

# Demographic and psychological predictors of Grade Point Average (GPA) in North-Norway:

## A particular analysis of cognitive/school-related and literacy problems

### Educational Psychology

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**Abstract**

Approximately 30 % of students drop out from Norwegian upper secondary schools. Academic achievement, as indexed by Grade Point Average (GPA) is one of the strongest predictors of dropout. The present study aimed to examine the role of cognitive, school-related and affective/psychological predictors of GPA. In addition, we examined the psychometric properties of a new scale for literacy problems (LP), as well as its role for GPA. Analyses showed that the scale had favourable psychometric properties. Multivariable regression analyses showed that study track choice, task solving skills, gender, lack of educational plans and literacy problems predicted GPA in descending order. The major implication of the study was that GPA is related to a multiple number of demographic, cognitive, and psychosocial factors, and that any interventions addressing GPA will be less effective if not addressing psychosocial in addition to cognitively/school-related factors.

*Keywords:* Academic achievement; grade point average; literacy problems; validation; secondary education.

## Introduction

The community benefits of investing in education for everyone by far exceed the costs (Belfield & Levin, 2007). In Norway, approximately 30 % of the students do not complete upper secondary school within a period of five years (Statistics Norway, 2013b). The problem is even more pronounced in North-Norway with drop-out rates ranging between 37% and 51 %, which is why the present study was conducted in this particular region. Nevertheless, school dropout is frequent in all OECD countries and its negative consequences both for the individual and for the society is well documented (OECD, 2013). The current situation has even been named a 'dropout crisis' (Pharris-Ciurej, Hirschman, & Willhoft, 2012; Rumberger & Lim, 2008). This has raised political concerns, and scientific approaches are therefore called for to find explanations and adequate solutions.

Grade Point Average (GPA) is one of the best predictors of school dropout, having high sensitivity and specificity in discerning dropouts from stayers (Battin-Pearson et al., 2000; Bowers, Sprott, & Taff, 2013). The GPA score is also a reliable true score indicator as it is based on the mean of all the grades contributing to a student's degree. Moreover, the GPA predicts future university achievement (Richardson, Abraham, & Bond, 2012), job performance (Roth, BeVier, Switzer III, & Schippmann, 1996), salary (Roth & Clarke, 1998), and other key life outcomes such as socioeconomic status, and subjective well-being (Fischbach, Baudson, Preckel, Martin, & Brunner, 2013). Studies examining factors that underpin GPA are needed in order to understand the reasons for such individual differences, and in the next step, preventing drop-out.

Previous studies show that dropout from upper secondary school (also referred to as *early leaving or non-completion*) is related to several factors like parents' educational level and employment status, gender, and former school performance (Alexander, Entwisle, & Kabbani, 2001; Battin-Pearson et al., 2000; Lundetræ, 2011; Markussen, Frøseth, & Sandberg, 2011; Rumberger & Lim, 2008). However, the contribution of these factors to GPA in addition to psychological factors, as well as literacy skills, have not been thoroughly studied.

Hence, the present study seeks to fill this void by examining a wider range of cognitive/school-related and psychological/affective factors underpinning the GPA in the same study. A second aim was to examine the psychometric properties of a self-report scale for literacy problems (LP), and to validate it against GPA as a criterion variable.

### **Selection of GPA Predictors**

A plethora of theories for explaining academic performance have been proposed. The most used ones seem to group within three broad areas: a cognitive domain, a social and an affective domain (Powell & Tod, 2004). The common objective of these theories are to explain how academic performance are affected by the way students think or learn, feel, and socially interact with each other. Our task is not to test the relevance of these domains of theories, but they represent a way of structuring the presentation and discussion of the various predictors examined in the present study. We focus here on the cognitive domain, including school-related variables, and the affective domain, including some selected psychological variables.

#### **Cognitive/school-related factors.**

General cognitive ability (or *g*) is perhaps the most important factor for learning (Flanagan, McGrew, & Ortiz, 2000) and accounts for a substantial proportion of the variance in academic performance (Naglieri & Bornstein, 2003), but is impractical to assess in large cohort studies like the present one. The correlation with GPA is around .40 to .50 (Carvajal & Pauls, 1995; Downey, Lomas, Billings, Hansen, & Stough, 2014), thus indicating that more than 75 % of the variance in GPA is related to other factors.

An important factor impeding a self-autonomous learning process is learning difficulties (LD). Students with LDs use less efficient learning strategies and procrastinate more, which may weaken their academic motivation and self-efficacy (Klassen, Krawchuk, Lynch, & Rajani, 2008). If the LDs become sufficiently severe and encompass impairments with either reading, writing, or mathematics, they may qualify for a DSM diagnosis of a specific learning disorder (APA, 2013). In the present study

a diagnostic approach was not feasible and a self-report solution was preferred. However, a validated self-report solution was not available in Norway when the study was planned. A small number of studies have employed screening questions, asking if the participants believe they have LD (e.g. Patterson, Moniruzzaman, Frankish, & Somers, 2012; Øverby, Lüdemann, & Høigaard, 2013). In the Patterson et al. study (2012) two questions predicted several outcomes (e.g., educational attainment, mental and substance abuse problems), thus showing that brief measures may have acceptable validity, but we considered two questions as too narrow in our study. In a review of our current understanding of reading disorders, Snowling and Hulme (2012) highlight that there are two different, commonly occurring forms of disorders: difficulties with decoding (dyslexia) and difficulties with reading comprehension. These different reading disorders have different causes and require different interventions, and the authors highlight that neither disorders lend themselves to categorical diagnosis. Irrespective of what form of disorder a student experience, they involve literacy problems which may cause difficulties for education, employment, and well-being (Goldstein, Naglieri, & DeVries, 2011; Klassen, Tze, & Hannok, 2013; Reiff, Hatzes, Bramel, & Gibbon, 2001).

The 'Tromsø Longitudinal study of Dyslexia' includes a parental questionnaire assessing literacy skills associated with both dyslexia and reading comprehension disorders, which showed moderate to strong correlations with objective literacy tests, and in particular with spelling (Nergård- Nilssen & Hulme, 2014). Moreover, the included literacy items differentiated significantly between individuals with and without literacy disorders, thus confirming that adults rate their true literacy skills well. Eight items originating from this study were thus adapted for use in an adolescent school sample.

Another school-related factor influencing GPA is problem behaviour during school lessons, which in essence represents inadequate self-regulation (e.g. Zimmerman, 1990). In fact, the link between self-regulatory abilities and academic achievement seems to be mediated by problem behaviour or negative interactions in the classroom (Montroy, Bowles, Skibbe, & Foster, 2014). We

therefore included a question about whether students had ever been in conflict with classroom rules, expecting that higher scores would negatively relate to GPA. Also, as educational aspirations have been related to academic achievement (Hegna, 2013; Rojewski & Kim, 2003), the students were asked to state the highest level of education they were planning to complete. We expected positive correlations between aspirations and GPA.

