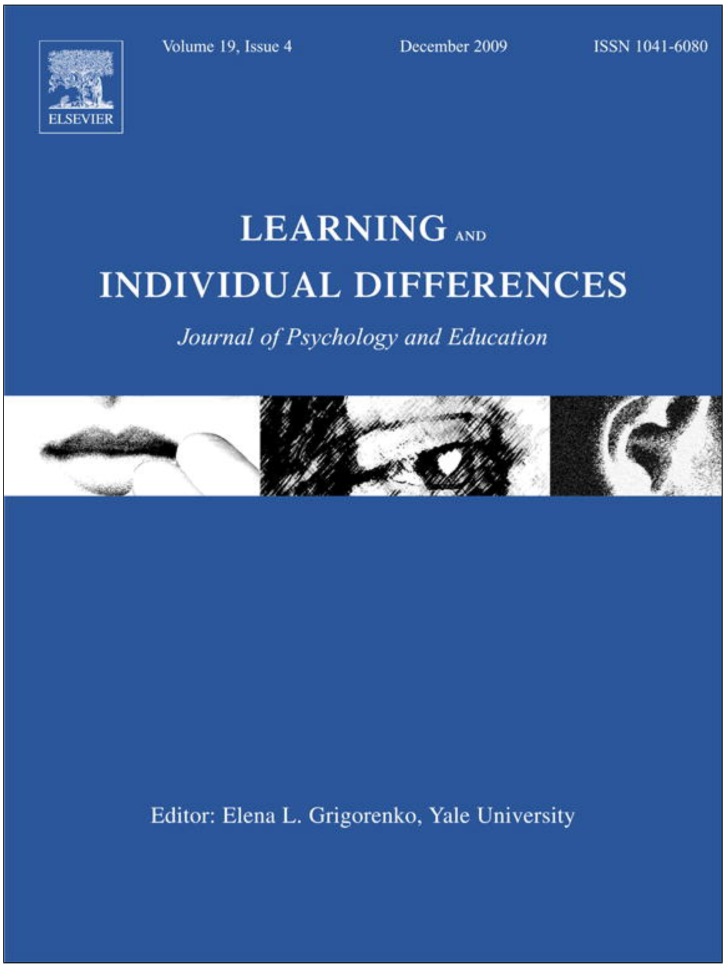
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Subjective evaluations of intelligence and academic self-concept predict academic achievement: Evidence from a selective student population

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The study examined the relationship between implicit theories, goal orientations, subjective and test estimates of intelligence, academic self-concept, and achievement in a selective student population ($N = 300$). There was no direct impact of implicit theories of intelligence and goal orientations on achievement. However, subjective evaluations of intelligence and academic self-concept had incremental predictive value over conventional intelligence when predicting achievement accounting for more than 50% of its variance. The obtained pattern of results is presented via structural equation models and interpreted within a dynamic regulative systems framework suggesting the importance of further studying complex sets of achievement predictors that include ability, personality and mediating constructs.

1. Introduction

A vast literature exists on predicting and explaining learning activity and academic achievement with numerous studies attempting to reveal the predictive value of cognitive abilities (e.g., Deary, Strand, Smith, & Fernandes, 2007; Harackiewicz, Barron, Tauer, & Elliot, 2002; see also Sternberg, Grigorenko, & Bundy, 2001 for a review), personality traits (e.g., Blickle, 1996; Bratko, Chamorro-Premuzic, & Saks, 2006; Chamorro-Premuzic & Furnham, 2003; see also De Raad & Schouwenburg, 1996) and mediating constructs (e.g., Chamorro-Premuzic & Furnham, 2006a,b; Elliot & McGregor, 2001) in both school and university domains. Implications of these survey and instructional studies vary from augmenting the existing measures used for educational placement (e.g., Stemler, Grigorenko, Jarvin, & Sternberg, 2003; Sternberg & Williams, 1997) to recommendations for teachers and students on how to improve achievement (e.g., Sternberg, Ferrari, Clinkenbeard, & Grigorenko, 1996; Sternberg, Torf, & Grigorenko, 1998).

In the academic motivation domain, the two last decades of educational and psychological research have been especially productive in terms of the development of the rationale for use of such constructs as self-concept or self-theories (Dweck, 1999, 2006; Markus & Wurf, 1987), self-esteem (Mruk, 2006; Koole & Pelham, 2003; Rodewalt & Tragakis, 2003), and self-efficacy (Bandura, 1986, 1997; Multon, Brown, & Lent, 1991); they are thought to be related to concepts like implicit theories (Dweck, 1999; Dweck & Leggett, 1988) and goal orientations (see Payn, Youngcourt, & Beaubien, 2007 for an overview).

Studies of cognitive predictors of achievement, on the other hand, have broadened conventional notions and measures of intelligence through the development of theories of multiple intelligences (e.g., R. Sternberg's theory of successful intelligence, Sternberg, 1999, 2003) and increased attention to the reliability and predictive validity of subjective estimates of intelligence (Chamorro-Premuzic & Furnham, 2006b; Furnham, 2001; Holling & Preckel, 2005; Visser, Ashton, & Vernon, 2008).

Although distinct, the components of the regulation of learning activity[1] mentioned above may function together in unity. For example, in Russian psychology, O. Tikhomirov's Sense Theory of Thinking (Tikhomirov, 1969, 1977, 1984/1988) suggests that self-concept components, motivation and goals together reflect the personality components of the regulation of thinking.

The current study examines the incremental predictive value of different components of a self-concept and self- and peer-estimated intelligence over conventional psychometric intelligence scores in the academic achievement of a selective[2] population of students. It also provides a theoretical model that integrates factors of self-concept

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[1] Learning activity is a system of specific learning actions necessary for the accomplishment of the main stages of the process of knowledge, habit and skill acquisition, and the development of abilities to quickly acquire (i.e., master) new experience in the future (Smirnov, 2008). Within the activity theory framework, different ability, personality and mediating constructs are viewed as involved in the psychological "regulation" of (or influence) this learning activity and subsequent academic achievement.

[2] Students that study in highly competitive programs and are believed to have a restricted academic ability range that restricts the extent to which conventional intelligence measures may predict academic achievement.

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and ability in explaining and predicting academic achievement. The following sections review previous research on the effects of self-beliefs and cognitive abilities on achievement and provide a theoretical rationale for viewing these components as functioning together in dynamic regulative systems.

1.1. Academic self-concept, implicit theories of intelligence, and goal orientations in academic achievement

In broad terms, self-concept is defined as a person's composite perception of himself or herself formed through experiences and continually reinforced by evaluative inferences (Bong & Clark, 1999; Bong & Skaalvik, 2003; Shavelson, Hubner, & Stanton, 1976).

After focusing on studying general self-concept for a long period of time (see Marsh, 1990a,b, for an overview), psychology switched to viewing self-concept as a multidimensional construct comprised of domain-specific components (Corbière, Fraccaroli, Mbekou, & Perron, 2006; Marsh, 1990a,b; Shavelson et al., 1976). Comprised of different components, these meaning systems directly or indirectly lead to individual differences in academic motivation and behavior (e.g., Ablard, 2002; Bong & Clark, 1999; Dweck, 1999; Leondari & Gialamas, 2002). Of particular interest to educational psychologists are those components of self-concept that are related to the learning domain. These components include (but are not limited to, as will be shown in the next section) academic self-concept and implicit theories of intelligence.

Conceptual definitions of academic self-concept include both cognitive (i.e., awareness and understanding of the self and its attributes, Bong & Clark, 1999) and affective components (i.e., feelings of self-worth, Covington, 1984) formed through the normative evaluation of perceived competence. Bong and Skaalvik (2003) consider such integration of cognition and affect as one of the key features of academic self-concept that distinguishes it from related and seemingly highly analogous constructs such as self-efficacy. Research also suggests (e.g., Bong & Clark, 1999; Corbière et al., 2006) that, although interrelated, these constructs should be viewed as distinct. Precisely, academic self-concept refers to individuals' self-concepts that are formed specifically toward an academic domain—as “knowledge and perceptions about themselves in achievement situations” (Bong & Skaalvik, 2003, p. 6), whereas self-efficacy beliefs are beliefs about the possibility of successfully performing a given academic task. In this case, academic self-concept is not only tapped at a higher level (e.g., of a subject), but is closely related to social comparisons and the information they provide.

