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On Subject Variations in Achievement Motivations: A Study in Business Subjects

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Abstract Student achievement motivations are crucial in learning in two ways: as a determinant and an aim of learning. In this study, we focus on two related questions with regard to achievement motivations: to what extent are they subject-specific, and to what extent are they malleable? Answers to both questions are especially important when aiming to influence motivations. Malleability of motivation is studied by designing structural equation models that explain achievement motivation out of the most stable student characteristics one can think of: gender, and personality traits. Subject matter variability is studied by estimating these models for five main subject areas in a business program. The motivation construct we use is based on the expectancy-value model and distinguishes four different facets: cognitive competence, difficulty, task-value and affect. We find evidence for strong subject-specificity and considerable non-malleability of achievement motivation; part of that last aspect is a remarkably constant over-confidence gender gap present in the data of the calibration of competency beliefs and performance in all subject areas.

Keywords Achievement motivations · Expectancy-value model · Personality factors · Gender effects · Subject domains · Structural equation models · Calibration

Introduction

How much does ‘subject matter’ matter? From a theoretical perspective, a lot: the ‘trend toward greater domain specificity in the educational psychology literature’ (Alexander 2006, p. 91) is one of the dominant trends in learning and teaching in general, and the role of achievement motivations in this in particular. However, that theoretical framework is still far from finished. ‘Yet, we are sadly short on theory when it comes to the alignment of domain beliefs and motivations. … How should the interplay of domain beliefs and motivations be configured? How would that configuration change across domains …?’

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(Buehl and Alexander 2009, p. 495) suggests that we are only at the very first stage of understanding subject-specific achievement motivations. From the empirical perspective, there is ample evidence that subject matters matter. E.g., both self-efficacy beliefs (Schunk and Pajares 2009) and competency beliefs (Wigfield et al. 2009) demonstrate subject-specificity in empirical studies. Yet, many of these studies focus on very diverse subjects and beliefs of relative young pupils, like the investigation of beliefs and motivations for a highly varied range of subjects as mathematics, reading, sports, or music amongst children and adolescents in middle and high school. In comparison, 'empirical work examining aspects of the college classrooms is not as extensive as those focused on elementary and middle school classrooms' (Maehr and Zusho 2009). Such studies would not only focus on older students, but should also address the issue of subject-specificity when subjects are much closer in nature within the spectrum spanned by e.g. math and music.

This paper discusses several aspects of subject-specificity of domain beliefs and achievement motivations within such a context: that of subjects composing a university curriculum in business studies. It is motivated by some recent studies on the role of subject matter in management education. Kolb and Kolb (2005) provide an example of the large body of literature analyzing the relationships between business disciplines and student's learning orientations, purporting that business disciplines have their own academic traditions and therefore pose varying demands on students. And expanding this line of research to a broader range of learning determinants, Burke and Moore (2003) conclude that students' learning motivations to organizational behavior compare unfavorably to learning motivations to accounting and computing, while students' learning orientations to these three subjects are relatively constant. And Ottewill and Macfarlane (2003) conclude that business students distinguish themselves from students in other fields by being much stronger extrinsically motivated. From studies of this type, it is however not easy to isolate pure subject effects, since effects found in these studies are likely a composition of both subject effects and individual difference effects. If indeed business students are more stimulated by external goals, such as job prospects or career considerations, rather than by discipline-related characteristics, is this a subject-effect, or is it the (selection-) effect of different students opting for different tracks or programs, or a combination of the two? To be able to isolate the subject effect itself, a different research design is needed than the one adopted in many studies investigating the relationship between student learning and discipline (see e.g. the review Loo 2002), where students having opted for different majors are compared: one that investigates subject specific beliefs over a range of subjects amongst one and the same students.