### **Affective/psychological factors.**

Poor mental health contributes to lower educational achievements as well as school drop-out (Myklestad, Roysamb, & Tambs, 2012; Patel, Flisher, Hetrick, & McGorry, 2007), and subsequently to later problems with unemployment and granting of medical benefits (Pape, Bjørngaard, Westin, Holmen, & Krokstad, 2011; Pape, Bjørngaard, Holmen, & Krokstad, 2012). As mental health problems may go unnoticed for years (Patel et al., 2007), associated comorbid health conditions or unhealthy life-style behaviours may evolve and further exacerbate the risk of poor achievement and dropping out of school. Anxiety and depression are the most common comorbidities (Cummings, Caporino, & Kendall, 2014), whereas typical lifestyle behaviour changes following mental health problems are reduced physical activity and substance abuse (Haarasilta, Marttunen, Kaprio, & Aro, 2004). As depression involves lack of interest or fatigue, and may invoke feelings of academic incompetence (Quiroga, Janosz, Bisset, & Morin, 2013), depression is expected to relate negatively to the GPA score.

Among the Big Five personality traits, conscientiousness is a notable predictor of GPA (McAbee & Oswald, 2013), possibly mediated by a well-organized, careful and self-disciplined style (McCrae & Costa, 1987). The interest in the Big Five model has however overshadowed the exploration of other personality models that may be more suitable for use among adolescents. It is a paradox that girls achieve better than boys, when traits more strongly associated with masculinity, for instance self-efficacy (Choi, 2004b), seem more important for academic achievement (Pintrich & De Groot, 1990; Richardson et al., 2012). Hence the Personality Attributes Questionnaire (PAQ;

Spence & Helmreich, 1978) assessing gender-related personality traits was included in the present study. The questionnaire is assessing traits which are regarded socially desirable by both genders, but are more prevalent either among men (masculine) or women (feminine). We wanted to examine whether the masculine or feminine scores were related to academic achievement. Our expectation was that higher scores on masculinity would predict GPA positively, but also to contribute more strongly to GPA than feminine traits.

Resilience is a concept describing good adaption despite negative expectations following exposure to significant trauma, losses, or psychological adversities (Luthar, 2006). Longitudinal studies (Cederblad, 1996; Werner, 1993) point to several key protective factors characterizing resilient people, which may be grouped in three major domains (Garmezy, 1993): psychological/dispositional attributes, family support and cohesion, and external social resources. The general findings are that a resilient outcome is positively related with good achievement in school and improved possibilities for getting skilled jobs (Werner & Smith, 2001). It was therefore of interest to assess if a validated measure of resilience protective factors (Friborg, Hjemdal, Martinussen, & Rosenvinge, 2009) covering the three broad categories as described above, had a role for GPA. Studies specifically addressing the relationship between protective factors and GPA have however not been conducted previously. Also, the few available studies on resilience outcomes and intelligence provide mixed results, and thus, a specific hypothesis was not possible to provide.

Motivation influences academic achievements (Pintrich & De Groot, 1990; Richardson et al., 2012). According to goal achievement theory, mastery oriented motivation is characterized by learning for reasons of intrinsic interests and a desire to acquire more competence or certain skills (Dweck, 1986; Senko, Hulleman, & Harackiewicz, 2011), which may be realized by using either of two strategies; approach or avoidance. This distinction is pursued in Higgins' regulatory focus theory (1997), where a promotion focus implies sensitivity to positive outcomes and the use of approach strategies to reach the desired goals, whereas a prevention focus implies sensitivity to negative

outcomes, taking responsibility and safety seriously, and the use of avoidance strategies to sidestep negative outcomes. Self-regulation (Zimmerman & Schunk, 2011) and self-control (Duckworth & Seligman, 2006) also contribute to individual differences in achievement. Self-regulated learners are actively engaged in their own learning process; they use more learning strategies and they actively monitor their effectiveness (Zimmerman, 1990). Enhancing self-regulatory processes and teaching effective learning strategies indeed helps students achieve better (Tuckman & Kennedy, 2011). Since the promotion focus represents a more active approach to learning, we expected promotion focused students to have better GPA than prevention focused students.

### **Moderator Effects**

Many students with learning difficulties experience problems with self-efficacy (Klassen et al., 2008). Thus, we examined whether including the interaction term between literacy problems and self-efficacy contributed to the prediction. Since self-efficacy is a fair predictor of GPA (Richardson et al., 2012), and GPA tend to be lower among students with learning difficulties (de Caso, Garcia, Diez, Robledo, & Alvarez, 2010), we suspected that self-reported ability to solve academic tasks would show a different relationship with GPA depending on the degree of self-reported literacy problems. A statistically significant interaction effect would provide additional support of the validity of the LP scale.

### **Hypothesis**

Following the above review, we hypothesised that having more literacy problems, less educational ambitions, more mental health problems, a prevention versus a promotion regulative focus of motivation, and less masculine personality traits would predict lower GPA in a sample of Norwegian adolescents.

## **Method**

### **Participants and procedure**



The study design was cross-sectional. All students entering upper secondary school in Troms County autumn 2010 were invited to participate ( $N=2434$ ). The response rate was 69 %, yielding 1676 enrolled in the study (804 females, 48%). The mean age was 16.7 ( $SD = 1.3$ , median 16.4). The age range was 15-31, and 3.3 % were 20 years of age or older. This is the normal situation in Norway because a smaller percentage of adults retake upper secondary exams. Age was thus non-normally distributed (skewness = 5.72,  $SE = 0.06$ ; kurtosis = 46.81,  $SE = 0.12$ ). A log-transformation improved the distribution (skewness= 4.54,  $SE = 0.06$ ; kurtosis = 29.56,  $SE = 0.12$ ). The proportion of vocational and general track students was roughly equal (54% versus 46%, respectively). Eleven students were registered on alternative track, meaning they had individual teaching plans. These students were excluded from the study because they were too few to represent a third current track category, leaving 1665 cases eligible for analyses. The flow of participants being included/excluded is presented in Figure 1.

All students received information about the study at school by project personnel. Students consenting to participate filled out a questionnaire during a classroom session. Parental consent was collected from participants below the age of 16.

*--- Insert Figure 1 about here ---*

### **Instruments/Variables**

A questionnaire asking about demographics, educational information, classroom behaviour and a range of other measures was used. Socio-economic status were assessed asking participants if they thought their family was well of. Both current track and students' educational plans were registered. Response alternatives for planned education were: aiming for higher education (BA or MA), finishing upper secondary school (general or vocational track), not sure, and other. When participants answered 'other' and specified a known type of higher education, they were moved to the questionnaire category were they belonged. We then created dummy variables with MA as the reference variable. Classroom behaviour and related factors were assessed with several items, of

which two were included in the analysis, 1) 'Have you ever been in conflict with the rules of the classroom', and 2) 'When lessons are over and assignments are given, to what degree are you capable of solving these tasks on your own'. Both were answered on a 6-point Likert scale, 1 being 'to a little degree' and 6 being 'to a large degree'.