Recent research on interrelations between academic self-concept and academic achievement concludes that the relations are reciprocal and mutually reinforcing rather than one-way and causal (Marsh, 1990b, Marsh, Trautwein, Lüdtke, Köller, & Baumert, 2005; Skaalvik & Hagtvet, 1990; Shavelson & Bolus, 1982; see also Hansford and Hattie's (1982) meta-analysis). Prior achievement experience forms future academic self-concept, which, in turn, is predictive of subsequent achievement even with prior achievement partialled out. This effect gets stronger when predicting high-stakes grades ($r \sim .40$) compared to low-stakes standardized tests ($r \sim .30$) (Marsh, 1987; Marsh et al., 2005). Along with direct self-fulfilling effects[3] and the predictive power that comes from the nature of this concept itself (i.e., the description and evaluation of oneself in achievement situations and the beliefs about one's academic ability have been shown to be highly predictive of achievement), having higher academic self-concept also leads to reduced test anxiety, lower aggressiveness likelihood, longer educational attainment and active pursuit of further academic challenges (Marsh & O'Mara, 2008; Marsh & Yeung, 1998; Taylor, Davis-Kean, & Malanchuk, 2007; Zeidner & Schleyer, 1999).

Another important component of self-concept that has been widely studied in academic motivation and achievement domains is that of implicit theories of intelligence (and personality) (e.g., Ablard, 2002; Blackwell, Trzesniewski, & Dweck, 2007; Dupeyrat & Mariné, 2005; Gonida, Kiosseoglou, & Leondari, 2006; Leondari & Gialamas, 2002; Spinath, Spinath, Riemann, & Angleitnerb, 2003). Implicit theories, as a concept developed within C. Dweck's (1999; Dweck & Leggett, 1988) social–cognitive theory of motivation distinguishes between individuals' beliefs about their abilities and personality traits as either fixed (entity theory) or malleable (incremental theory). These beliefs are sources of individual differences in certain cognitions and goal orientations, which affect achievement (Dweck, 1999; Elliot, McGregor, & Gable, 1999; Heyman & Dweck, 1992). Of particular interest is the connection between implicit theories of intelligence and a goal framework. Dweck's (1986, 1999) theory suggests that “entity” theorists perceive their abilities as fixed traits and tend to adopt performance goals seeking to gain favorable and avoid unfavorable judgments about their competence. Their “incremental” opposites, on the contrary, adopt mastery (or learning) goals, in which they seek to understand and master something new, and, thus, increase their competence. Entity theorists give up when facing challenges and generally try to avoid them, whereas incremental theorists are quite persistent in overcoming possible setbacks and often seek challenging situations that promote learning (Elliot & Dweck, 1988).

Studies conducted in the last decade, however, suggested that implicit theories do not affect achievement directly and neither do goal orientations. Their impact on achievement was shown to be rather mediational. For example, in their 2×2 achievement goal framework study, Elliot and McGregor (2001) argued that implicit theories are important antecedents of goal orientations (i.e., entity theory as an antecedent of mastery- and performance-avoidance goal orientations). Moreover, Kornilova, Smirnov, Chumakova, Kornilov, Novototskaya-Vlasova (2008) showed that implicit theories of intelligence and personality are closely related (representing an individual's more general incremental or entity beliefs about himself or herself) and correlate with goal orientations. Goal orientations, in turn, may influence achievement through mediating constructs, such as learning strategies (Ford, Smith, Weissbein, Gully, & Salas, 1998), effort expenditure (Dupeyrat & Mariné, 2005) and perceived competence (Leondari & Gialamas, 2002).

Although there have been studies of implicit theories and academic self-concept in specific populations such as ethnic minorities or students with mental disorders (e.g., Cokley & Patel, 2007; Cokley, Komarraju, King, Cunningham, & Muhammad, 2003; Da Fonseca et al, 2008), the relationship between these self-concept components and achievement has rarely been studied in highly-selective population as in the present study. Second, this study examines the relationships between implicit theories, goal orientations and achievement since there has been mixed evidence for both direct and indirect effects, and the selective nature of the sample may reveal different patterns of these relationships. Some studies showed that this selective status leads to a restricted range of achievement/ability indicators and increased importance and predictive value of personality and mediating constructs (e.g., Kornilova et al., 2008).

1.2. Self-, peer-estimated and psychometric intelligence predict academic performance

It is not surprising that conventional intelligence measures predict academic achievement as they have had a long history of validation specifically against achievement criteria (Deary et al., 2007; Mackintosh, 2006; Sternberg, 2003). Psychology has systematically studied the predictive value of intelligence measures in the educational domain and there is little doubt that this value is significant: Correlations between

[3] That is, a person acts in ways that would seem to confirm his or her initial perception of his or her level of ability. In self-estimated intelligence research, these effects have been associated with increased motivation, greater task persistence and more self-regulated learning (Peterson & Whiteman, 2007).

psychometric intelligence and achievement are usually moderate to strong (e.g., Deary et al., 2007; Mackintosh, 2006; McGrew & Knopik, 1993). However, conventional IQ measures typically explain only about 25% of variance in academic achievement and their predictive power seems to lower when studied in university or in selective samples (MacKinnon, 1962; Grigorenko & Kornilov, 2007; Sternberg et al., 2001).

One of the possible ways of increasing the predictive value of intelligence measures is by broadening the concept of intelligence itself. For example, Sternberg's (1999) theory of successful intelligence suggests that relatively independent analytical, practical and creative abilities each make a unique contribution to achievement. This approach addresses previously unexamined types of abilities that play a role in adaptation and achievement; cultural differences in beliefs about abilities that are considered valuable; and students' individual profiles of weaknesses and strengths as well. Another approach is to study the incremental explanatory power of intelligence measures obtained through self- and other-reports. This approach is of special interest to us because a self-estimated intelligence construct is by definition closely related to a self-concept.[4] Self-estimated (or self-assessed) intelligence represents "individual differences in people's level of awareness of their capacity to perform on intellectually demanding tasks" (Chamorro-Premuzic & Furnham, 2006a, p. 257) and is usually measured with direct self-estimates, Likert scales, percentile ranks, and visual analog scales (see Holling & Preckel, 2005).

Similar to the relationship between academic self-concept and academic achievement, the relationship between self-estimated intelligence and achievement is often referred to as having self-fullfilling effects (Furnham, 2001). It is also obvious that if self-estimated intelligence as a measure of one's insight into the level of his or her abilities correlates with actual ability measures, part of its predictive power may come from this correlation. An increasing number of studies showed that these self-evaluations significantly and positively ($r=.14$ to $r=.37$) correlated with conventional intelligence measures (Borkenau & Liebler, 1993; Mabe & West, 1982; Paulus, Lysy, & Yik, 1998; Rammstedt & Rammsayer, 2000). This means that if self-estimates of intelligence are specific and relatively accurate estimates of abilities, they can be used to predict achievement just as intelligence measures are. Indeed, Chamorro-Premuzic and Furnham (2006b) argue that, unlike other self-evaluation constructs, self-estimated intelligence is an intelligence measure, but a subjective one. However, a view of self-estimated intelligence as a proxy for psychometric measures in studying cognitive predictors of academic achievement is still doubtful (Paulus et al., 1998; but also see Holling & Preckel, 2005) since previous research showed that personality measures explain about 8% in self-estimated intelligence scores (Furnham & Dissou, 2007); these scores are systematically biased in subsamples and moderated by social comparisons, gender, experience with the tasks applied to assess the ability, and feedback (see Holling & Preckel, 2005, for an overview). Also, as already mentioned above, there is evidence for self-estimated intelligence having motivational effects like those of academic self-concept (e.g., Chamorro-Premuzic & Furnham, 2006a,b).

There are several gaps in the body of research that have directed us toward the simultaneous investigation of the relationships between self-estimated intelligence, conventional intelligence measures, self-concept components and achievement and the incremental predictive power of self-estimated intelligence over conventional intelligence measure. First and foremost, discussions on whether self-estimated intelligence is related to intelligence or personality (or both) domains are far from being over and empirical research is needed in the field (moreover, most studies focus on the relationship between self-estimated intelligence and personality traits but not other self-concept components). Second, the incremental predictive power of a self-estimated intelligence over conventional intelligence measures has also rarely been studied.