Domain Specificity: Subject-Matter Areas in Business Programs

The overall purpose of this article is to investigate the variation in domain beliefs and achievement motivations for subjects that are part of a business curriculum. Business programs offer an attractive field of application for research in subject specificity since such programs are grounded in three scientific disciplines: mathematics, economics, and behavioral science (Kolb and Kolb 2005). Students learn about statistics, the most prominent mathematical subject in a business program. Additionally, students also complete coursework in economic subjects such as finance and accounting as well as three subjects grounded in behavioral science. Through this choice, a full coverage of potential domain structures is achieved, from well-structured domains as mathematics and economics to ill-structured domains as the behavioral sciences (e.g., Lawless and Kulikowich 2006). In this context, we investigate the subject-specific and multi-dimensional nature of

domain beliefs and achievement motivations. Domain specificity is investigated at the level of categories of subjects as defined by the three dimensional scheme of Biglan, based on the Schommer-Aikins classification: hard–soft, pure–applied, and nonlife–life (Biglan 1973a, b; Burke and Moore 2003; Schommer-Aikins et al. 2003; Smart and Elton 1982).

Models of Achievement Motivation

The prototype models of achievement motivation are laid out in Atkinson's "Theory of Achievement Motivation" and Lewin's "Resultant Valence Theory" (Graham and Williams 2009; Pintrich and Schunk 2002). In these models, performance choices are described as the outcome of an optimization problem by rational human beings. Atkinson's model, for example, regards behavior as a function of the three components: motives, probability of success, and incentive value. All of these components describe personal characteristics. Hence, people come to different performance choices not because the mechanism of choosing is different, but because of individual differences in motives, perceived probability of success, and incentive value. Atkinson's and Lewin's prototype models developed into the contemporary expectancy-value models for achievement motivation in classroom settings (Pintrich and Schunk 2002; Wigfield et al. 2009). Expectancy-value models take their name from the key role of two components in the motivation to perform an achievement task: students' expectancies for success, and the task value, that is the value they attribute to succeeding the task. These are basically two of the three components in Atkinson's model, leaving out the affective motives component. In contemporary expectancy-value models (Pintrich and Schunk 2002; Wigfield and Eccles 2000, 2002; Wigfield et al. 2009), the expectancy component consists of two subcomponents: students' self-perceptions of ability or competence, and students' judgments of the difficulty of the task. Empirical work based on the expectancy-value model, investigating students' motivations for a wide range of subjects, has found that competency beliefs and achievement values are clearly distinct constructs (e.g., Wigfield and Eccles 2000).

Schau's Expectancy-Value Model

The expectancy-value model has met with some criticism (e.g., Pintrich and Schunk 2002; Pintrich and Zusho 2007), because it lacks affective constructs in comparison with the achievement motivation model developed by Atkinson. This criticism gave way to the development of versions of the expectancy-value model that incorporate an affective construct, as e.g. the model by Schau and co-authors (Dauphinee et al. 1997; Hilton et al. 2004; Schau 2003; Schau et al. 1995). Schau's expectancy-value model contains four constructs. The first two expectancy factors deal with students' beliefs about their own ability and perceived task difficulty: Cognitive Competence and Difficulty. The third construct is the subjective task-value: Value. Together, these three constructs constitute the contemporary expectancy-value model (Pintrich and Schunk 2002; Wigfield and Eccles 2000, 2002). In addition to task-value, Schau and co-authors introduced a second task-related factor: Affect. Schau's four-factor model of achievement motivations thus strongly resembles early operationalizations of expectancy-value theory, such as Atkinson's model, and mirrors Pintrich's and Zusho's (2007) advice regarding the composition of expectancy-value models: 'Three general components seem to be important in these different models: (a) beliefs about one's ability or skill to perform the task (expectancy component); (b) beliefs about the importance and value of the task (value components), and (c) feelings about the self, or emotional reactions to the task (affective components)' (Pintrich and

Zusho 2007, p. 766). The re-introduction of the affective component is also motivated by the vast evidence of the role of affective factors in learning in mathematics-related domains. Statistics being the single mathematical subject in many social science studies, it is hypothesized that task-related affective attitudes toward statistics are an important component of achievement motivations (Schau 2003). Empirical research within the domain of statistics (Dauphinee et al. 1997; Hilton et al. 2004; Schau et al. 1995) supports the distinction of Affect and Value. Earlier research by the authors, Tempelaar et al. (2007), provides evidence of the relevance of Schau's model in other domains than statistics. In the framework of theories on learning in academic domains (Alexander 2006; Buehl and Alexander 2009), factors as perceived task difficulty and value are more a domain belief, than a motivation; however, we will mostly address the ensemble of four expectancy-value factors shortly as students' motivations.

