach goals (to demonstrate and prove ability) and performance avoidance goals (to avoid the demonstration of lack of ability) (Elliot, 2005). The theory assumes that mastery and performance approach goals are related to higher achievement (or achievement growth) than performance avoidance goals. Such relations are supported by several studies (Fortier, Vallerand, & Guay, 1995; Pintrich, 2000; Wolters, 2004) with correlations ranging from .17 to .47 between goal orientation and achievement (Leondari & Gialamas, 2002; Pelegrina et al., 2003). However, a direct relationship failed to be confirmed by other previous findings. They propose, on the contrary, that goal orientation has an indirect effect on achievement, mediated through self-efficacy beliefs (Leondari & Gialamas, 2002). Goal orientation should also be more associated with adolescents' investment in school than directly with achievement (Stevens et al., 2004).

Attribution theory is a highly important key-concept of motivation. People who think they are able to control their outcomes are likely to pursue their goals in maintaining appropriate behaviour (Elliot & Dweck, 2005; Fortier et al., 1995). Causal attributions are related to the explanations the adolescents give regarding their academic achievement. Numerous studies have been conducted concerning the causes that can explain achievement. In order to understand the world and predict events, people attribute causes – luck, powerful others, task difficulty, ability and effort – to events concerning themselves and others. One of the dimensions focused on by attributional theory is locus of causality. Luck, powerful others and task difficulty are considered as external causes on which the person usually has no control; ability and effort are considered as internal to the person. Individuals usually have less control over ability than over effort. Causal attributions enable them to control their life (Augoustinos & Walker, 1995). Higher achievement is expected to be found in adolescents thinking they are able to control their academic outcomes.

Implicit theory of intelligence are beliefs referring to intelligence as a fixed entity (entity theory) which can not be changed, or a malleable ability which can be improved through effort (incremental theory) (Dweck, 1999). Incremental theory is thought to be related to higher achievement than entity beliefs but direct relationship failed to be proved. Following Dweck and Legget (1988), implicit theories of intelligence should be considered as representations of intelligence leading to specific interpretations for success and failure in learning and achievement tasks. Given an incremental or entity the-

ory of intelligence, individuals adopt different goals towards learning activities. Someone with an incremental conception of intelligence will be more willing to engage in mastery goals while someone else, believing in an entity conception of intelligence will be motivated by performance goals. As shown in previous results (Leondari & Gialamas, 2002), it is proposed that implicit theory of intelligence should be related to achievement by an indirect pathway going through goal orientation.

The distinction between *self-esteem* and self-efficacy beliefs is sometimes confusing in the literature. Self-esteem appears to be a generalised form of self-efficacy beliefs. While self-esteem may be considered as global self-evaluation based on social comparisons (for example "I do better at school than other adolescents") or self-comparisons (for example "I am better in mathematics than in language arts"), self-efficacy beliefs are domain-specific focusing on specific abilities. Because of their specificity, self-efficacy beliefs are hypothesised to be more related to achievement than self-esteem (D'Amico & Cardaci, 2003). Nevertheless, apart from D'Amico and Cardaci (2003), few studies consider both self-efficacy beliefs and self-esteem regarding academic achievement. They report significant correlations between self-efficacy beliefs and achievement (.35 to .54) but no significant correlations between self-esteem and achievement. In other studies however, correlations between academic and global self-esteem and achievement range from .21 to .53 (Alves-Martins et al., 2002; Hair & Graziano, 2003; Leondari & Gialamas, 2002; Newbegin & Owens, 1996; Pelegrina et al., 2003; Schmidt & Padilla, 2003). Previous findings display regression coefficients for adolescents' academic and global self-esteem predicting achievement ranging from .23 to .30 while no significant prediction for social self-esteem (Hair & Graziano, 2003; Keltikangas-Järvinen, 1992).

Environmental predictors

Two sets of environmental predictors (parenting and class environment) are considered in the present study as potential moderators over the relation between adolescents' motivation, implicit theory of intelligence, self-esteem and their academic achievement.

Two variables have regularly been used as *parenting* measures regarding adolescents' achievement: parents' involvement and childrearing behaviour, which is considered in the present research. Previous studies stressed the importance of considering the adolescent's perception of parenting rather than parents' reports (Pelegrina et al., 2003). Parents who provide support to adolescents have been shown to promote higher achievement than controlling parenting. Positive correlations between support and achievement ranging between .13 to .39 and negative correlations between control and

achievement ranging from $-.27$ to $.04$ were reported (Fei-Yin Ng, Kenney-Benson, & Pomerantz, 2004; Juang & Silbereisen, 2002; Pelegrina et al., 2003; Schmidt & Padilla, 2003). Correlations were also displayed between parenting and motivational variables such as goal orientation, self-efficacy beliefs and self-esteem (de Bruyn et al., 2003; Schmidt & Padilla, 2003). Results however failed to consistently demonstrate a direct causal relationship between parenting and achievement. The relation between parenting and achievement was hypothesised to be mediated by motivational variables (Elliot & Dweck, 2005; Marchant et al., 2001).