It is clear that people have perceptions not only of their own abilities, but of others' abilities as well. Kornilova et al. (2008) have designed a procedure that provides peer- and self-estimated intelligence scores for a group of students in a single short procedure. This procedure is based on ranking a student's classmates by intelligence[5] based on a list of the class. The specificity of this procedure is that no clear definition of intelligence or actual information about the distribution of intelligence scores in the population is given. The procedure, called Group Estimation of Intelligence (GEI), is built around: 1) a construct of implicit theories of intelligence[6] as a core concept in an individual's evaluation of his or her and others' abilities; 2) a social comparisons method, which does not require a participant to provide a numerical estimate of his or her intelligence, but rather compare it with the intelligence of reference group members, namely classmates.

These peer ratings may potentially be accurate for four main reasons. First, students observe their classmates in a variety of intellectually demanding achievement situations. These peer-estimates, just as self-estimates, may act as ability estimates and represent beliefs about someone's abilities. When many experts are involved, their combined scores may be even more precise than self-estimates—such use of multiple informants and the improved accuracy and predictive validity of the scores that come from multiple feedbacks, for example, underlie the 360-degree assessment technique (e.g., Craig & Hannum, 2006, but also see van Hooft, van der Flier, & Minne, 2006). Second, implicit theories of intelligence themselves represent beliefs about the types of valued behavior that are considered to be intelligent and lead to success (Sternberg, 2000). Third, since no operational definition of intelligence is given, these estimates possibly reflect beliefs about a broader range of abilities than encompassed by conventional notions of intelligence. These peer-estimates may reflect not only analytical, but other forms of intelligences as well (e.g., social, practical or emotional), thus tapping variance from multiple sources. Fourth, there is some evidence for motivational and self-fulfilling effects of other-estimates of abilities (see Furnham, 2001, for an overview): These self-fulfilling effects are often discussed in relation to the widely known Pygmalion effect.

Although there have been studies of subjective evaluations of intelligence focusing on self- and relatives-estimates of abilities, peer-estimates were somewhat excluded from this list (except for studies of relatively young children's perception of other children's abilities, e.g., Hughes & Zhang, 2007; Simpson & Rosenholtz, 1986; Stipek & Tannatt, 1984). The present study examines the incremental predictive validity of peer-estimated intelligence scores generated by multiple students over conventional intelligence measures and its relationship with actual and self-estimates of ability which the authors consider to be precise and predictive for the reasons mentioned above.

1.3. Dynamic regulative systems in learning and academic achievement

Although this study explicitly aims at revealing the predictive value of academic self-concept and self-estimated intelligence, it is important to note that within the cultural–historical and activity frameworks these components are viewed as functioning in the learning activity within

[4] The constructs are distinct yet similar in that both academic self-concept and self-estimated intelligence 1) include a person's perception either of himself or herself in an achievement situation (academic self-concept), or of his or her ability to perform well on intellectually demanding tasks (self-estimated intelligence). In the present paper, we view both as components of a higher-order self-concept factor (see Fig. 1).

[5] Note that students are asked to rank their classmates distinguishing between more or less smart ("umniy") peers. This "um" noun in Russian is not identical to and has a broader denotation than intelligence, namely, including characteristics of wit, reasonableness and intellect together.

[6] Whereas C. Dweck's concept of implicit theories generally reflects beliefs about nature, and thus malleability of intelligence, another meaning of this concept is possible and suggests that implicit theories represent beliefs about the content, structure and role of abilities in different life settings (Sternberg, 1995, 2000; see also Furnham, 1988).

dynamic regulative systems in which they are connected with other components of a self-concept and motivation.

Vygotsky's (1934/1962) idea that thought is born not from another thought, but from the motivating sphere of consciousness became a leading principle in understanding sense regulation of thinking (Tikhomirov, 1977, 1984/1988), with another level of regulation being related to self-consciousness: both self-evaluation and sense direct thinking in learning. In Russian psychology, this is reflected in the idea that the self-consciousness is a top level in the system of personality regulation of activity (Leontiev, 1975/1978; Stolin, 1983). Self-consciousness as a leading level in the activity-personality mediation of a person's interaction with the world may act as a form of self-control and motivate activity. This point of view was concretized in the development of A.N. Leontiev's activity theory approach (Smirnov, 2008; Stolin, 1983) suggesting that psychological studies of learning activity may attempt to reveal either structural (i.e., actions, operations, motives, goals) or dynamic systems (DRS) of its regulation. Motivation and self-consciousness interact in DRSs with cognitive components which function on both conscious and unconscious levels: these dynamic regulative systems may direct cognition in learning. For example, imagine a DRS that includes three components reflecting three levels of learning activity regulation: self-estimated intelligence (self-consciousness), intelligence (ability) and goal orientation (personality). Each one of these components can potentially be a leading one. Together, they constitute a set of possible dynamic regulative systems reflecting individual differences in these components and their combinations that have different impacts on academic achievement. For example, a student with certain level of intelligence that has ability level as leading in such DRS would benefit less from having high self-estimated intelligence, than a student with the same intelligence and self-consciousness level a leading one. Empirically, these concrete DRSs can be revealed in case studies; more general tendencies in DRSs, however, can be revealed via correlational analysis and structural equation modeling which explicate interrelations among intellectual and personality components of regulation of learning activity.

The learning activity in a university suggests multiple intellectual decisions. Not only intelligence contributes to the achievement of learning goals, but beliefs about which goals are reachable. These beliefs are, in turn, influenced by motivation and values, resulting in an emotional evaluation of specific goals that, along with beliefs about one's intellectual potential, includes the developing self-concept. Thus, not only abilities regulate learning activity, but so-called dynamic regulative systems in which different psychological attributes form an integrated whole, rather than being relatively independent and separate factors. Kornilova (2008; Kornilova & Smirnov, 2002) developed the DRS concept and showed how different regulative systems influence characteristics of thinking strategies in decision making and experimental learning (including concept formation). The present paper examines the impact of these DRSs as self-regulation units on academic achievement in a real-life university setting. We argue that dynamic regulative systems include both conscious and unconscious levels of psychological components, which are integrated by components of integral self-regulation, and that both levels include self-evaluation components.

Implicit components of a self-concept may correlate in this case with sense domain, which is only partially conscious. According to the activity approach, sense is a relation of a motive (unconscious; usually many motives form hierarchical structures that induce, motivate and direct the activity) to a goal (which is always conscious) and regulates one's attitudes towards learning. Thus, attitudes towards learning goals and beliefs about efforts put into learning activity may constitute general academic self-concept[7] along with one's beliefs about his or her academic

[7] For examples of both specific and general academic self-concept measures see Peterson and Whiteman's (2007) paper that demonstrates that such measures include along with "I am good at..." also "I am interested in...", "I like..." and "I enjoy..." descriptive items, which tap motivational components of academic self-concept.

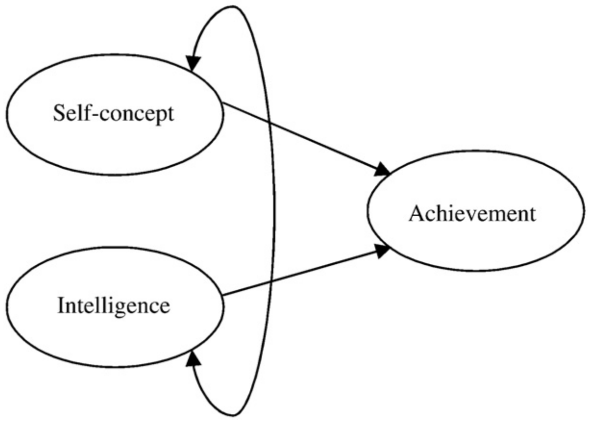

Fig. 1. A diagram for the model proposed by Kornilova (2008).

abilities (Kornilova et al., 2008), about place in the students' "hierarchy", and overall effectiveness as a subject of a learning activity. We also assume that self-estimated intelligence as a self-concept component is a component of a personality, rather than of a cognitive regulation of learning. Judge, Erez, Bono, and Thoresen (2002) suggested that higher-order constructs of core self-evaluations may be identified and used to predict performance if lower-order self-evaluation (i.e., academic self-concept and self-estimated intelligence in this study) constructs share common variance. Fig. 1 shows the initial model, proposed by Kornilova (2008). The present paper examines the validity of this model (as shown in Fig. 3) along with a more simple regression model predicting academic achievement (Fig. 2).