Personality Factors

Empirical research into the relationship between personality factors and achievement motivations is limited. Generally, such research focuses on goal orientation behavior. Judge and Ilies (2002) reported positive relations for the personality factors conscientiousness and emotional stability with goal-setting motivation. Day et al. (2003) investigated the relation between personality factors and goal-orientation. They found learning goal orientation to be positively influenced by conscientiousness, emotional stability and especially intellect, but performance goal orientation to be negatively influenced by the same three personality factors and in addition by extraversion. Vermetten et al. (2001), studying goal orientations in the framework of ego, task, and effort orientation, found intellect to be a predictor of task orientation, and conscientiousness and agreeability to be predictors of effort orientation. In a recent study investigating the relationship between a multi-dimensional self-concept measure, Big 5 personality factors, and course achievements, Marsh et al. (2006) found conscientiousness to be positively related, and intellect to be negatively related, to math self-concept. Following the main-stream approach in personality research, we adopted the Big 5 conceptualization of personality (Marsh et al. 2006) that distinguishes five major dimensions of personality. The first dimension is indicated as Agreeableness, and comprises aspects of agreeableness, conformity, docility, and friendliness at one end of the dimension, and indifference to others, and self-centeredness at the other end. The second dimension, Conscientiousness, is to be interpreted as the will to achieve. Dimension three, Extraversion, is often referred to as surgency. It contains extraversion and introversion as the two ends. The fourth dimension, Emotional Stability, expresses level of emotional control at one end. At the other end of the dimension, Neuroticism is used to label this dimension. The fifth dimension, Intellect, has been interpreted as intellect, intelligence, and openness to experience at one end. At the other end, the dimension characterizes thinking that is considered closed to new experiences with less cognitive flexibility.

Gender

Learning processes are known to be gendered phenomena (see e.g. Alexander (2006), Hyde and Durik (2005), Meece et al. (2009), and Pintrich and Zusho (2007) in a general context, or Arbaugh (2000), for examples in the context of management learning). The role of gender refers both the learning process itself, and determinants of the learning process. For example, Costa et al. (2001), report gender differences in personality factors to be

pervasive but subtle in size. The most consistent patterns they found are: agreeableness seems to be a predominantly female personality factor, and emotional stability a predominantly male personality factor. Gender patterns found in achievement motivations are as consistent as personality factors, but somewhat more complex in nature. Firstly, both research in expectancy-value based motivations and research in students' self-concept show differences in motivations according to gender, depending on the type of subject (Alexander 2006; Marsh and Yeung 1996; Meece et al. 2009; Shotick and Stephens 2006; Wigfield and Eccles 2000). These differences correspond with the position of those subjects along the pure and hard versus applied and soft dimensions: male students are in general more strongly motivated for mathematics and sciences, while female students have a stronger motivation for languages. A second difference refers to the kind of motivation: male students tend to be relatively more self-confident than female students, even for subjects where females tend to outperform males (Alexander 2006; Marsh and Yeung 1996; Wigfield and Eccles 2000).

Research Questions

In an earlier study (Tempelaar et al. 2007), we established that domain beliefs and motivations in different business subjects are multi-dimensional, i.e. vary over subjects. Moreover, we found that subject-specific motivations contain a generic part that explains 30–40% of the variation, the remaining part being truly specific for the particular business subject. Except for being multi-dimensional, subject motivations are multi-faceted, i.e. can be decomposed in several components, such as competence, task value, and interest. This decomposition appears not to be invariant over subjects, as does the relationship between student characteristics and these components of motivations. This phenomenon was modeled in Tempelaar et al. (2007) as subject-specific relationships between student personality traits and motivations.