Class environment has been shown to influence adolescents' motivation and beliefs through teachers' and peers' feedback as well as through social comparisons (Elliot & Dweck, 2005). Lots of variables have been involved such as the adolescents' perception of class structure (Greene et al., 2004), class size, social climate, frequency of repeaters (Bennacer, 2000), peer relations and peer support (Marchant et al., 2001), sense of belonging and support from teachers and peers (Goodenow, 1993), linking to self-efficacy beliefs, goal orientation and school value. We also assume that belonging to a class with high mean grade could be motivating for good students and rather demotivating for less good adolescents. Mean class grade would therefore moderate the relation between motivation and academic achievement.

Method

Sample

1130 adolescents (557 male and 573 female) aged from 11 to 20 years ($M = 14.32$, $SD = 1.80$) participated to our study. The adolescents were sampled in the 1st-6th grades of eight Belgian secondary schools. Four were located in the French-speaking part of Belgium while the four others were located in the Dutch-speaking part. Among these adolescents, 880 were French-speaking students and 250 were Dutch-speaking students; 274 were in 1st grade, 161 in 2nd grade, 219 in 3rd grade, 215 in 4th grade, 149 in 5th grade and 112 in 6th grade.

Procedure

Data collection began in November 2004 and ended in June 2005. Academic achievement was collected for the exam sessions of June 2004, December 2004 and June 2005 so that subjects were screened across two different school years. The adolescents we considered were in the same track (humanities section) from June 2004 to June 2005. The information about the

adolescents' grades was given by the teachers with a minimum of 0 and a maximum of 20 points. The grades were collected for mathematics and language arts (French or Dutch) achievement. A Grade Point Average (GPA) was also computed implying all the academic disciplines (mathematics, language arts, second and third tongue (Dutch/English/French/German), sciences, history, geography). Of the 1130 adolescents, only two of the three time points were completed for 298. Most of missing data were due to the fact that those who were in 1st grade came from elementary schools implying that grades for the session of June 2004 were not available. Data concerning individual and environmental predictors were collected in October 2004 by mean of self-report questionnaires.

Measures

Individual predictors

Motivation was assessed with the "Mesure de la Motivation Scolaire des Adolescents" of Ntamakiliro, Monnard, and Gurtner (2000). It is composed of three subscales. Five- or seven-points Likert-type scales – from not true at all for me to really true for me – are provided under each item. The first subscale assesses the adolescent's perception of learning (31 items). It combines *school appeal, anxiety, willingness for learning language arts, willingness for learning mathematics, school value and self-efficacy beliefs in language arts and in mathematics*. In the current study, α s were moderate to high and yielded from .65 to .93. A factor analysis was conducted on the current data using maximum likelihood extraction with varimax rotation. The seven expected factors were extracted explaining 60.12% of the variance. The second subscale focuses on goal orientation (10 items). It combines *mastery goals, performance approach goals and performance avoidance goals*. α s were moderate, ranging from .56 to .78. A factor analysis was conducted on the current data using maximum likelihood extraction with varimax rotation. The three expected factors were extracted explaining 41.76% of the variance. The third subscale is concerned with causal attributions (23 items). The participants were asked to attribute the academic achievement to *luck, teacher, effort and competence*. α s are moderate, comprised between .59 and .66. A factor analysis was conducted on the current data using maximum likelihood extraction with varimax rotation. The four expected factors were extracted explaining 28.81% of the variance.

The *Implicit theory of intelligence* was assessed with the "Échelle des conceptions personnelles de l'intelligence" (Faria & Fontaine, 1997) based on Dweck's studies. Three items concern the incremental theory of intelligence and three other items concern the entity theory of intelligence. In the current study, α s are .74 for the incremental items and .81 for the entity items. A fac-

tor analysis was conducted on the current data using maximum likelihood extraction with varimax rotation. The two expected factors were extracted explaining 58.60% of the variance. A single score was computed by reversing the scores of entity items, with higher score reflecting *incremental theory* of intelligence. Elliot and Dweck (2005) report 40% of people being entity theorists, 40% being incremental theorists and 20% remaining undecided. Similar frequencies may be observed in our sample with 35.9% of adolescents having a mean lower than 3 (entity theorists), 25.6% having a mean from 3 to 4 (undecided adolescents), and 38.5% having a mean higher than 4 (incremental theorists).