The following hypotheses will be tested in this study:

H1. Implicit theories of intelligence will correlate with other self-concept components, namely, the academic self-concept and the self-estimated intelligence.

H2. Implicit theories of intelligence and the academic self-concept will not be directly related to intelligence, whereas the self-estimated intelligence will positively correlate with intelligence.

H3. Implicit theories of intelligence and goal orientations will not be directly related to the achievement, whereas conventional and peer-estimates of intelligence and the academic self-concept will be positively related to achievement.

H4. Components of a self-concept and subjective evaluations of intelligence will have incremental predictive power over a conventional intelligence measure in predicting achievement.

H5. Measured and peer-estimated intelligence and the academic self-concept and self-estimated intelligence will form two distinct latent factors, respectively, and these correlated factors, as functioning within a dynamic regulative system, will predict achievement.

2. Method

2.1. Participants

Three hundred undergraduate students (73.7% female, the mean age was 19.48, SD = 1.98) from two departments at MSU (Moscow State University) participated in this study in return for course credit. The first group consisted of 224 psychology majors (83.5% female, Mean age = 19.62, SD = 2.29) taking an Experimental Psychology course and the second group were 76 biocomputer science and engineering majors (44.7% female, Mean age = 19.10, SD = .61) taking an introductory psychology course. All of the participants were white and reported "Russian" as their nationality or refused to report the latter

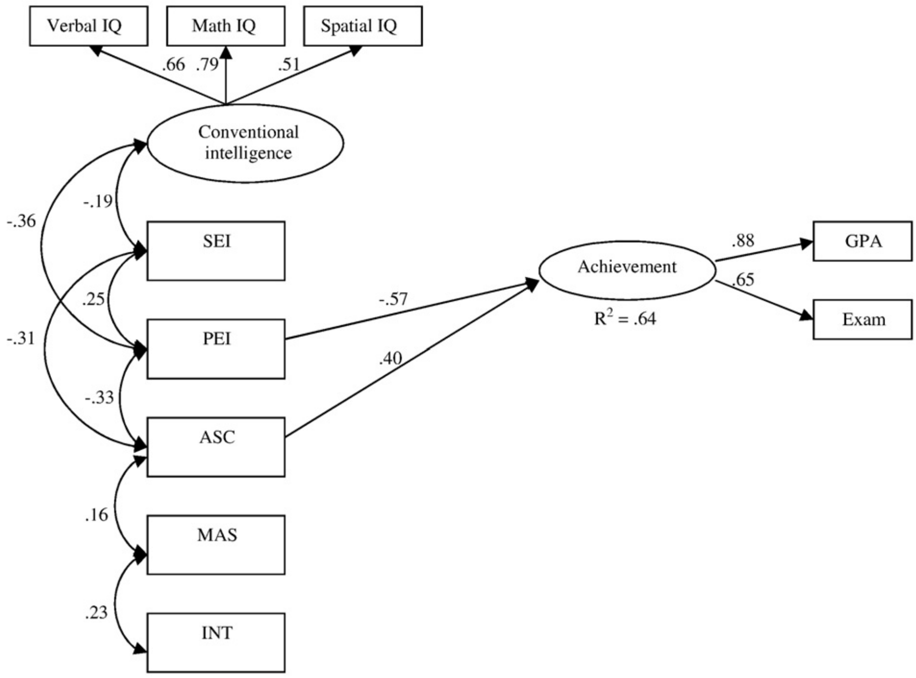

Fig. 2. A diagram for Model 1. SEI—Self-estimated intelligence; PEI—Peer-estimated intelligence; ASC—Academic self-concept; MAS—Goal orientation; INT—Implicit theories of intelligence.

(approximately 10% of the total *N*). The gender distribution in psychology students may seem surprising, but it is quite usual in the social sciences departments in MSU. Also, the department of biocomputer science and engineering is a relatively new department and this program only accepted a limited number of students, which was approximately three times smaller than the number of students in psychology programs.

2.2. Procedure

First, we administered the Implicit Theories Inventory to the students. The next week participants went through the GEI procedure. A week later, the participants completed the IST-70 test. At the end of the semester, academic achievement records were obtained. Students did not receive any feedback until the study was over. The total time of testing with both sections included was approximately 2 h.

We used correlational analysis to test H1–3, hierarchical linear regression to examine H4 and structural equation modeling to address the most complex H5.

The dataset for this study contained a significant amount of missing data due to the random absence of some participants at the time of testing or the absence of their achievement scores in the official records. 42.3% had all the variables used in further analysis, 12.3% had 1 variable missing, 14.3% had 2 variables missing and 32.1% had 3 or more variables missing.

All missing data in the sample were managed using the pairwise maximum likelihood (pairwise ML) method as implemented in EQS 6.1 (Bentler, 1995) software. The pairwise ML method (Savalei & Bentler, 2005) provides computed statistics for correlations based on all available cases that have scores on pairs of variables. Thus, it is possible to avoid case elimination and score imputation. Computed ML estimators are then corrected for non-normality as in the Satorra-Bentler approach. This method is known to provide accurate parameter estimates, but the test statistics may be somewhat inflated (Savalei & Bentler, 2005).

2.3. Measures

2.3.1. Academic achievement

We collected students' *GPA* for the three semesters through official transcripts as a baseline measure of academic achievement. For 44 students there were no records at the time this study was conducted. Preliminary analysis of the distribution of GPA scores ($M = 4.48$, $SD = .41$ on a 1 to 5 scale) has shown that it significantly differs from a normal distribution (Kolmogorov-Smirnov $Z = 1.661$, $p < 0.01$; skewness $= -.671$; kurtosis $= -.26$).

175 psychology majors also received a grade in an Experimental Psychology course (*EXP*; $M = 3.75$, $SD = 1.30$) and 70 biocomputer science majors received a grade in a Biochemistry course (*BIO*; $M = 4.11$, $SD = 1.06$). We used these measures as complementary to GPA for two reasons: 1) students rated these courses as the most difficult in the psychology and biocomputer science programs, respectively (data on students' ratings were obtained through the Educational Boards of the departments); 2) recent studies have shown that students at MSU (and in most cases—other universities as well) typically have a relatively high GPA ($M = 4.53$, $SD = .45$ as reported by Grigorenko & Kornilov, 2007) and the variance in GPA is quite limited; 3) these measures were collected at the end of the semester and, therefore, assume a significant time lag between going through the assessments used in this study and receiving a grade. Compared to GPA, the complementary measures as presented in a grade received for a difficult exam addressed more variance in academic achievement. Exam scores were also standardized within the two groups of students.

2.3.2. Implicit theories inventory

Implicit theories, goal orientations and academic self-concept were assessed using the Russian version of S. Smirnov's translation[8] of three of C. Dweck's (1999) brief questionnaires. Acceptance of the implicit theory of incremental intelligence (*INT*) and enriched personality (*PER*) reflect whether a student holds an "entity" or "incremental" theory of these attributes. For example, "entity theorists" believe that intelligence is a

[8] Although there was no back-translation of the inventory, we relied on the translator's expertise in English and would like to note that the original translation was done with the help of a proficient English-speaking psychologist. Moderate to high reliability scores and confirmed factor structure for the translated inventory were reported by Smirnov and his colleagues (Kornilova, Smirnov, Chumakova, Kornilov, & Novototskaya-Vlasova, 2008).

fixed trait; whereas "incremental theorists" tend to think that they would be able to improve their intellectual performance through learning and practice. Learning or mastery goals measure (*MAS*) reflects goal orientations: Mastery goals aim at increasing competence, whereas performance goals are related to confirming competence and avoiding negative judgments.

We have broadened the initial inventory by adding one more scale. Seven additional items form the *academic self-concept* scale (ASC). This measure represents a student's beliefs about the overall effectiveness of his or her learning activity and subjective value of efforts put into the learning activity, and whether a student tends to think that he or she is among successful students. For example, a student is asked to agree or disagree with the following statement: "You put forth maximum efforts to master knowledge and skills and that's why you're sure you'll become a high-level professional." Other items from this scale may be found in the Appendix A.