The following measures were chosen to address our hypotheses. Short measures were preferred when available to enhance response rates.

### **Literacy problems (LP).**

The second aim of the present study was to examine the properties of a newly adapted self-report scale of LPs. These items were originally developed by the third author and adapted for the present study by the fourth author. The items overlap the diagnostic criteria for Specific Learning Disorder A1-4 in DSM 5 (APA, 2013), asking for problems within four areas: 1) decoding, 2) reading comprehension, 3) spelling, and 4) written expression. In order to distinguish between past and current learning difficulties, items addressing general reading or writing difficulties both in the present and the past tense were included. A number of eight items were adapted (see Table 1). A dichotomous response format was used, and thus additional item response analyses were relied on to ascertain their discriminative and item difficulty values. The LP items were also included to examine our hypothesis that learning problems predict lower GPA.

### **General mental health.**

Poor mental health is associated with lower educational achievements (Patel et al., 2007) and should therefore be controlled for when studying GPA. For measuring general mental health, the 5-item Hopkins Symptom Checklist were included (Derogatis, Lipman, Rickels, Uhlenhuth, & Covi, 1974), asking about nervousness, anxiety, hopelessness, sadness, and worrying among participants. The short version has been shown to have acceptable validity and reliability (Strand, Dalgard, Tambs, & Rognerud, 2003).

**Personality traits.**

The Personal Attributes Questionnaire (PAQ; Spence & Helmreich, 1978) assessed the personality traits masculinity and femininity. It uses a five-point semantic differential response format (e.g., 1: not at all competitive to 5: very competitive) describing opposing personal characteristics. The 24 items cover three subscales: The masculine (M) subscale represents trait descriptions considered as socially desirable in both genders, but which occur more often in males, (e.g. independent, competitive), and vice versa for the feminine (F) subscale (e.g. emotional, understanding of others). The masculine/feminine (M/F) subscale consists of items believed to be socially desirable for one gender but not for the other (e.g. aggressive, home-oriented). The instrument measures gender-related individual differences and is found to have good construct validity (Choi, 2004a). Originally, Cronbach's  $\alpha$  for the subscales were .85, .82, and .78 for the M, F, and M/F subscale, respectively (Spence & Helmreich, 1978). In our data, the last subscale (M/F) had poor reliability (Cronbach's  $\alpha$ , .46) and had to be excluded. Cronbach's  $\alpha$  for the masculine subscale was .73, and for the feminine subscale .82.

**Resilience.**

The Resilience Scale for Adults (RSA; Friborg et al., 2009) was used to assess the role of protective factors. We used a short version, consisting of 12 items covering four factors: positive perceptions of self, social competence, family cohesion and social resources (Cronbach's  $\alpha$  in the present study: .76, .88, .86, .89, respectively). A high resilience score implies access to more protective factors/resources and hence fewer tendencies to succumb to hopelessness when faced with life stressors (Hjemdal, Friborg, & Stiles, 2012).

**Motivation.**

Motivation has been linked to achievement, and in the present study we aimed to examine the role of two different motivational strategies for achievement (GPA). Motivation was assessed using the General Regulatory Focus Measure (Lockwood, Jordan, & Kunda, 2002) based on the

regulatory focus theory of Higgins (1997). Eighteen items was used to measure promotion focus (Cronbach's  $\alpha = .88$ ) and prevention focus ( $\alpha = .79$ ), alphas being slightly better than originally reported (.81 and .75, respectively; Lockwood et al., 2002). In a psychometric review of five different regulatory measures, the promotion/prevention scale was particularly recommended for research on academic achievement or performance (Haws, Dholakia, & Bearden, 2010).

### **GPA.**

All final grades from the last year of the lower secondary school (recorded two-three months before the present study) were averaged in a single score. Grade scores range from 0 to 6, and a minimum of 2 is needed to pass a subject. Grades above 5 is roughly equivalent with the international A. GPAs were obtained from administration registry of Troms County, and mean GPA for the sample were 4.1 (SD = .79; range 1.56-5.94; skewness = -0.17, SE = 0.07; kurtosis = -0.49, SE = 0.13) (see Figure 2, showing the kernel density smoothed distribution for females and males, respectively).

--- Insert Figure 2 about here ---

### **Statistical Analyses**

IBM SPSS for Windows v21 was used for descriptive and inferential analyses, while Mplus v7.0 (Muthén & Muthén, 2010) was used for the psychometric analyses. Prior to the analyses, the variables were examined for missing values and assumptions of fit for multivariate analysis. Five cases were multivariate outliers according to the Mahalanobi's test ( $p < .001$ ). Removing these left 1660 cases for analysis (see Figure 1).

### **Missing value analysis.**

GPA recordings were missing for 19.2 % of the cases for three reasons: 1) students were admitted to upper secondary school for reasons unrelated to GPA (like age), 2) students with a Steiner school background do not receive grades, and 3) some students had grade exemptions for

reasons of physical or mental dysfunctions or being a minority student not speaking Norwegian fluently. The total amount of missing data in the predictor variables were 7.5%, which were imputed using the expected-maximization algorithm with 200 iterations in PreliS 8.8 (Jöreskog & Sörbom, 2005). Cases containing more than 40% missing were not part of the imputation procedure (RSA, 142 cases; PAQ, 131 cases; RFQ, 148 cases). The LP scale consists of only 8 items, and cases with more than 2 items missing were not imputed (52 cases).

### **Psychometric analyses.**

In order to cross-validate the LP scale, the sample was randomly split, using the first to conduct exploratory factor analyses (EFA) and the second to conduct confirmatory factor analyses (CFA). The analyses were conducted in Mplus as it automatically calculates tetrachoric correlations for binary scored items. The weighted least squares estimator with means and variance adjusted chi-square test statistic (WLSMV), and the default oblique geomin rotation was used.

Mplus was also used for item response theory (IRT) analyses. A two-parameter model was estimated since a three-parameter model including guessing was irrelevant. A strength of IRT is the provision of information about which items discriminate best between individuals having low or high degrees of literacy problems. It estimates parameters for item discrimination ( $a$ , slope) and for difficulty level ( $b$ , location). Items with higher slope values ( $a$ ) have steeper curves and discriminate or rank order the respondents better than items with a lower slope and a flatter curve. The location parameter,  $b$ , indicates how large or small the problem (or the latent trait) needs to be before admitting a positive answer. More precisely, it indicates the minimum latent trait level required for a 50% probability of responding positively to the item.