Self-Esteem was assessed by the widely used “Self-Perception Profile for Adolescents” (Harter, 1988). Only three subscales were considered: academic, social and global self-esteem. Items are presented in the form of

“ Some adolescents	BUT	Other adolescents
Do well at school		Don’t do well at school”

The adolescent is asked which kind of adolescent he/she is most like – the adolescents described on the right or the left. Once having made this decision, the adolescent decides whether the description on that side is “really true for me” or “sort of true for me”. In several items of each domain, the first part of the statement reflects high self-esteem; in other items, low self-esteem is described first. This four-choice format is designed to prevent the adolescent to give socially desirable answers. Each item is scored from 1 to 4, where a score of 1 indicates low self-esteem and a score of 4 reflects high self-esteem. The SPPA has adequate reliability and validity. In the current study, Cronbach alphas (α s) were moderate ranging from .60 to .76. A factor analysis was conducted on the current data using maximum likelihood extraction with varimax rotation. Three factors were extracted corresponding to academic, social and global self-esteem and explaining 35.51% of the variance.

Environmental predictors

Parenting was assessed with the “Échelle des Pratiques Éducatives Parentales” (Meunier & Roskam, 2007). The EPEP is a 30 items questionnaire with a five-points Likert-type scale provided under each. It has been recently validated with French-speaking parents and display good psychometrical properties. Following previous Dutch studies (Van Leeuwen & Vermulst, 2004), a nine-factor solution was replicated explaining 62.60% of the variance. A second-order solution allows to average the items according to two factors, one *supportive parenting* (monitoring, positive parenting, rules, autonomy) and one *controlling parenting* (inconsistent discipline, discipline, material rewarding, harsh punishment, ignoring) which have been used in the current study demonstrating in the confirmatory factor analysis

an acceptable fit to the data ($GFI = 0.92$, $RMSEA = 0.12$, $RMR = 0.07$) with all estimated factor loadings being significant.

The *class environment* was first considered from the mean *class GPA* of all students in the 59 classes where they are nested ($M = 12.76$, $SD = 1.41$). An averaged score was computed implying all the academic disciplines and the three time points. Second, the *frequency of repeaters* was also considered ($M = 17.25\%$, $SD = 14.19$).

Data analysis

To examine the influence of previous academic achievement on adolescents' individual variables, backward regressions were computed regressing mathematics and language arts grades as well as GPA from first session June 2004 on motivation, implicit theory of intelligence and self-esteem assessed in October 2004.

To examine intraindividual change in academic achievement, the Hierarchical Linear Modeling (Raudenbush, Bryk, Cheong, & Congdon, 2001) was used with outcome variables standardised. In the within-person (Level 1) model, academic achievement is regressed on time for each person. The results yield fixed effect and random effects estimates of the intercept and slope parameters for mathematics and language arts grades and GPA. The fixed effects define the overall trajectory for the sample and the random effects define the individual deviations from the overall trajectory. In line with Hui and Berger (1983) stating that linear models render a good approximation of non-linear effects over a short period, linear rather than non-linear models are estimated.

A level 2 model considers the slopes and intercepts from level 1 as outcomes to identify possible predictors of the initial level of academic achievement (intercept) and academic achievement change (slope). Possible predictors are the adolescents' individual variables (motivation, implicit theory of intelligence and self-esteem) and parenting. A causal relationship can be established under three conditions: if a significant relationship between two variables is displayed, if there is a time precedence between these two variables and if a model of causal relationship between them is specified (Ma & Xu, 2004). Since data about individual predictors were collected in October 2004, the prediction focuses on growth curves implying grades from the two sessions of December 2004 and June 2005. This additive model guides the analysis of the causal relationships between motivation, implicit theory of intelligence, self-esteem, parenting, and academic achievement. It stresses how much these variables add to the prediction of grades after the predictive power of each other variables has been controlled. This model finally depicts motivation, implicit theory of intelligence, self-esteem and parenting as correlated but in a non causal fashion.

A level 3 model considers the level 2 parameters as outcomes to identify the moderator effect of the class environment (class GPA and frequency or repeaters) over the relation between adolescents’ motivation, implicit theory of intelligence, self-esteem and their academic achievement.

Results

Does the adolescents’ previous academic achievement predict their later motivation, implicit theory of intelligence and self-esteem?

Table 1 displays the results of the backward regression.

Table 1.

Backward regressions of mathematics, language arts grades and GPA from June 2004 on motivation, implicit theory of intelligence and self-esteem.