The combined inventory consists of 28 items and was first published in Russian by Kornilova et al. (2008). They have established the four-factor structure of the inventory and reported moderate reliability scores of .87 for the INT scale, .90 for the PER scale, .56 for the MAS scale, and .73 for the newly developed ASC scale. The study also showed the moderate ($r = .60$) predictive validity of the ASC scale in academic achievement.

2.3.3. Self-and peer-estimated intelligence

Previous research has shown higher validity for self-estimates of intelligence based on social comparisons than self-estimates that did not require such comparisons (Mabe & West, 1982). Unlike the traditional direct self-estimates of intelligence obtained through giving a numerical estimate of intelligence with reference to the normal distribution (Bennett, 1996; Furnham & Rawles, 1999) or a Likert-type scale (Fingerman & Perlmutter, 1994; Paulus et al., 1998), the Group Estimation of Intelligence (GEI) procedure facilitates social comparisons within a specific reference group. We asked students to rank themselves and their classmates by perceived "intelligence" using a class list, preliminarily having written which qualities a person whom they consider to be clever should possess. A weighted mean rank of a student in a group—a variable *of peer-estimated intelligence (PEI)*—is computed. The weighted rank that a student assigned to himself or herself is used as a measure of *self-estimated intelligence (SEI)*.

Students who participated in this study have spent at least two years together in classes of 20–30 students, inevitably observing and evaluating each other's successes and failures in learning. We assumed that the estimation of intelligence of one's classmates was primarily based on the evaluation of learning activities observed. However, the self-estimated intelligence scores can be influenced by an evaluation of a range of indicators of one's own intelligence unavailable to other individuals (i.e., beliefs about one's potential along with the present level of ability). Note that students underwent the GEI procedure prior to intelligence testing so that they could not base their estimations on feedback received from their classmates after the completion of the conventional intelligence test.

2.3.4. Cognitive ability

Intelligence was assessed with the IST-70 (Amthauer, 1973) test, which contains the following sub-scales: sentence completion, verbal classification, verbal analogies, and verbal concept formation (% of correct responses in these subtests is a *Verbal IQ* score); numerical tasks, and number series (*Mathematical IQ*); figure matching, and spatial orientation (*Spatial IQ*) and memory. Even though the latest version of this test is the IST-2000 R (Amthauer, Brocke, Liepmann, & Beauducel, 2001) and it is widely used in some European countries, its previous version, IST-70, has not been properly revised yet, though it remains the main test of general intelligence in Russia. Druzhinin (2007) reports test reliability scores obtained from numerous Russian studies ranging from .83 to .91, with a predictive validity of $r = .20–.89$.

The Russian version of the IST-70 intelligence test (Gurevich, Akimova, Kozlova, & Loginova, 1993) was administered in groups of ~20 students (total $N = 238$). The test contains abstract figural reasoning tasks as markers of fluid intelligence, and knowledge items as markers of crystallized intelligence, which form the three sub-scales mentioned above and the *General IQ* scale as well. Due to time limitations, we could not include the last subtest, memory, in our study. The test scores were normally distributed.

3. Results

3.1. Reliabilities

Internal-consistency reliabilities (α coefficient) for our combined Implicit Theories Inventory measures were .88 for the INT scale, .89 the PER scale, .56 for the MAS scale, and .76 for the ASC scale. These reliabilities are satisfactory and generally replicate those reported by Kornilova et al. (2008).

Table 1
Descriptive statistics.

Subgroup measure	Psychologists (women)	Psychologists (men)	Biocomputer scientists (women)	Biocomputer scientists (men)	Both samples combined
	Mean/S.D.				
The Implicit Theories Inventory					
(1) INT	6.60/5.70	8.40/6.67	7.12/5.40	6.67/8.04	6.93/6.19
(2) PER	1.03/5.84	6.21/7.21	1.10/7.36	3.06/7.85	2.05/6.76
(3) MAS	5.08/4.71	6.24/4.78	4.37/4.25	3.80/4.72	4.97/4.69
(4) ASC	8.21/5.36	5.14/5.64	7.17/6.66	4.31/5.37	7.08/5.75
The IST-70					
(1) General IQ	105.33/15.42	105.60/18.32	113.29/18.36	120.97/14.47	108.47/16.97
(2) Verbal IQ	66.92/8.65	65.65/9.77	68.79/7.98	70.75/9.91	67.49/9.00
(3) Math IQ	54.00/16.95	56.14/18.97	64.11/18.85	75.53/17.81	58.49/19.05
(4) Spatial IQ	55.40/13.04	56.86/15.83	60.89/16.19	65.23/11.78	57.63/14.08
The GEI procedure					
(1) SEI[a]	9.31/8.30	6.90/6.04	7.27/4.71	9.25/10.65	8.81/8.02
(2) PEI[a]	15.65/7.74	15.23/7.84	18.06/7.70	18.39/6.90	15.94/7.71
Academic achievement					
(1) GPA	4.53/.41	4.37/.42	4.50/.39	4.40/.40	4.48/.41
(2) Exam in a field of major	3.76/1.29	3.71/1.36	4.09/1.09	4.13/1.04	3.85/1.25

[a] Since both GEI measures are based on a ranking procedure, higher values of SEI and PEI represent lower self- and peer-estimations (e.g., the higher the value on the SEI, the lower the self-estimated intelligence score actually is).

For the IST-70 test, reliabilities were .67 for the total General IQ score (.46 for Verbal IQ, .87 for Mathematic IQ, and .70 for Spatial IQ). The verbal intelligence subtests of the Russian version of the IST-70 have not been revised for a long time and we expected their internal consistency to be lower.

3.2. Descriptive statistics

Table 1 shows descriptive statistics for all of the measures used in the study. Among all of the variables, the self-estimated intelligence scores, GPA and experimental psychology/biochemistry exam results were negatively skewed and distributed non-normally (Kolmogorov-Smirnov $Z=2.80$, 1.66, 2.92 and 2.50, respectively, $p<.01$).

3.3. Correlations

Tables 2 and 3 present correlations between the measures used in this study. Table 2 shows correlations for the total sample (psychologists and biocomputer scientists combined). Table 3 shows partial correlations between Implicit Theories Inventory measures, GEI measures and achievement, controlled for sex, age, verbal, mathematical, and spatial intelligences. Missing values were excluded pairwise. The next subsections discuss these tables.

3.3.1. Between implicit theories and self-concept measures

Based on previous research on achievement goals and implicit theories (e.g.,Dweck, 1999; Dupeyrat & Mariné, 2005; Elliot & Dweck, 1988, we expected that both measures of implicit theories would be significantly and positively correlated with mastery goal orientation ($r=.25$, $p<.01$, $n=239$ and $r=.22$, $p<.01$, $n=239$ for implicit theories of intelligence and personality, respectively).

The correlation between academic self-concept and self-estimated intelligence was −.33 ($p<.01$, $n=186$). This correlation, however, suggests positive relations between the two as, again, GEI constructs should be treated inversely.

3.3.2. Between implicit theories, self-concept measures and intelligence

Implicit theories of intelligence were not related to intelligence, as well as the academic self-concept measure.

Self- and peer-estimated intelligence correlated positively at .27 ($p<.01$, $n=207$).

Table 3
Partial intercorrelations (controlled for age, sex, field of study, verbal, mathematical and spatial intelligence) for combined sample.

Measures	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
The Implicit Theories Inventory								
(1) INT	1							
(2) PER	.52**	1						
(3) MAS	.25**	.18	1					
(4) ASC	.23**	.13	.18*	1				
The GEI procedure								
(5) SEI	−.09	.03	−.09	−.28**	1			
(6) PEI	−.07	−.02	−.10	−.45**	.22**	1		
Academic achievement								
(7) GPA	.00	−.05	−.11	.59**	−.23**	−.62**	1	
(8) Exam in a field of major	.16	.04	−.04	.43**	−.11*	−.42**	.62**	1

*P<.05.
**P<.01.

Both self-estimated and peer-estimated intelligence were positively related to General, and Verbal IQ (−.23, $p<.01$, $n=184$, −.32, $p<.01$, $n=184$, respectively, for SEI, and −.37, $p<.01$, $n=203$, −.30, $p<.01$, $n=203$, respectively, for PEI), but correlations with Math IQ and Spatial IQ were established only for peer-estimated intelligence (−.34, $p<.01$, $n=203$ and −.22, $p<.01$, $n=203$, respectively).