### **Regression analyses.**

A hierarchical regression analysis was conducted to examine the predictive value of the variables. Demographic variables were entered first. Variables related to school and cognitive domains were entered in the second block: Information regarding current and planned education

and the questions about classroom behaviour and problem solving. In the third block, affective/psychological variables were introduced: Regulatory focus, resilience, personal attributes, and the symptom checklist. As the literacy problems scale was of particular concern, it was entered last as a main effect in order to decide whether it contributed significantly to the model on top of all the other variables. The interaction term between LP and academic task solving were examined last. A manual stepwise approach was used by consecutively removing non-significant variables.

## Results

### Factor Structure and Reliability of the Literacy Problems Scale

We divided the sample randomly in half, analysing the first using an exploratory factor analysis (EFA). Two components with an eigenvalue  $> 1$  were extracted (items 1/2/5/6/7 loaded on the first factor and items 4/8 on the second, while item 3 cross-loaded on both). As the second eigenvalue (1.05) was not significantly higher than a randomly produced eigenvalue based on a parallel analysis criteria (Watkins, 2000), a single factor was preferred. A confirmatory factor analysis on the second split (the hold-out sample) supported a single factor, as the improvement in root mean square error of approximation (RMSEA) for two factors was marginal (.085) compared to one factor (.097). The Cronbach's  $\alpha$  of the full scale was 0.84.

The IRT parameters showed that the items asking if respondents have or have ever had reading difficulties (items 1 and 2) or writing difficulties (items 5 and 6) discriminated best between the subjects, while the two items asking about slow reading and problems with writing mistakes (items 3 and 7) had intermediate discriminatory abilities. The items addressing more general problems with understanding reading material and articulating sentences (items 4 and 8), discriminated less well. Removing items 4 and 8 from the full scale score yielded a Cronbach's alpha of .86. However, as their factor loadings were considered high enough (.61 and .55), they were not excluded.

As all the b-coefficients were positive (mean = .88), and the latent LP trait score needed to pass the 50% probability threshold for affirmative item responses were 0.77, the full scale discriminates best among pupils having a moderate to a high degree of LPs. Parameters for the literacy items are reported in Table 1.

--- Insert Table 1 about here ---

### **Correlations between the Variables**

Learning difficulties, current educational track, and vocational track (upper secondary school) as the highest planned education, correlated negatively with GPA ( $r = -.40$ ,  $r_s = -.59$ , and  $r_s = -.37$ , respectively). GPA correlated positively with student's self-perceived ability to solve academic tasks ( $r = .43$ ), and with having a promotion focus ( $r = .32$ ). Self-perceived ability to solve tasks alone correlated negatively with learning difficulties ( $r = -.41$ ) and positively with PAQ masculine ( $r = .31$ ). The coefficients, means and standard deviations for all the variables are reported in Table 2, as is Cronbach's  $\alpha$  for all scales.

--- Insert Table 2 about here ---

### **Hierarchical Regression Analyses: Predicting GPA**

The variables were entered in predefined blocks (see Table 3) showing the final unstandardized and standardized beta weights. The unstandardized weight indicates exactly how much the GPA score change for a unit change in the explanatory variable. In the first demographic block, gender, age, and current track contributed significantly to the model. Males and older subjects had a lower GPA, and students enrolled in the general track had a significantly higher GPA than students in the vocational track. In the second block, planning for higher education was not a significant predictor, however, *not* planning for an education above upper secondary school had negative effects on GPA. Reporting a higher self-perceived ability to solve tasks alone was positively associated with GPA, and having been in conflict with classroom rules was negatively associated with

GPA. Age became non-significant after the inclusion of the second block. In the subsequent block, measures of regulatory focus, resilience, personality traits, and mental health status were included. Higher scores on promotion focus, more social resources, and higher scores on masculine traits were all associated with higher grades, while scoring high on the RSA social competence subscale was associated with lower grades. Mental health status was not significant. The LP scale was included in the final block, predicting as expected a lower GPA. The final model explained 55% of the variance in GPA.

*--- Insert Table 3 about here ---*

The interaction effect between LP and the question addressing self-perceived ability to solve academic tasks (LP x task solving) was statistically significant. The positive association between task solving skills and GPA depended on the degree of LPs by attenuating it as LPs increase (see Figure 3). Moderation values of LP were set according to the scale as 0 (absent), 2 (58 percentile), and 4 (89 percentile).

*--- Insert Figure 3 about here ---*

## **Discussion**

The aim of the present study was to examine the contribution of cognitive/school-related, psychological/affective as well as literacy problems to the Grade Point Average (GPA) index. We examined a wide range of psychosocial factors and literacy skills in a sample of North-Norwegian upper secondary school students. A second aim of the study was to examine the psychometric properties and the usefulness of a self-report scale on literacy problems (LP).

### **Predictors of GPA**

The most important predictors for GPA were, in declining importance, current educational choice (general track higher than vocational track) and academic task solving skills, while gender (women higher than men), planned educational track (university higher than lower education), and



LP contributed equally to the prediction. The eight item self-report questionnaire assessing LP showed favourable psychometric properties as well as incremental validity. The prediction coefficient for LP was the third highest, which supported the validity of the scale as well as replicating the importance of LP for academic achievement. Moreover, it also contributed significantly by moderating the relationship between task solving skills and GPA, providing further support of its tenability.

The current study did not address or examine particular theories explaining individual differences in achievement. However, as quite a number of theories for explaining academic performance exist ranging within three broad areas: a cognitive domain, a social and an affective domain (Powell & Tod, 2004), our findings are discussed in line with such division.

#### **Demographic factors.**

The analyses confirmed a gender gap in academic achievement (Pomerantz, Altermatt, & Saxon, 2002; Statistics Norway, 2013a) in our North Norwegian sample. Female students had a higher GPA than male students. Several reasons for this gender gap in achievement are suggested, including home and school/classroom environment, socio-economic factors, peer culture, gender differences in attitudes towards school work (Warrington, Younger, & Williams, 2000), and degree of self-discipline (Duckworth & Seligman, 2006). Consequences are a higher degree of special education and higher dropout rates among men (Legewie & DiPrete, 2012), which lead to a range of possible negative concerns related to work status, income, behaviour, and quality of life (Belfield & Levin, 2007).

Current track was also a strong predictor, and being enrolled in a general program increases GPA with more than half a grade. A similar result was obtained by Rojewski and Kim (2003), who documented that weaker academic achievement is associated with reduced perceived vocational choices and ambitions.

#### **Cognitive/school-related factors.**

Having LP was associated with a lower GPA, as expected. This is in line with earlier research (Reiff et al., 2001) and the notion that learning disorders are diagnosed partly because of low academic achievement. Students with learning difficulties do not however normally suffer a general impairment in cognitive functions (Swanson, Harris, & Graham, 2013). Rather, specific cognitive domains as for instance executive functions like working memory and planning, as well as linguistic functions related to phonological and semantic processing, may be affected. These impairments slow down acquisition of basic academic skills and comprehension of theoretical knowledge, and impacts the GPA indirectly.