	Significant predictors	β	r^2
Motivation : perception of learning			
School appeal	GPA	.085*	.007
Anxiety	Mathematics grade	-.144***	.021
Willingness for language arts	Language arts grade	.181***	.026
	Mathematics grade	-.140***	
Willingness for mathematics	Mathematics grade	.237***	.041
	Language arts grade	-.142***	
School value	GPA	.077*	.006
Self-efficacy beliefs in language arts	Language arts grade	.320***	.102
Self-efficacy in mathematics	Mathematics grade	.490***	.114
	GPA	-.216***	
Motivation : goals orientation			
Mastery	NS		
Performance approach	NS		
Performance avoidance	NS		
Motivation : causal attributions			
Luck	NS		
Teacher	Language arts grade	-.144***	.021
Effort	Language arts grade	-.080	.006
Competence	NS		
Implicit theory of intelligence	NS		
Self-esteem			
Academic	GPA	.13***	.017
Social	Language arts grade	-.096**	.009
Global	Mathematics grade	.086*	.007

NS: no significant predictors * $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

The three predictors (mathematics and language arts grade and GPA) were introduced separately in the regression analysis. All three lead to significant results even if r^2 values are low. General motivation variables are predicted by GPA (school appeal and value) while specific motivation variables (willingness and self-efficacy beliefs) are predicted by previous mathematics and language arts grades. Furthermore, it appears that the results for mathematics and language arts grades could be opposite when both of them are considered within the same model. Indeed, willingness for learning language arts is positively predicted by language arts grade and negatively by mathematics grade and conversely for willingness for learning mathematics. Mathematics grade seems also to exert specific relations to adolescents' motivation since it is the only achievement variable able to negatively predict school anxiety and since self-efficacy beliefs in mathematics are negatively predicted by GPA and positively by mathematics grade.

The most powerful relation is observed between previous grades and self-efficacy beliefs. Higher academic self-esteem is also predicted by GPA while global self-worth is related to mathematics grade and social self-esteem is negatively related to language arts grade. Only the attribution to the teacher is predicted by previous results. As expected, the prediction is negative for the teacher. Goal orientation as well as implicit theory of intelligence are not predicted by previous achievement.

Do the adolescents' previous motivation, implicit theory of intelligence, self-esteem and parenting predict their later academic achievement growth?

Level-1 analysis

Descriptive data for the adolescents' academic achievement in mathematics, language arts and GPA are presented in table 2.

Table 2.

Means (M) and standard deviations (sd) of the adolescents' mathematics and language arts grades and GPA.

	June 2004 <i>M (sd)</i>	December 2004 <i>M (sd)</i>	June 2005 <i>M (sd)</i>
Mathematics	11.77 (3.59)	11.70 (3.43)	11.19 (4.12)
Language arts	12.97 (2.47)	12.57 (2.67)	12.53 (3.76)
GPA	13.19 (2.41)	12.71 (2.47)	12.53 (2.40)

Individual growth curve modeling provides fixed effect and random effect estimates of the intercept and the slope parameters which define the average trajectories of the adolescents for the three measures of academic achievement: mathematics grade, language arts grade and GPA. Fixed and random

effects are presented in table 3a with a three-time design from June 2004 to December 2004 and June 2005 (across two different school years) and 3b with a two-time design from December 2004 to June 2005 (across the same school year).

Table 3a.
Fixed and random effects estimates of individual growth models of school achievement (from June 2004 to December 2004 and June 2005).

	Mathematics	Language arts	GPA
FIXED	Estimate (se)	Estimate (se)	Estimate (se)
Slope	-0.130 (0.014)***	-0.068 (0.018)***	-0.097 (0.017)***
Intercept	0.282 (0.080)***	0.151 (0.072)*	0.232 (0.069) **
RANDOM			
Intraindividual level	49.67%	57.24%	32.23%
Individual level	32.22%	25.29%	39.00%
Class environment level	17.10%	18.15%	29.70%

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Table 3b.
Fixed and random effects estimates of individual growth models of school achievement (from December 2004 and June 2005).

	Mathematics	Language arts	GPA
FIXED	Estimate (se)	Estimate (se)	Estimate (se)
Slope	-0.134 (0.027)***	-0.008 (0.035)	-0.072 (0.017)***
Intercept	0.323 (0.092)***	-0.001 (0.110)	0.128 (0.090)*
RANDOM			
Intraindividual level	39.69%	65.01%	15.34%
Individual level	43.61%	24.38%	51.31%
Class environment level	18.38%	23.03%	33.57%

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

All of the three measures of academic achievement have average slopes that are significantly different from zero, indicating a significant decrease in academic achievement in mathematics, language arts and all the disciplines over the course of the study. Decline is however not significant any more for language arts between December 2004 and June 2005. Language arts slope is thus not considered in level-2 analysis.

Random effects estimate the variance components at the three levels. The variance at level-1 is lower for GPA than for Mathematics and Language arts.

GPA is a composite measure of academic achievement, its fidelity could therefore be higher.

Since the variance estimates of the intercepts and the slopes of the adolescents' academic achievement are significantly different from zero (level-1), they can potentially be explained by level-2 predictors.