In this paper, we take the investigation into subject-specificity of motivational constructs some important steps further, firstly by studying the additional impact of gender in these relationships. To the extent that gender and personality traits, generally viewed as the most outspoken stable student characteristics, act as determinants of students' motivations, the scope for pedagogy will become meager: the ability to influence motivations demands at least malleability of its determinants. In addition to gender, the present study also introduces academic achievements. In doing so we closely follow the 3P modeling approach of Prosser and Trigwell (1999). This allows raising a second type of questions, relevant for the pedagogical challenge: even if we can influence students' subject specific motivations, does it matter to do so: do increased student motivations raise course performance? And if it does: are all facets of subject motivation equally important in determining course performance?

The combination of gender, competency beliefs and achievement data enables to put the issue of subject-specificity in a different light. As a third type of question, we will investigate the role of subjects in a phenomenon that has been addressed in a range of learning studies under different names as over-optimism, self-serving bias or (lack of) calibration. Perry and colleagues (Haynes et al. 2006; Perry et al. 2001) have investigated within an attribution theoretic context the risk students run in the transition from high school to college when their perceived control is at unrealistic high levels. Such over-optimism may be the outcome of what is described as self-serving bias in the attribution theory framework: the tendency to take personal responsibility for successes, but deny responsibility for failures (Alexander 2006; Weiner 1992). In the context of studies on

self-efficacy beliefs, this is termed calibration of efficacy beliefs, based on the disparity of one's sense of efficacy of performing in a subject or task, and ones actual performance (Hacker and Bol 2004; Zimmerman and Moylan 2009). All these studies suggest that being over-optimistic or under-confident may be an individual difference characteristic, depending e.g. on low or high achieving, and gender. To the extent this is the case, over-optimism contains a component that is not subject-specific. This contrasts other studies in both the areas of attribution theory and self-efficacy beliefs, see e.g. Alderman (2004), Wigfield and Eccles (2002), and Shotick and Stephens (2006), that aim to classify subjects and tasks according to gender gaps in self-efficacy beliefs, in order to discover in what areas motivational interventions are most needed for to address the largest gaps between male and female students' self-efficacy levels. That is, these studies implicitly assume that variation in self-efficacy levels is (dominantly) subject or task-specific. Since the educational implications of both types of explanations are very different, it is worthwhile investigating the generic versus subject-specific nature of the calibration or over-optimism mechanism.

Method

Model

In the present study, a modeling approach is applied that closely resembles the 'Presage-Process-Product modeling approach of classroom learning' that was developed by Biggs (1993, 1999) and elaborated by Prosser and Trigwell (1999). According to this 3P modeling approach, learning is seen as a progression from presage (teaching context) through process (teaching acts) to products (class achievement). The approach distinguishes several building blocks in explaining learning outcomes. The presage contains two building blocks, of which the first, Characteristics of the Student, contains student-based factors developed from an individual differences perspective in psychology on student learning. The second building block, Learning and Teaching Context, builds on traditional staff-developmental models, and focuses on teacher behavior. The Process building block derives from information processing psychology, and focuses on the process, such as strategies for handling the task, and the efficiency with which basic cognitive strategies are developed. The Product building block refers to outcomes of student learning. The complete model integrates teaching-based, student-based and process-based approaches to learning. Our modeling approach also fits the framework proposed by Pintrich and Zusho (2007), based on the five model components (A) Personal Characteristics, (B) Classroom Context, (C) Motivational Processes, (D) Self-Regulatory Processes, and (E) Outcomes, with the annotation that the fourth component, the self-regulatory processes of the students, is not made explicit in our model.

In our study, the presage contains with regard to students' characteristics both gender and personality traits. Two further prominent personal characteristics components, age and ethnicity (Pintrich and Zusho 2007) are not adopted, since our sample demonstrates very little variation in these directions. Other presage components are the characteristics of five subjects from a business curriculum as the learning context, and the instructional method of problem-based learning as the teaching context. Since the whole business program is based on the same technology of problem-based learning, this part of the teaching context reduces to one factor being invariant over subjects. Following Arbaugh (2005) and Burke and Moore (2003), we will adopt course performance as product: the main outcome