The presence of literacy problems and weak GPA may have several unfortunate consequences, such as depression, anxiety, loneliness and poorer quality of life (Ginieri-Coccosis et al., 2013; Klassen et al., 2013), more frequent risk behaviour, substance use, aggressive and delinquent acts (McNamara & Willoughby, 2010), as well as drop-out from school (Goldstein et al., 2011). Yet, more adolescents with literacy problems attend higher education than before. Since interventions for these problems are often available in schools, an easy to use and valid method for identifying those with LP may help reduce both personal and societal costs.

The variable addressing self-perceived ability of students to solve academic tasks or assignments moderately predicted GPA. The wording of this question was closely related to self-efficacy, which is related to achievement (Richardson et al., 2012), hence replicating previous findings. Moreover, the relationship between task solving ability and GPA was moderated by literacy problems as more LPs weakened the positive relationship, which mimics other research showing that self-efficacy is lower in adolescents with more LD (Hen & Goroshit, 2014). An implication of these results could be that enhancing self-efficacy or the skills to cope with academic tasks can contribute to a reduced negative effect of LD on GPA. Creating opportunities for students having LD to increase their self-efficacy and optimism has been attempted in a few studies with positive results (de Caso et al., 2010; Garcia & Fidalgo, 2008). Since LD students are performing poorer than their non-LD peers,

they probably will be more likely to choose vocational, more practical educations (Gregg, 2007). Interventions tailored for these educational tracks might therefore be the most effective.

### **Affective/psychological factors.**

As expected, students reporting a promotion focus and hence the use of approach strategies rather than avoidance strategies in the learning process did in fact achieve better GPA. This is in line with research showing that motivational strategies are associated with achievement (Richardson et al., 2012). Focusing on reaching a specific goal (e.g. achieving good grades) seems to be a better strategy than focusing on avoiding a failure (e.g. poor grades or failing an exam).

The fact that students reporting good social resources achieve better than students reporting less social support is not surprising. However, that higher social competence has a negative effect on grades is more intriguing. One explanation for this may be related to the content of the items in the RSA subscale, which indicates openness towards other people and potential new friends. This may be an important quality for social functioning, but perhaps not equally helpful for achievement, if highly social adolescents spend less time on homework and more time with friends. The included measure of personality traits associated with stereotypical masculine or feminine qualities predicted GPA, but since the contribution of masculine personality traits were minor, we did not consider it further. Depression and anxiety symptoms measured by HSCL-5 was not a significant predictor for GPA. Even if substantial research points to a relationship between mood disorders and academic achievement and attainment, other studies exist which have failed to find this relationship (e.g. Breslau, Lane, Sampson, & Kessler, 2008).

### **The Self-Report Literacy Scale**

The psychometric properties of the self-report literacy scale was adequate in terms of reliability and validity. The scale assessed four key aspects of literacy: spelling, decoding, written expression, and reading comprehension. Although studies have demonstrated persistence of reading and spelling disorders into adolescence (Snowling, Muter, & Carroll, 2007) and adulthood (Bruck,

1990), characteristics of literacy disorders change over time due to a number of factors (e.g. response to intervention). Hence, the scale also addressed both present and past reading and writing difficulties.

The item response theory (IRT) analyses indicated that at least six of the eight items discriminated well between the students. As the IRT location parameters were approximately one standard deviation above the mean for these items, they discriminated best between students having moderate-to-high degrees of literacy problems compared with students not reporting literacy problems. The location of these items is preferable for screening purposes as it maximizes the detection of students with literacy problems in the percentile area of 0.65 to 0.90.

The two items addressing written expression and reading comprehension had poorer discriminatory properties. One possible reason for this might be that these two items are associated with reading comprehension disorders, not dyslexia. As emphasized by Snowling and Hulme (2012), the decoding impairments seen in dyslexia appears to be caused by a weakness in phonological processing whereas reading comprehension disorders appear to reflect broader language processing weaknesses including vocabulary, grammar, listening comprehension and narrative skills. Reading comprehension disorders are often seen in children with a childhood history of specific language impairments (Bishop & Adams, 1990; Catts, Adlof, & Ellis Weismer, 2006). Students in the present sample reported more often difficulties associated with decoding and spelling compared to difficulties associated with comprehension and written expression. This can be taken to suggest that there was a higher incidence of dyslexia than reading comprehension disorder in the sample. Another possible reason may be that the two questions attempted to capture two closely related, but different aspects of literacy. The first asked for problems with understanding and remembering sentences, while the second asked for problems with articulation and getting thoughts on paper. Such questions are denoted as double-barred questions and may be justified if people correctly interpret such conjunctive (or Boolean) statements. The prevalence of subjects responding

affirmatively to these two items were high (39% and 35%, respectively), indicating that the conjunction did not narrow the prevalence sufficiently. As such, the contribution of these two items to the total score were minor, and should be revised in future studies. They can also be removed without noticeable negative effects as the reliability for the six remaining items were equally high. Moreover, as the initial exploratory factor analysis indicated a weak tentative second factor (eigenvalue = 1.04), which specifically accounted for these two items, omitting these will not affect the factorial validity of the scale. Since the location of these two items were closer to the mean of the normal distribution, omitting them would also imply better discrimination of students with slightly more severe literacy problems.

To conclude, the finding that students who report poor skills in reading and spelling also achieve low GPA, supports the validity of the scale. Due to the favourable psychometric properties and discrimination in the upper range, it holds promise as a screening tool for LPs, and potentially also school dropout. This would be a task for a future study to address.

### **Strengths and Limitations**

A strength of the study was the large sample size. Given that the city of Tromsø consists of about 70000 inhabitants, and that the participation rate was fair, the sampling outcome strengthens the generalizability of the results.

The present study is not without limitations. First, a relatively high proportion of the students were left out of the analyses because of missing values on the GPA variable, representing 331 students. This is hardly negative for the validation of the LP scale as many students who were not receiving grades also undoubtedly have significant learning problems. Had these data been available, the reported relation would be expected to be stronger rather than weaker. The relation between GPA and the other covariates might however change in unpredictable directions. A t-test comparison of students that were lost versus kept in the analyses revealed significant differences ( $p < .001$ ) on four of the variables: age, LP, task solving skills, and planned education/vocational track. Age was one

of the reasons for being admitted in school without GPA. The same was mental and physical dysfunctions, which are likely to cause LP. The group differences on these variables were therefore not surprising, but still it represents a weakness to the study. However, as the number of students lost due to missing data on the GPA were approximately 20%, its influence is likely to be minor.