These results suggest that peer-estimated intelligence scores, probably due to their composition of numerous assessments of students' abilities by most of their classmates, encompass a wider range of abilities than self-estimated intelligence, and, according to stronger correlations, do so more accurately. Another reason for this pattern of results may be that peer- and self-estimates rely on distinct bases of evaluations.

3.3.3. Between all independent variables and achievement

Based on previous research in the field (e.g., Deary et al., 2007; Sternberg, 2003; Sternberg et al., 2001; Mackintosh, 2006), intelligence scores were expected to be positively related to achievement measures. General IQ, Verbal IQ, Math IQ positively correlated with students' GPA (.27, .24, .24, $p<.01$, $n=204$, respectively). However, only General and Verbal IQ (.15, .14, $p<.01$, $n=193$, respectively)

Table 2
Intercorrelations.[a]

Measures	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
The Implicit Theories Inventory												
(1) INT	1	245	239	245	209	209	209	209	187	212	213	209
(2) PER	.54**	1	239	245	209	209	209	209	186	211	213	208
(3) MAS	.25**	.22**	1	239	203	203	203	203	182	206	208	205
(4) ASC	.11	.07	.25**	1	209	209	209	209	186	211	213	208
The IST-70												
(5) General IQ	−.10	.04	−.11	.08	1	238	238	238	184	203	204	193
(6) Verbal IQ	−.05	.00	−.13	.06	.82**	1	238	238	184	203	204	193
(7) Math IQ	−.10	.06	−.09	.08	.84**	.52**	1	238	184	203	204	193
(8) Spatial IQ	−.08	.07	−.04	.04	.67**	.31**	.43**	1	184	203	204	193
The GEI procedure												
(9) SEI	−.06	.06	−.07	−.33**	−.23**	−.32**	−.14	−.02	1	207	175	167
(10) PEI	.08	.11	−.12	−.40**	−.37**	−.30**	−.34**	−.22**	.27**	1	215	209
Academic achievement												
(11) GPA	−.07	−.04	.02	.60**	.27**	.24**	.24**	.11	−.27**	−.66**	1	229
(12) Exam in a field of major	.03	.02	.11	.47**	.15*	.14	.14*	.04	−.18*	−.49**	.60**	1

*P<.05.
**P<.01.
[a] Below the diagonal are the correlations for the combined sample; the n's are presented above the diagonal.

appeared to be related to exam results. This may have happened due to low and non-significant correlations between intelligence measures and exam results for the biocomputer science majors.

From all of the Implicit Theories Inventory variables only the academic self-concept scale positively and significantly correlated with GPA (.60, $p<.01$, $n=213$) and exam results (.47, $p<.01$, $n=208$). When age, sex, intelligence and field of study were controlled, the correlations remained significant and lowered a little (.59 and .43 for GPA and exam, respectively).

The correlations between self-estimated intelligence and achievement in the total sample were −.27 ($p<.01$, $n=175$) for GPA and −.18 ($p<.05$, $n=167$) for exam results, but were non-significant for biocomputer science majors. Partial correlations were $r=-.23$ ($p<.01$) and $r=-.11$ ($p<.05$).

Peer-estimated intelligence correlated with GPA at $r=-.65$ ($p<.01$, $n=215$) and exam results at $r=-.43$ ($p<.01$, $n=209$) with partial correlations of −.62 and .42, respectively.

Neither implicit theories of intelligence and personality, nor goal orientations were directly related to achievement.

Table 4
Hierarchical regressions: Test-, self-, peer-estimated intelligence, implicit theories, goal orientations, and academic self-concept predict GPA.

	β	t	Model summary
Model 1			Adj. $R^2=.01$
Sex	−.12	−1.58	$F(2,172)=1.94$
Age	−.07	−.93	MS = 1.91, .99
Model 2			Adj. $R^2=.08$
Sex	−.19*	−2.44	$F(5,169)=4.08$**
Age	−.00	−.01	MS = 3.73, .91
Verbal IQ	.14	1.59	R^2 change for IQ scales
Mathematical IQ	.21*	2.24	$\Delta R^2=.09$
Spatial IQ	.01	.06	
Model 3			Adj. $R^2=.11$
Sex	−.20*	−2.62	$F(6,168)=4.65$**
Age	−.01	−.18	MS = 4.12, .89
Verbal IQ	.08	.93	R^2 change for SEI
Mathematical IQ	.21*	2.31	$\Delta R^2=.04$
Spatial IQ	.01	.06	
SEI	−.19*	−2.61	
Model 4			Adj. $R^2=.35$
Sex	−.16*	−2.49	$F(7,167)=14.37$**
Age	.10	1.51	MS = 9.31, .65
Verbal IQ	.08	1.06	R^2 change for PEI
Mathematical IQ	.12	1.53	$\Delta R^2=.23$
Spatial IQ	−.04	−.53	
SEI	−.03	−.40	
PEI	−.54**	−7.90	
Model 5			Adj. $R^2=.34$
Sex	−.17*	−2.56	$F(10,164)=9.97$**
Age	.10	1.49	MS = 6.55, .66
Verbal IQ	.08	1.01	R^2 change for INT, PER, MAS
Mathematical IQ	.12	1.46	$\Delta R^2=.00$
Spatial IQ	−.04	−.58	
SEI	−.04	−.52	
PEI	−.55**	−7.79	
INT	−.04	−.48	
PER	.06	.73	
MAS	−.02	−.25	
Model 6			Adj. $R^2=.50$
Sex	−.01	−.11	$F(11,163)=16.81$**
Age	.04	.71	MS = 8.37, .50
Verbal IQ	.11	1.67	R^2 change for ASC
Mathematical IQ	.06	.85	$\Delta R^2=.15$
Spatial IQ	−.04	−.65	
SEI	.06	1.03	
PEI	−.38**	−5.91	
INT	−.06	−.83	
PER	.00	.05	
MAS	−.10	−1.69	
ASC	.48**	7.31	

*$P<.05$.
**$P<.01$.

3.4. Regression analysis

Hierarchical regressions were performed to investigate the incremental predictive validity of self-, peer-estimated intelligence and academic self-concept over the conventional intelligence measure. The results are summarized in Table 4.

Sex and age were entered in the first step and these demographic variables predicted about 1% of the variance of GPA. Conventional intelligence variables, entered in the second step, added 7% more to the explanatory power of the model. Self-estimated intelligence had an incremental predictive power of about 3%. Neither implicit theories nor goal orientations had significant predictive power. The most dramatic increase in predictive power occurred when peer-estimated intelligence scores and academic self-concept were entered into the model (24% and 16% of the unique variance explained, respectively). Thus, as predicted, academic self-concept as a self-concept component in the learning domain exerted a significant predictive power over other measures in this study.

3.5. Structural equation modeling

To integrate the patterns of relationships between the independent and dependent variables discussed in the above sections, we have fitted a number of structural equation models. These models attempted to predict the academic achievement of the students based on our measures of conventional, self-, peer-estimated intelligence and academic self-concept.

However, we must note that the results presented below and summarized in Table 5 should be interpreted with caution due to a large amount of missing data and a relatively small sample size.

3.5.1. Model 1

First, we fitted a simple regression model (Model 1). In this model, we specified two latent variables, each of which was determined by multiple indicators. First, conventional intelligence was defined through three IQ variables, namely, Verbal IQ, Math IQ and Spatial IQ. The achievement factor was defined by the GPA and exam variables. In this model, independent variables correlated and the achievement factor was regressed on the conventional, self-, peer-estimated intelligence and academic self-concept variables. The overall fit of the model was satisfactory ($\chi^2(31)=43.90$, $p=.06$, RMSEA = .037, CFI = .97). Together, peer-estimated intelligence and academic self-concept explained 65% of the achievement variance.

3.5.2. Model 2

Second, we defined a model, initially proposed by Kornilova (2008; as shown in Fig. 1) in terms of the variables in our study. In this model, four latent factors are introduced. The achievement factor is that of the previous model; the intelligence factor is comprised of conventional intelligence (a latent factor as in the previous model) and peer-estimated intelligence; the last factor, self-concept, is defined by self-estimated intelligence and academic self-concept. The two main factors, self-concept and intelligence, are correlated and predict achievement.