Level-2 analysis

The second level attempts to explain the individual differences in trajectories (level 1). The correlations between the level-2 predictors are displayed in table 4. Lots of significant correlations are displayed but only low to moderate with a minimum of significant coefficient of .09 between controlling parenting and performance avoidance goals and a maximum of .53 between willingness for learning mathematics and performance approach goals. The results stresses evidence that school anxiety is positively related to several motivation constructs (for example willingness for learning and value) and supportive parenting but negatively to self-efficacy beliefs and self-esteem. Adolescents valuing school and having parents who make autonomy demands, having mastery or performance approach goal orientation, are those who experience higher school anxiety. In turn, their self-efficacy beliefs and self-esteem are lower than those of less anxious students. External attributions (chance and teacher) are negatively related to motivation but associated with performance avoidance goals. Internal attributions (effort and competence) are positively related to motivation and also to mastery and performance approach goals. Significant correlation is observed between self-efficacy beliefs in mathematics and language arts, academic and global self-esteem.

The relationships between the adolescents' individual predictors (motivation, implicit theory of intelligence and self-esteem) and parenting as potential predictors of change and initial level of their academic achievement, are presented in table 5a and 5b. Globally, individual predictors forecast initial level in a greater and more coherent extent than they moderate adolescents' growth. Furthermore, the influence of individual predictors are sometimes different over the initial level and over the growth. Several variables indeed predict high initial level but moderate the growth in a negative way; others predict low initial level but moderate growth in a positive way. Such results suggest that the influence of the predictors may be different in cross-sectional than in developmental studies.

Table 4.
Correlations between level-2 predictors.

	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20
Motivation : perception of learning																				
1 School appeal																				
2 Anxiety	-.00																			
3 Willingness for language arts	.43*	.44*																		
4 Willingness for mathematics	.22*	.08	.43*																	
5 School value		.37*	.26*	.40*																
6 Self-efficacy beliefs in language arts		.19*	.26*	.18*	.34*															
7 Self-efficacy in mathematics		.22*	.08	.36*	.19*	.18*														
Motivation : goal orientation																				
8 Mastery																				
9 Performance approach																				
10 Performance avoidance																				
Motivation : causal attributions																				
11 Luck																				
12 Teacher																				
13 Effort																				
14 Competence																				
15 Implicit theory of intelligence																				
Self-esteem																				
16 Academic																				
17 Social																				
18 Global																				
Parenting																				
19 Supportive																				
20 Controlling																				

* $p > 0.01$ ** $p > 0.001$

Table 5a.
Individual predictors and parenting as predictors of change of school achievement.

FIXED	Mathematics	GPA
	Estimate (se)	Estimate (se)
Motivation : perception of learning		
School appeal	0.062 (.030)*	-0.043 (.018)*
Anxiety	0.005 (.021)	-0.022 (.013)
Willingness for language arts	-0.094 (.032)**	-0.025 (.020)
Willingness for mathematics	0.009 (.029)	0.019 (.018)
School value	0.037 (.036)	0.007 (.022)
Self-efficacy beliefs in language arts	-0.010 (.029)	-0.003 (.018)
Self-efficacy beliefs in mathematics	0.022 (.024)	-0.021 (.015)
Motivation : goals orientation		
Mastery	-0.054 (.028)*	-0.014 (.017)
Performance approach	0.081 (.033)*	0.061 (.020)**
Performance avoidance	0.098 (.028)***	0.034 (.017)*
Motivation : causal attributions		
Luck	-0.035 (.055)	-0.024 (.034)
Teacher	0.056 (.054)	0.039 (.034)
Effort	-0.043 (.051)	-0.091 (0.031)**
Competence	0.088 (.055)	-0.029 (.034)
Implicit theory of intelligence	0.000 (.028)	-0.021 (.017)
Self-esteem		
Academic	0.141 (.064)*	0.001 (.040)
Social	0.050 (.055)	-0.029 (.034)
Global	-0.039 (.055)	0.095 (.034)**
Parenting		
Supportive	-0.092 (.055)	-0.077 (.034)*
Controlling	.151 (.059)**	-0.111 (.037)**
RANDOM		
Intraindividual level	37.87%	14.42%
Individual level	29.88%	34.86%
Class environment level	12.93%	27.55%

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Table 5b.
Individual predictors and parenting as predictors of initial level (intercept) of school achievement.