Another limitation was that the outcome variable, the GPA, was based on the final grades from the lower secondary school, set in June 2010. The predictor variables were however measured two to three months later in 2010 when the students began their upper secondary schooling. The predictions were hence backwards, while a better approach would be to use GPA scores collected at the end of the first upper secondary school year, or even three years later (when students finish the upper secondary school). However, these analyses are not accessible as permission to extract these grades are not available. Yet, as grades are relatively stable across levels of education and the retrospective time frame was quite short, and as prior GPA strongly predict later GPA (Casillas, Robbins, Allen, & Kuo, 2012), we consider the present results as valid. Several of the predictor variables, such as gender, literacy problems, and personality traits, are also considered stable over time, hence supporting the validity of the predictions. A prospective design would most probably yield a lower multiple R (the combined explanatory power of the predictors), but the relative contribution for the statistically most significant predictors would be expected to replicate.

The sole use of self-report measures represents a limitation, potentially including response biases and overlooking more sensitive methods. Typical biases are acquiescence and social desirable responding (Cheung & Rensvold, 2000). The latter may be problematic if making affirmative responses may invoke feelings of stigmatization or inadequacy. However, as the context of the data collection did not invite demand characteristics related to impression management, these potential biases should be of less concern. Nevertheless, inclusion of a scale aimed at measuring the tendency to social desirability responding would have been beneficial. The influence of acquiescence is

normally small (Friborg, Martinussen, & Rosenvinge, 2006) and most likely compensated for as several of the included questionnaires managed acquiescence by using reverse scoring rules.

The use of other assessment methods, for example reports by teachers, might have yielded more sensitive measures related to students' academic achievement. Still, as the teachers had just met the students, such extra assessments would not provide reliable results. They were not feasible to conduct either. A group-administered screening test, which could have been carried out in whole classes or large groups, were not available at the time the data were collected.

### **Implications and Further Research**

Recently, a screening device has been developed for identifying literacy problems in students in upper secondary schools. 'The Norwegian Screening Test for Literacy Disorders' was designed to be carried out group-wise, easy to administer, and to assess a broader range of literacy skills that are required by students who wish to accomplish upper secondary school (Nergård-Nilssen & Eklund, under review). Comparisons between a normative sample and a validation sample (i.e. students with a formal dyslexia diagnosis) showed significant differences on all measures and yielded large effect sizes. Logistic regression analyses showed that the screening battery correctly classified 95.4 % of cases overall and that the screening battery thus has good discriminatory power. In future research, this 50-min screening test can be carried out in the present sample to further validate the self-report literacy scale used here. Moreover, the screening test can be carried out in a large sample to examine the prevalence of specific learning disorders in students in upper secondary education, which to this date has not been studied in the dropout population in Norway. The findings from the present study show that this issue deserves more attention and ought to be addressed in future studies.

In conclusion, predictors for GPA in a North-Norwegian sample are study track, problem-solving abilities, gender, future plans for education, and literacy problems. A short instrument

assessing literacy had adequate psychometric properties and may be used in epidemiologically-related research where short self-report scales are needed.



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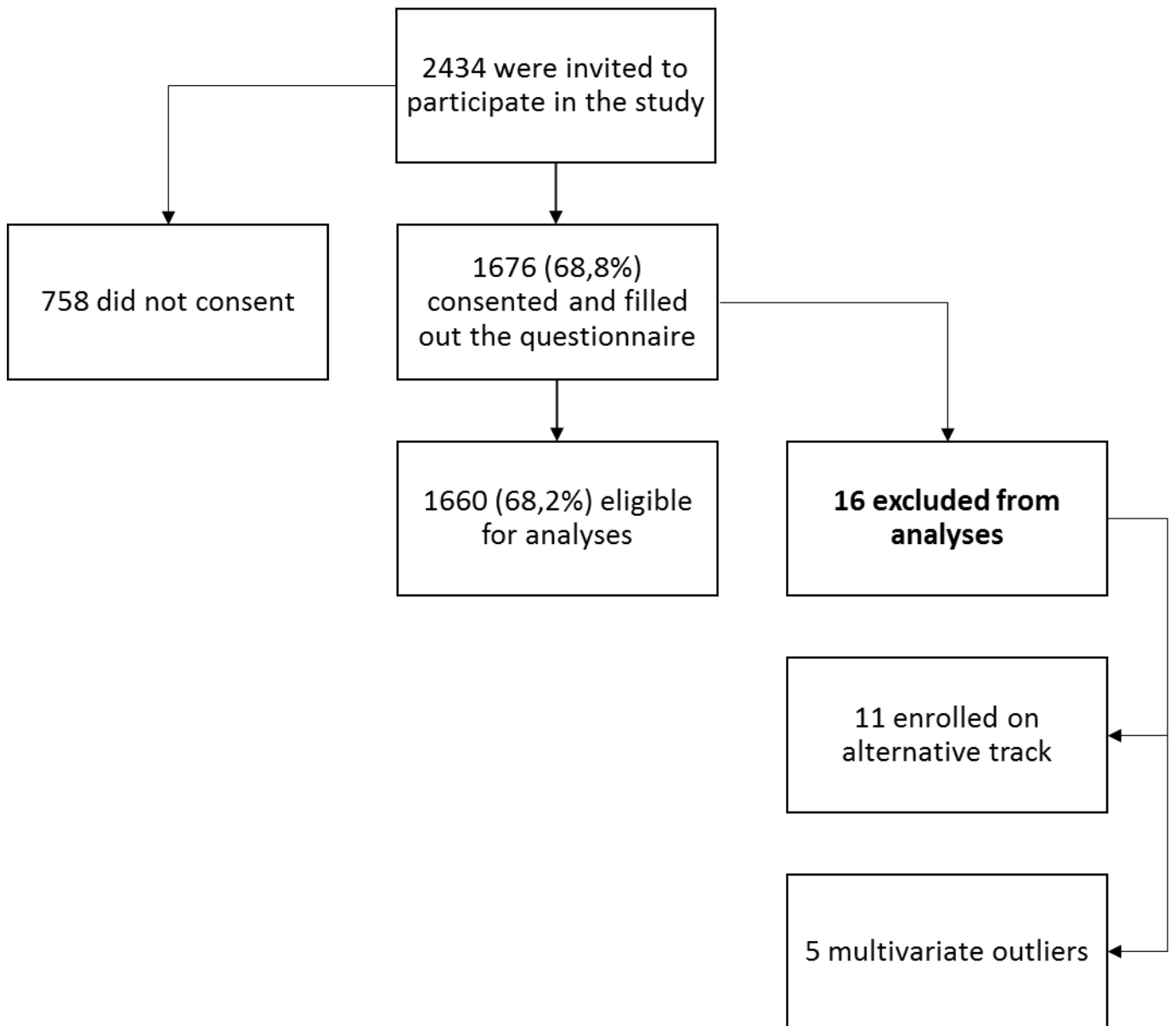
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*Figure 1.* Flow of participants through the study.