The fitted model is shown in Fig. 3. The model provided satisfactory fit ($\chi^2(16)=24.28$, $p=.08$, RMSEA = .042, CFI = .98). In general, the model suggests that the relationship between self-estimated and psychometric intelligence scores is also mediated by a correlation between higher-order factors of intelligence and self-concept. Together, intelligence and self-concept factors had the predictive validity of 75% of the variance in academic achievement.

4. Discussion

This study explored the relationship between implicit theories, goal orientations, subjective evaluations of intelligence, conventional intelligence measure, academic self-concept, and achievement. It attempted

Table 5
Model fit statistics and parameter estimates from the two fitted models.

Variable	Model 1	Variable	Model 2
Conventional intelligence: Verbal IQ	.66	Conventional intelligence: Verbal IQ	.63
Conventional intelligence: Math IQ	.79	Conventional intelligence: Math IQ	.83
Conventional intelligence: Spatial IQ	.51	Conventional intelligence: Spatial IQ	.52
Conventional intelligence: SEI	−.19	Intelligence: Conventional intelligence	−.41
Conventional intelligence: PEI	−.36	Intelligence: PEI	.94
Achievement: GPA	.88	Self-concept: ASC	.84
Achievement: Exam	.65	Self-concept: SEI	.39
SEI: PEI	.25	Achievement: GPA	.89
ASC: SEI	−.31	Achievement: Exam	.66
ASC: PEI	−.33	Intelligence: Achievement	−.52
PEI: Achievement	−.57	Self-concept: Achievement	.48
ASC: Achievement	.40	Intelligence: Self-concept	−.50
Model fit			
Scaled (Satorra-Bentler) χ^2	43.90 (31) $P = .06$		24.28 (16) $P = .08$
RMSEA	.037 (.000 .061)		.042 (.000 .073)
CFI	.97		.98

to investigate three main ideas: 1) That implicit theories of intelligence and goal orientations have no direct impact on achievement; 2) That subjective evaluations of intelligence and academic self-concept may have an incremental predictive power over a conventional IQ measure; 3) That self-estimated intelligence and academic self-concept may be viewed as indicators of a latent factor of self-concept, whereas peer-estimated intelligence and conventional IQ form a latent factor of intelligence, and these two correlated factors may predict achievement.

Implict theories of intelligence and personality were interrelated and correlated with goal orientations but neither had direct impact on academic achievement. The significant relationship observed between implicit theories and goal orientations in this study replicates the results of the previous studies (Dupeyrat & Mariné, 2005; Elliot & Dweck, 1988; Elliot & McGregor, 2001), which show that students with incremental theories of intelligence and personality tend to adopt mastery versus performance goals. The absence of any significant direct relationship between implicit theories and other components of self-concept, namely, academic self-concept and self-estimated intelligence is consistent with the Dweck's (1999) theory and suggests that implicit theories that are less conscious than self-concept function relatively autonomously of the latter (Leontiev, 1975/1978; Stolin, 1983; Tikhomirov, 1969, 1984/1988). This study also contributes to a growing body of evidence that implicit theories of intelligence and goal orientations may have no direct impact on students' achievement (at least not in a selective student sample). According to Dweck's (1999) model, holding an incremental implicit theory of intelligence does not necessarily directly lead to improved achievement: This relationship is rather mediated by an adoption of mastery versus performance goal orientation. However, studies of the relationship between implicit theories and goal orientations yielded mixed and inconsistent results (e.g., Hayamizu & Weiner, 1991; Stipek & Gralinski, 1996) suggesting that this relationship may be not as strong as predicted in Dweck's theory. Moreover, goal orientations' impact on achievement may be indirect and mediated by the use of deep-processing learning strategies (e.g., Greene & Miller, 1996; Nolen & Haladyna, 1990), increased persistence, effort expenditure and perceived competence (Dupeyrat & Mariné, 2005; Ford et al., 1998; Leondari & Gialamas, 2002), which is in line with the significant positive relationship between the academic self-concept (which includes perceived competence as a component) and goal orientations found in the present study, and with the hypothesized interactive effect between goal orientations and academic ability self-concept (e.g., Butler, 1992; Smiley & Dweck, 1994). In one recent study on the effect of this interaction on actual achievement outcomes, Spinath and Stiensmeier-Pelster (2003) confirmed that goal orientations should not be viewed as directly affecting achievement, but that the interaction between goal orientation and ability self-concept predicts achievement with low perceived task-specific ability leading to avoidance strategies whereas high ability self-concept fosters ability demonstration.

As predicted, neither implicit theories of intelligence nor academic self-concept was directly related to intelligence estimates, unlike the self-estimated intelligence which reflects the level of an individual's insight into his or her level of abilities, implicit beliefs about the content of these abilities and one's perceived place in the hierarchy within a particular group of students. Although these self-evaluations are generally argued to be relatively accurate (Furnham & Chamorro-Premuzic, 2004, Furnham, 2001), it is worth noting that in the present study this accuracy only applied to general and verbal intelligence, meaning that students primarily relied on evaluations of general and verbal factors when assessing their overall "smartness." This result implies that students hold beliefs about the greater importance of verbal and general rather than numerical or spatial ability in their academic achievement, and this is in line with the findings suggesting that both g and verbal ability are highly predictive of a variety of important outcomes, including educational attainment, academic achievement and job performance (e.g., Gottfredson, 1997; Kuncel,

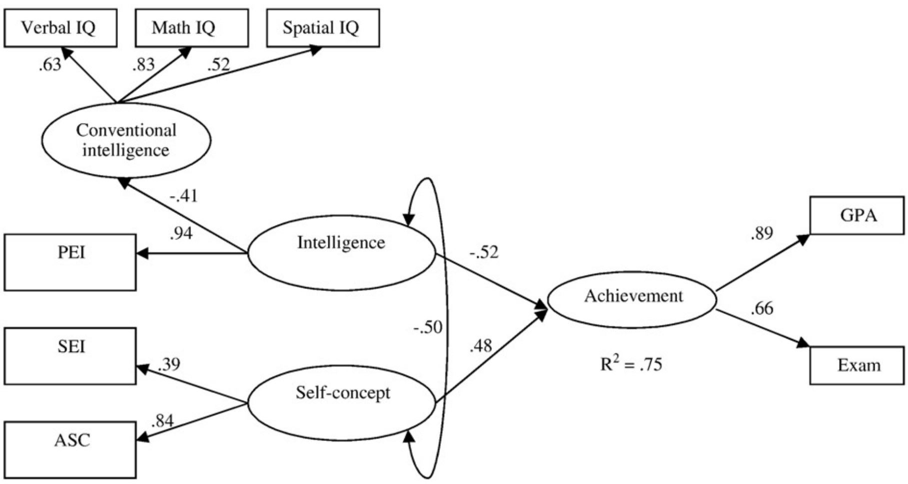

Fig. 3. A diagram for Model 2. SEI—Self-estimated intelligence; PEI—Peer-estimated intelligence; ASC—Academic self-concept.

Hezlett, & Ones, 2004; Mackintosh, 2006). Moreover, general problem-solving skills are viewed as essential components of intelligence in implicit theories studies (e.g., Raty & Snellman, 1992; Sternberg, 1985, 2000). The results obtained in this study also expand the notion of self-estimated intelligence itself: Although others suggest that self-estimated intelligence may be viewed as a subjective IQ measure that is validated against academic performance (Chamorro-Premuzic & Furnham, 2006a,b), in our study self-estimated intelligence positively correlated not only with psychometric intelligence, but with academic self-concept as well. Moreover, the model proposed in this study provided evidence for viewing self-estimated intelligence as a component of a self-concept along with academic self-concept, confirming that self-estimated intelligence is related to personality measures (Chamorro-Premuzic, Furnham, & Moutafi, 2004; Chamorro-Premuzic, Moutafi, & Furnham, 2005) and contributes to a higher-order factor of a general academic self-concept, although in other studies this overlap was smaller (e.g., Peterson & Whiteman, 2007).