	Mathematics	Language arts	GPA
FIXED	Estimate (se)	Estimate (se)	Estimate (se)
Motivation : perception of learning			
School appeal	-0.171 (.079)*	-0.073 (.100)	0.123 (.053)*
Anxiety	-0.002 (.057)	-0.045 (.072)	0.061 (.038)
Willingness for language arts	0.255 (.085)**	0.094 (.107)	0.133 (.056)*
Willingness for mathematics	-0.034 (.078)	-0.122 (.098)	-0.100 (.052)
School value	-0.111 (.095)	-0.039 (.119)	-0.058 (.063)
Self-efficacy beliefs in language arts	0.168 (.077)*	0.347 (.096)***	0.238 (.051)***
Self-efficacy beliefs in mathematics	0.213 (.064)***	0.208 (.081)**	0.271 (.043)***
Motivation : goals orientation			
Mastery	0.083 (.074)	0.047 (.093)	-0.017 (.049)
Performance approach	-0.208 (.086)*	-0.173 (.109)	-0.204 (.057)***
Performance avoidance	-.234 (.074)**	-0.213 (.093)*	-0.117 (.049)*
Motivation : causal attributions			
Luck	0.050 (.144)	-0.085 (.182)	-0.010 (.096)
Teacher	-0.188 (.144)	-0.158 (.182)	-0.138 (.096)
Effort	0.078 (.134)	0.235 (.169)	0.192 (.088)*
Competence	-0.216 (.145)	-0.208 (.184)	0.058 (.096)
Implicit theory of intelligence	-0.021 (.074)	0.014 (.094)	0.015 (.049)
Self-esteem			
Academic	-0.169 (.169)	0.333 (.214)	0.281 (.112)*
Social	-0.265 (.144)	0.013 (.183)	-0.119 (.095)
Global	0.094 (.352)	-0.137 (.183)	-0.214 (.095)*
Parenting			
Supportive	0.340 (.144)*	0.342 (.183)*	0.374 (.095)***
Controlling	-0.450 (.157)**	-0.00 (.200)	0.159 (.103)
RANDOM			
Intraindividual level	37.87%	63.84%	14.42%
Individual level	29.88%	14.38%	3486%
Class environment level	12.93%	18.83%	27.55%

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

Few variables are shown to moderate the adolescents' growth in academic achievement. The results display an incoherent pattern for goal orientation with mastery goals moderating change in a negative way and performance goals, both approach and avoidance, moderating growth in a positive way. The negative moderation of attribution to efforts is also few coherent. Nevertheless, the results support the independence of disciplines with willingness for language arts moderating growth in mathematics in a negative way. Contrarily to what was expected, the self-efficacy beliefs do not moderate growth but academic self-esteem moderates growth in mathematics and global self-esteem moderates GPA growth. Finally, parenting is shown to moderate adolescents' growth but in a different pattern for mathematics and GPA.

Several variables are relevant to predict the adolescents' initial level in mathematics, language arts and GPA. Higher initial level is predicted by school appeal (surprisingly in a negative way for mathematics), willingness for learning and attributions to effort. Higher initial level of achievement is also predicted by previous self-efficacy beliefs in a strong and coherent pattern of results. The same but lower prediction is observed between academic self-esteem and GPA. Negative relations nevertheless remain between GPA initial level and global self-esteem. As expected, performance goals (both approach and avoidance) are negatively related to the further initial level of school achievement. Finally, the results stress the importance of supportive parenting to predict the adolescents' initial level while controlling parenting predicts lower initial level in mathematics.

Compared with the variance components at level-1, the predictors at level-2 allow to explain respectively 13.73% of the variance of mathematics (12.44% for motivation, 0.02% for implicit theory of intelligence, 1.02% for self-esteem and 0.25% for parenting), 10.00% of the variance of language arts (8.32% for motivation, 0.11% for implicit theory of intelligence, 1.16% for self-esteem and 0.41% for parenting) and 16.45% of the variance of GPA (13.41% for motivation, 0.10% for implicit theory of intelligence, 2.15% for self-esteem and 0.79% for parenting). By entering each of the variables step by step, it appears that in a coherent pattern, motivation (with respectively, 12.44, 8.32 and 13.41%) and self-esteem (with respectively, 1.02, 1.15 and 2.15%) are the predictors which account for the greatest amount of the explained variance.

Since the variance estimates of the intercepts and the slopes are significantly different from zero (level-2), they can potentially be explained by level-3 predictors. Since we are interested both in the adolescents' developmental data and the influence of individual predictors, only the slopes are tried to be explained by level-3 variables. The moderator effects of the class environment variables (class GPA and frequency or repeaters) over the rela-

Table 6.

Moderator effect of class environment variables (class GPA and frequency or repeaters) over the relation between motivation, implicit theory of intelligence, self-esteem and academic achievement.