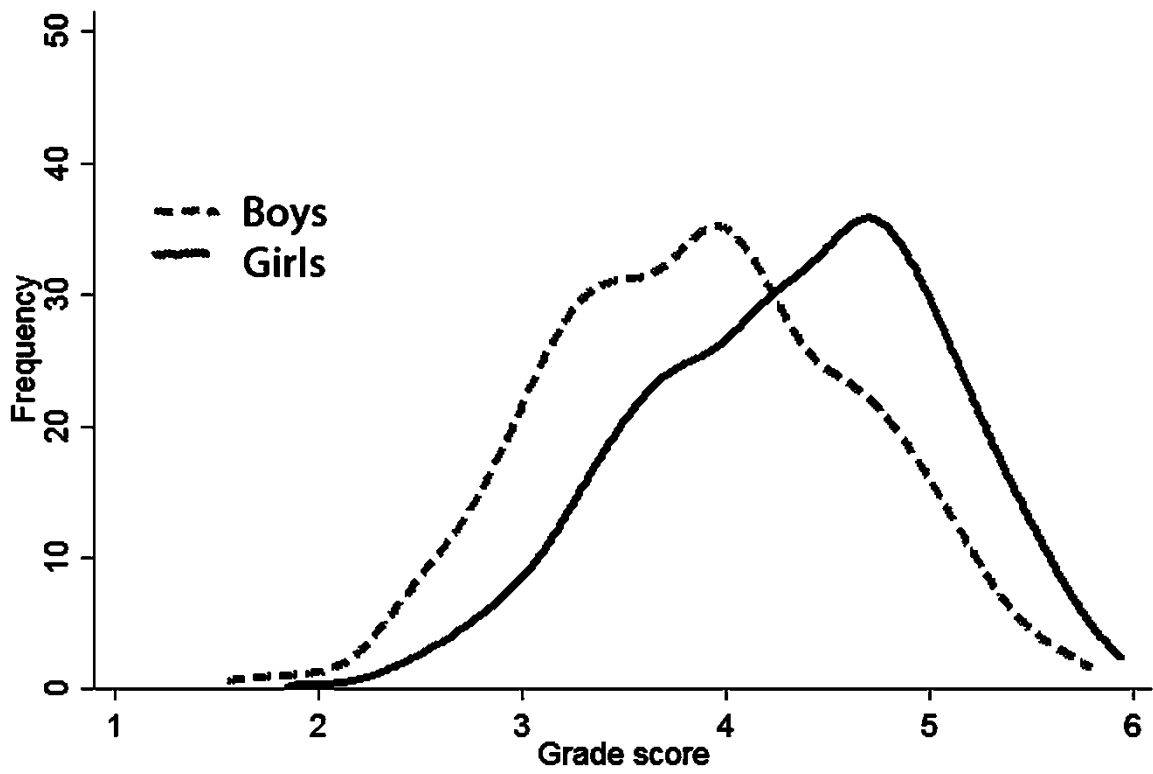


Figure 2. Kernel density smoothed distribution of GPA scores.

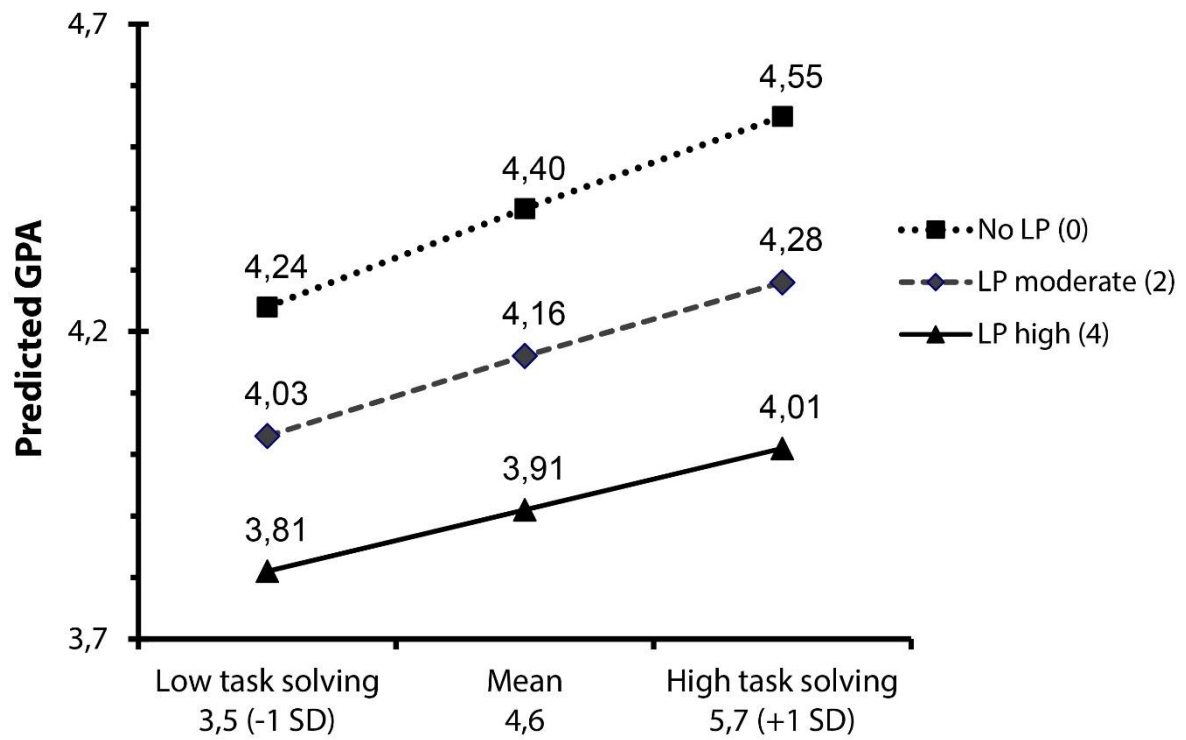


Figure 3. Regression slopes predicting GPA based on the self-reported ability to solve academic tasks (continuous score). Literacy problems (LP) moderated this relationship, as the positive effect of task solving ability became weaker if students reported more LPs (flatter slopes).

Table 1.

*Test parameters for the literacy items (N=1609).*

Items	<i>a</i>	<i>b</i>	$\lambda$	%
1: Do you have reading difficulties?	3.11	1.19	.95	12.9
2: Have you ever had reading difficulties?	2.48	0.89	.93	20.6
3: Do you read slowly?	1.29	0.84	.78	25.7
4: Do you have problems understanding, and/or remembering what you have read?	0.75	0.45	.61	39.3
5: Do you have writing difficulties?	3.72	1.11	.97	14.2
6: Have you ever had writing difficulties?	3.09	0.88	.95	20.1
7: Do you make many writing mistakes?	1.21	0.93	.77	23.7
8: Do you need much time to articulate sentences and to get your thoughts on paper?	0.66	0.71	.55	34.9

*Note:* *a*, slope (item discrimination); *b*, location (item difficulty);  $\lambda$ , standardized factor loading; %, percentage of correct answers. See the *Statistical analyses* in the Method section for further details about interpretation of the parameters.