The study also examined the relationship between psychometric intelligence, subjective evaluations of intelligence and achievement and found that both psychometric intelligence and its subjective estimates were related to achievement. The coefficients were comparable for self-estimated and psychometric intelligence and were dramatically higher for peer-estimated intelligence. Students have insight into the level not only of their own, but of others' abilities as well, and evaluations based on this accurate insight are highly predictive of academic achievement even when controlled for conventional measures of IQ. The fact that peer-estimates proved to be more predictive than self-estimates, that is, were more accurate and tapped a wider range of abilities (i.e., including numerical and spatial intelligence versus general/verbal scores for self-estimates) can be interpreted in a few ways. We think that although obtained through the single procedure, peer- and self-estimates of intelligence are based on different criteria. Both peer- and self-estimates inevitably rely on lay conceptions of abilities, but peer-estimates seem to incorporate a wider range of ability-related criteria (i.e., including non-academic forms of intelligence, see Sternberg, 1985, 2003; Gardner, 1983, 1999, for an overview) and overall evaluation of activities and achievements seen as crucial for academic success (i.e., overall goal achievement, various educational outcomes, participation in extracurricular activities). Although this study included neither "subjective" nor "objective" measures of nontraditional forms of intelligence (e.g., practical, creative or emotional intelligence) and studies have shown that conventional IQ measures are believed to be the best predictors of the self-estimated overall intelligence (see Furnham, 2001, for an overview), the pattern may differ for peer-estimates in general or peer-estimates within a selective population: i.e., students may explicitly or implicitly believe that "traditional" analytical intelligence has already played its major role in their educational placement but may have less impact on their subsequent academic achievement.

Finally, the study revealed the incremental predictive value of subjective evaluations of intelligence and academic self-concept over conventional intelligence in predicting achievement. In this study, peer-estimated intelligence and academic self-concept had the largest contribution to achievement. When sex, age, and intelligence were taken into account, subjective evaluations of intelligence and academic self-concept accounted for an additional 42% of the variance in GPA. Note that when peer-estimated intelligence was entered into the model, general intelligence and self-estimated intelligence lost their predictive power, which speaks in favor of assuming that peer-estimated intelligence measure encompasses a wider range of ability and non-ability criteria than conventional and even self-estimated intelligence, as mentioned above. The significant positive relationship between academic self-concept and achievement obtained in this study is consistent with a growing body of research documenting positive correlations between academic self-concept and achievement (Hansford & Hattie, 1982; Marsh, 1987, 1993; Marsh et al., 2005; Skaalvik & Hagtvet, 1990), although in this study the relationship is notably stronger ($r = .60$). The interpretation of the causal ordering between academic self-concept and achievement has important theoretical and practical implications and is discussed within three major approaches (see Marsh et al., 2005, for an overview; see also Calsyn & Kenny, 1977): the skill development model implies that academic self-concept is a consequence of academic achievement; according to the self-enhancement model, academic self-concept determines achievement; the recently developed reciprocal effects model states that prior achievement affects subsequent academic self-concept and vice versa, and strong support has been found for this model (e.g., Marsh, 1990b; Marsh & O'Mara, 2008; Marsh et al., 2005). As predicted (e.g., Marsh & Yeung, 1997, 1998), the present study also shows that the relationship between academic self-concept and achievement and the predictive value of self-concept components is especially strong when achievement is based on high-stakes grades in a highly-selective population of university students.

A more general interpretation of the results obtained in this study is possible within the dynamic regulative systems framework (Kornilova, 2008; Kornilova & Smirnov, 2002). When examining these systems, a researcher may include different processes and a different number of processes in a model of the regulation of learning activity. Evaluated effects will change depending on the presence of other processes defined through other variables (representing both ability and personality constructs) in the model. For example, the present study did not include direct motivation measures (although academic self-concept measure used in this study included some descriptive components related to motivation) and the models presented in the study may have changed if it did. However, structural equation models fitted in this study showed that latent factors of intelligence and self-concept are significantly and positively related and together explain about 75% of the variance in the latent achievement factor, suggesting: 1) The usefulness of viewing self-estimated intelligence as a personality measure rather than a cognitive measure; 2) That there are different criteria underlying self- and peer-estimates of intelligence; 3) The significant incremental predictive power of subjective evaluations of intelligence and academic self-concept; 4) The need to take the interactions between cognitive and personality domains in learning and academic achievement into account.

One of the main advantages, and, at the same time, limitations of this study is the selective nature of the sample of students that participated in this study. Psychology and biocomputer science programs in Moscow State University are both highly competitive and we did not expect our students to have a wide distribution in intelligence or achievement scores or low achievement motivation (Grigorenko & Kornilov, 2007; Kornilova et al., 2008). We also expected that the selective nature of the sample would restrict the extent to which conventional intelligence measures might predict achievement, since educational placement in competitive programs is very concerned with evaluating students' general reasoning ability. Furthermore, students in selective populations may be viewed as having just the required level of this ability. Thus, the major part of the variance in achievement would be attributed to other constructs that are not assessed when evaluating a prospective student. It is possible that in other samples the academic self-concept measure would be less predictive of achievement than in our sample, which is a priori considered to have higher level of abilities (essential for the achievement in the given context) than the general population. The second limitation is that the measure of goal orientations in this study did not take into account the recent research on goal framework suggesting a wider range of goals instead of the learning-performance goals dichotomy (i.e., mastery-performance × approach–avoidance models, Elliot & Harackiewicz, 1996; Elliot & McGregor, 2001). Also, the GEI measure used in this study differed from the procedures that are most commonly used for measuring self-estimated intelligence aimed at providing direct estimates (Bennett, 1996; Fingerman & Perlmutter, 1994; Furnham & Rawles, 1999). The GEI procedure provides no quantitative comparable scores for single individuals outside of some group context, and this context itself may affect the scores in differing samples. Also, as pointed out earlier, the relatively small sample size and unexpectedly high percentage of missing data may have affected the results of the structural equation modeling, which should be treated with caution.

However, this study may have important implications for both psychology and education domains. Constructive feedback given in academic achievement situations is preferred for promoting the perceived competence and the more general self-concept in learning. Although there are some concerns about the importance of self-beliefs (e.g., Baumeister, Campbell, Krueger, & Vohs, 2003), the general idea of promoting self-confidence and self-esteem in educational domains, which have been shown to predict global outcomes though only to a limited extent (see Swann, Chang-Schneider, & Larsen McClarty, 2007, for an overview), still needs further investigation. Promoting academic self-concept clearly has important direct and indirect implications (see Marsh & O'Mara, 2008, for an overview): These include, as mentioned above, reduced test anxiety, reduced dropping out of the institution and longer educational attainment. Additionally, even though implicit theories of intelligence have been shown to not influence academic achievement directly in our selective student population, the fact that they were related to goal orientations, which in turn, were related to the academic self-concept, suggests that learning about these implicit theories and developing the “growth mindset” (Dweck, 2006) may eventually result in better achievement. On the other hand, in the research domain, subjective evaluations of intelligence may be considered as incremental measures of abilities concerning their significant incremental predictive power. Moreover, even though the use of peer-estimates of intelligence may raise some ethical questions, they can be highly predictive of both the achievement and actual ability scores.

Our results are largely consistent with the recent research suggesting the significant predictive value of self-concept components when studying achievement in university students, documenting the incremental predictive value of the subjective evaluations of abilities that may and do tap a wider range of abilities (and achievement criteria) than conventional intelligence measures. The study also joins a growing body of literature, suggesting that more research into the interaction of ability and personality domains in learning and academic achievement is needed.

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Appendix A. The Academic Self-Concept Scale items

Directions: Using the scale below, please indicate the extent to which you agree or disagree with each of the following statements by writing the number that corresponds to your opinion in the space next to each statement.

1	2	3	4	5	6
Strongly Agree	Agree	Mostly Agree	Mostly Disagree	Disagree	Strongly Disagree

1. You often have to force yourself to start doing another academic task.
2. You use your abilities in learning only to a limited extent.
3. You cannot be said to be a well-achieving student.
4. You rarely experience joy from learning, especially if it requires a lot of effort.

*5. You put forth maximum efforts to master knowledge and skills and that's why you're sure you'll become a high-level professional.

*6. You enjoy completing all academic tasks in time and at a high level.

*7. Generally, you receive “excellent” grades.

*Reversed scoring.

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