	Class environment predictors	Mathematics	GPA
Level-2 outcomes	FIXED	Estimate (se)	Estimate (se)
Motivation : perception of learning			
School appeal	Class GPA	0.006 (.008)	0.004 (.007)
	FR	0.019 (.042)	-0.006 (.037)
Anxiety	Class GPA	-0.003 (.005)	-0.007 (.004)
	FR	0.015 (.039)	0.017 (.034)
Willingness for language arts	Class GPA	-0.011 (.008)	-0.003 (.007)
	FR	-0.104 (.043)	-0.041 (.038)
Willingness for mathematics	Class GPA	-0.011 (.008)	-0.011 (.007)
	FR	-0.010 (.058)	-0.007 (.051)
School value	Class GPA	0.031 (.009)***	0.023 (.008)**
	FR	-0.014 (.059)	-0.044 (.052)
Self-efficacy beliefs in language arts	Class GPA	0.007 (.007)	0.000 (.006)
	FR	-0.009 (.041)	0.013 (.036)
Self-efficacy beliefs in mathematics	Class GPA	-0.005 (.005)	-0.044 (.005)
	FR	-0.004 (.029)	-0.002 (.026)
Motivation : goals orientation			
Mastery	Class GPA	-0.007 (.007)	0.003 (.006)
	FR	0.028 (.055)	-0.011 (.035)
Performance approach	Class GPA	0.001 (.007)	-0.001 (.006)
	FR	-0.029 (.040)	0.003 (.049)
Performance avoidance	Class GPA	0.000(.006)	0.005 (.006)
	FR	-0.005 (.047)	0.009 (.042)
Motivation : causal attributions			
Luck	Class GPA	0.030 (.014)*	0.027 (.012)*
	FR	0.040 (.087)	0.001 (.077)
Teacher	Class GPA	0.007 (.013)	0.003 (.011)
	FR	0.038 (.081)	0.039 (.071)
Effort	Class GPA	0.006 (.012)	0.018 (.011)
	FR	0.030 (.082)	-0.020 (.072)
Competence	Class GPA	0.016 (.013)	0.007 (.012)
	FR	0.000 (.083)	0.035 (.074)
Implicit theory of intelligence	Class GPA	-0.011 (.006)	-0.007 (.006)
	FR	0.078 (.046)	0.031 (.041)
Self-esteem			
Academic	Class GPA	-0.036 (.016)*	-0.036 (.014)**
	FR	0.077 (.098)	0.058 (.086)
Social	Class GPA	-0.006 (.012)	-0.004 (.011)
	FR	-0.015 (.070)	-0.001 (.062)
Global	Class GPA	0.028 (.012)*	0.019 (.011)
	FR	0.002 (.068)	0.013 (.060)
RANDOM			
Intraindividual level		37.20%	15.12%
Individual level		28.23%	33.01%
Class environment level		03.82%	03.86%

* $p < 0.05$ ** $p < 0.01$ *** $p < 0.001$

tion between motivation, implicit theory of intelligence, self-esteem and academic achievement are presented in table 6.

Level-3 analysis

Belonging to a class with high GPA moderates the relation between school value, global self-esteem (regarding mathematics grade), attribution to luck, and academic achievement in a positive way. However, belonging to a class with high GPA also moderates the relation between academic self-esteem and academic achievement in a negative way. The frequency of repeaters is not identified as moderator between motivation, implicit theory of intelligence or self esteem and academic achievement.

Compared with the variance components at level-2, the predictors at level-3 allow to explain respectively 8.18% of the variance of mathematics and 23.14% of the variance of GPA.

Discussion

Previous studies inclined us to expect a decline in school performance over the course of the study. The decrease is confirmed in the three-times design for mathematics and language arts grades as well as for GPA. That decrease is however not supported within the same school year for language arts. In line with existing literature, the results obtained for one discipline are not relevant for the others. As can be observed, the mean intercept, causal relationships and predictions are specific to mathematics and language arts. Contrarily to what was however expected, specific outcome variables (mathematics and language arts) do not generate more significant results and causal relations than GPA. Our results indeed infirm that specific grades are preferable than GPA. Indeed, higher percentage of variance is explained for GPA than for mathematics and language arts. As suggested, GPA is a composite measure of academic achievement; its fidelity could therefore be better than the fidelity of single measure.

Previous studies allowed bringing out the expected contribution of individual predictors on the adolescents' academic achievement. The correlations between the level-2 variables confirm the low to moderate relations between the motivational constructs: self-efficacy beliefs, attitude to school, anxiety, goal orientation and causal attributions. Self-efficacy beliefs were expected to be the most important predictor among the motivational constructs. Indeed, strong significant relationships are observed between self-efficacy beliefs and achievement and the largest amount of variance at level-2 is explained by motivation variables including self-efficacy beliefs. Furthermore, a reciprocal model between self-efficacy beliefs and academic

achievement was hypothesised for the adolescents. The reciprocal model is well supported by the results with previous academic achievement predicting later self-efficacy beliefs and self-efficacy beliefs predicting later academic achievement. Weaker but similar relations were also expected for self-esteem. Low to moderate correlations are reported between academic self-esteem and self-efficacy beliefs in mathematics and language arts. A similar but weaker pattern of reciprocal relations is observed between self-esteem and achievement. Reciprocal relations were also expected between attitude to school and achievement as well as between school anxiety and achievement. Such relation is only confirmed for attitude to school. Previous academic grade predicts later attitude towards school which in turn predicts later academic growth and achievement.