Table 2.

*Descriptive statistics and correlation coefficients (N=1178)*

Variable (range)	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22
1. GPA (0-6)																						
2. Gender (0 ♀, 1 ♂)	-.30																					
3. Age (15-31)	-.02	.02																				
4. Financial status (1-4)	.15	-.05	.06																			
5. Current track (0/1) <sup>1</sup>	.58	-.14	.03	.15																		
6. Planned: BA (0/1)	.08	-.15	.00	.00	-.02																	
7. Planned: general track (0/1)	-.08	.08	.01	-.03	.03	-.11																
8. Planned: vocational track (0/1)	-.38	.15	-.01	-.10	-.41	-.22	-.07															
9. Planned: not sure (0/1)	-.12	.01	.02	-.07	-.07	-.34	-.11	-.23														
10. Planned: other (0/1)	-.09	.04	.05	-.01	-.07	-.06	-.02	-.04	-.06													
11. Classroom rules (1-6)	-.25	.15	.07	-.01	-.17	.02	.02	.09	.02	.02												
12. Task solving (1-6)	.43	-.05	-.05	.17	.19	.05	-.09	-.14	-.14	-.03	-.21											
13. Prevention (1-5)	.02	-.20	.02	-.03	.03	.05	.00	-.05	.04	-.05	.03	-.15	<b>.79</b>									
14. Promotion (1-5)	.32	-.14	.02	.16	.25	.05	-.01	-.17	-.11	-.02	-.12	.17	.41	<b>.88</b>								
15. RSA <sub>pos self</sub> (1-5)	.09	.22	.04	.15	.09	-.02	.03	-.02	-.14	.01	-.07	.23	-.29	.17	<b>.76</b>							
16. RSA <sub>soc comp</sub> (1-5)	.04	-.03	.04	.16	.06	.01	.02	-.07	-.05	.04	.01	.12	.14	.20	.52	<b>.88</b>						
17. RSA <sub>fam coh</sub> (1-5)	.18	-.03	.03	.18	.16	.00	-.05	-.08	-.07	.02	-.16	.22	-.11	.23	.46	.44	<b>.86</b>					
18. RSA <sub>soc res</sub> (1-5)	.28	-.19	-.01	.17	.18	.02	-.05	-.10	-.07	.01	-.15	.22	-.09	.26	.40	.45	.69	<b>.89</b>				
19. PAQ <sub>masculine</sub> (1-5)	.24	.11	.02	.24	.22	.02	.05	-.11	-.20	-.01	-.03	.32	-.22	.27	.51	.43	.29	.27	<b>.73</b>			
20. PAQ <sub>feminine</sub> (1-5)	.23	-.29	-.04	.11	.15	.08	.01	-.12	-.06	.00	-.15	.19	.13	.32	.06	.24	.24	.29	.34	<b>.82</b>		
21. HSCL (1-4)	-.01	-.19	-.02	-.15	-.01	.03	.00	-.01	.02	.02	.07	-.22	.40	.05	-.40	-.27	-.27	-.17	-.33	.04	<b>.85</b>	
22. LP (0-8)	-.40	.12	-.03	-.14	-.23	-.04	.04	.15	.05	.05	.15	-.41	.12	-.15	-.11	-.12	-.15	-.17	-.25	-.16	.22	<b>.84</b>
<i>M</i>	4.16	.49	16.3	2.64	1.54	.24	.04	.13	.26	.01	2.34	4.61	3.03	3.71	3.70	3.69	4.04	4.45	3.39	3.82	1.58	1.91
<i>SD</i>	.77	.50	.28	.64	.50	.43	.18	.34	.44	.11	1.42	1.08	.70	.70	.87	1.00	.94	.84	.62	.65	.64	2.28

*Note:* <sup>1</sup>0=vocational track, 1=general track. LP = Literacy problems, RSA = Resilience Scale for Adults (pos self = positive perception of self, soc comp = social competence, fam coh = family cohesion, soc res = social resources). PAQ = Personal Attributes Questionnaire. HSCL = Hopkins Symptom Checklist. Items along the diagonal (bold) are Cronbach's alpha for scales used in the analyses. Spearman's rho is reported for dichotomous variables (2; 5-10), Pearson correlation for continuous variables.

Correlations above  $r \geq .06, p < .05$ ;  $r \geq .08, p < .01$ ,  $r \geq .10, p < .001$ .

Table 3

*Hierarchical Multiple Regression with Factors Predicting GPA*

Step and predictor	<i>Unadj. R<sup>2</sup></i>	<i>Adj. R<sup>2</sup></i>	<i>Final beta</i>	<i>Final <math>\beta</math></i>
1. Demographic (N=1315)	.39***	.39***		
Gender (0 ♀, 1 ♂)			-.24***	-.16***
Age			ns	ns
Self-reported financial status			ns	ns
Current track (0/1) <sup>1</sup>			.56***	.36***
2. Cognitive/school (N=1284)	.35***	.52***		
Task solving ability			.15***	.20***
Conflict with classroom rules			-.03**	-.06**
Planned education: University, MA (ref)				
University, BA <sup>2</sup>			ns	ns
Upper secondary, general <sup>2</sup>			-.33***	-.08***
Upper secondary, vocational <sup>2</sup>			-.34***	-.15***
Not sure <sup>2</sup>			-.15***	-.09***
Other <sup>2</sup>			-.36*	-.05*
3. Psychological/affective (N=1210)	.20***	.54***		
Prevention			ns	ns
Promotion			.11***	.10***
RSA <sub>positive self</sub>			ns	ns
RSA <sub>social competence</sub>			-.09***	-.12***
RSA <sub>family cohesion</sub>			.ns	ns
RSA <sub>social resources</sub>			.09***	.09***
PAQ <sub>maskulin</sub>			.06*	.05*
PAQ <sub>feminine</sub>			ns	ns
HSCL			ns	ns
4. Literacy problems (N=1197)	.18***	.55***		
LP			-.06***	-.16***
LP x Task solving ability			-.01*	-.04*



*Note.* <sup>1</sup> 0 = vocational track, 1 = general track. <sup>2</sup> Dummy variables. PAQ = Personal Attributes Questionnaire, RSA = Resilience Scale for Adults, HSCL = Hopkins Symptom Checklist, LP = Literacy problems. Beta = unstandardized beta.

*Unadj.  $\Delta R^2$*  = Contribution by the block if entered alone (unadjusted contribution to the model). *Adj.  $R^2$*  = The adjusted total explained variance.

\*  $p < .05$ , \*\*  $p < .01$ , \*\*\*  $p < .001$