Indirect relations were supposed between goal orientation and achievement. Indeed, previous achievement is not related to later goal orientation but a coherent pattern is observed between previous goal orientation and later level of achievement with performance approach and avoidance orientations predicting lower level of achievement. Performance approach and avoidance orientation however predict adolescents' growth in a positive way while the prediction for mastery goal orientation is negative. A direct relation is supported but with specific causal ordering from goals to achievement.

Higher achievement was also expected for the adolescents thinking they are able to control their academic outcomes. The results display that lower previous academic achievement predicts attribution to the teacher considered as external uncontrollable cause while attribution to internal cause of effort predicts higher level of achievement but lower growth (GPA).

Indirect relations were expected for implicit theory of intelligence. No direct relation is observed between implicit theory and achievement and low correlations are reported with other cognitive constructs, performance approach orientation, causal attributions and attitude to school. While low, those correlations are reported in the expected direction.

Previous studies allowed bringing out the expected contribution of environmental predictors on the adolescents' academic achievement. Supportive parenting was expected to promote higher achievement than controlling parenting. The correlations between the level-2 variables display numerous significant coefficients for supportive parenting related to positive attitude to school, high self-efficacy beliefs and self-esteem, anxiety, mastery and performance approach goals, attribution to effort rather than luck, and incremental theory of intelligence. Furthermore, a direct relationship is displayed in our results that stresses the importance of supportive parenting for the initial level of achievement in mathematics, language arts and GPA. It surprisingly moderates the adolescents' growth in GPA in a negative way. In line with the expectations, controlling parenting predicts later decrease in GPA

and lower level of achievement but for mathematics only. It surprisingly moderates the adolescents' growth in mathematics in a positive way.

Class environment was supposed to moderate the influence of self-efficacy-beliefs, goal orientation and school value over academic achievement. Significant results are only displayed for class GPA while the frequency of repeaters appear to have no importance regarding the adolescents' achievement. The moderation over the relation between school value and academic achievement is supported for mathematics grade and GPA. Belonging to a class with high mean GPA emphasises the influence of valuing school over academic achievement. Furthermore, belonging to a class with high mean GPA accentuates the prediction between global self-esteem and academic achievement in a positive way but stresses the prediction of academic self-esteem on academic achievement in a negative way. These results can be explained with the social comparison theory (Augoustinos & Walker, 1995). When the level of GPA of the group reference is high, the adolescents individually tend to devalue them regarding academic self-esteem and self-efficacy beliefs. Conversely, belonging to a successful class can reinforce the global self-esteem of the adolescents. Significant moderation is also reported over the prediction between causal attributions to luck and academic achievement. Belonging to a class with high mean GPA encourages the adolescents to consider that being successful at school depends on external causes.

In sum, the results display an interesting pattern of causal relations between the adolescents' motivation, implicit theory of intelligence, self-esteem, environmental influences through parenting and class environment, and their academic growth and level of achievement. It appears that previous achievement predicts attitude towards school, self-efficacy beliefs and self-esteem, anxiety and external attribution. In turn, attitude to school, self-efficacy beliefs and self-esteem predict later level of achievement and academic growth following reciprocal direct relations. Through their correlations with attitude to school, anxiety, self-efficacy beliefs and self-esteem, goal orientation and internal attribution to effort also contribute to predict academic level of achievement and growth. Since it is related to motivation, implicit theory of intelligence and self-esteem, supportive parenting predicts higher level of achievement but lower academic growth (only for GPA). Class environment where the adolescents as subject-in-development are nested moderates the relation between motivational constructs, especially the attitude towards school, self-esteem and external attributions, and academic achievement.

Such a dynamic pattern pleads for considering the adolescents as subjects-in-development; for providing them individual support to their motivation and self-concept regarding their academic achievement and growth but in constant collaborative work both with school environment and parents. Interesting results should not hide the large amount of variance that remains

to be explained at different levels. The adolescents' IQ could probably explain a large amount of level-2 variance as suggested by Gagné and St Père (2001). Regarding level-3 variance, several variables from class environment could be further considered, for instance the adolescents' perception of class structure, class size, social climate, frequency of repeaters, peer relations and peer support, sense of belonging and support from teachers and peers.

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