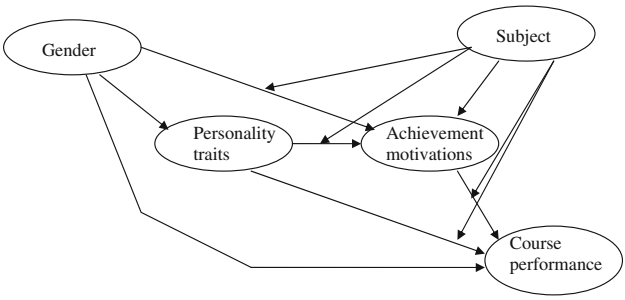

Fig. 1 Model structure with direct impacts of subject on achievement motivations levels, and indirect impacts on structural relationships

variable of the learning process. In identifying the process component, we will follow Snow's 'aptitudes for learning' taxonomy (Snow et al. 1996). In that taxonomy three modes of mental functioning are distinguished: the cognitive mode, the affective mode, and the mode of conation or volition. Students' beliefs and motivations are prime components of both the affective and conative modes. The role that motivations play in learning is twofold: they have a direct impact on the learning process, and in addition have an indirect impact through cognitive factors like learning orientations (Alexander 2006). Our approach to identify subject-specific motivations for achievement is similar to the one of Burke and Moore (2003) and based on the expectancy-value framework; the next subsection provides more details on that approach.

The primary focus of this study is on the relationship between subjects and students' motivations, thereby assuming that this relationship can take different forms: subjects can directly influence motivations, but also impact the relationships between students' characteristics and students' motivation, and the relationships between motivation and outcomes. Therefore, the structure of the model applied in this study is the one depicted in Fig. 1.

A secondary focus of our study is on the malleability of motivations. In contemporary views on education, it is well-accepted that motivational concepts act not only as inputs of learning processes, but also as outputs. Good teaching aims at cognitive attainments, as well as at affective ones, such as raising student motivation. This second goal brings forward the issue of malleability: in order to be able to steer motivations into the desired direction, they should be malleable. To find the very minimum of malleable motivations, students' characteristics are operationalized by the most stable aspects one can think of: gender and personality traits. To the extent that these stable background characteristics do explain achievement motivations, there is little room for attaining instructional goals in that aspect.

Measures

Subject Achievement Motivations

Achievement motivations for business subjects are measured with an instrument derived from the Survey of Attitudes Toward Statistics (SATS) developed by Schau and co-authors (Dauphinee et al. 1997; Hilton et al. 2004; Schau et al. 1995). The instrument is based on expectancy-value theory as the interpretative framework to understand formation of motivations (Eccles and Wigfield 2002; Wigfield and Eccles 2000, 2002). The SATS

instrument measures four aspects of students' motivations: two expectancy factors that deal with students' beliefs about their own ability and perceived task difficulty: Cognitive Competence and Difficulty, and two subjective task-value constructs that encompass students' beliefs and attitudes about the value of the subject: Affect and Value. The naming of the Difficulty scale is somewhat counterintuitive, since in contrast to other scales, lower scores and not higher scores correspond to higher levels of conceived difficulty. Therefore, the scale is mostly addressed with 'lack of Difficulty' in the next sections. Validation research has shown that a four-factor structure provides a good description of responses to the SATS-instrument in two very large samples of undergraduate students (Dauphinee et al. 1997; Hilton et al. 2004) for the subject statistics. Subsequently, the adequacy of the SATS-instrument for measuring achievement motivations for business subjects has been demonstrated in Tempelaar et al. (2007).

Personality

As a personality instrument, the 50-item version of the IPIP Big 5 factor unipolar markers (Goldberg 2010; Goldberg et al. 2006; Gow et al. 2005) is used. The instrument consists of ten items for each of the Big 5 personality factors: Extraversion, Agreeableness, Conscientiousness, Emotional Stability (the opposite pole of Neuroticism) and Intellect (sometimes labeled as Openness to Experience). The instrument is considered to be an important standard in the field of personality research and is freely available on the internet (Goldberg 2010; Goldberg et al. 2006).

Course Performance

As single indicator for course performance, the grade in the final written exam is used in four subject courses (the courses delivered in semesters 3 and 4, see Table 1). Only for one course, Business Statistics, multiple performance indicators are available: subtopic scores (statistics and mathematics), and scores for different assessment instruments applied in the performance portfolio: final written exam, quizzes, homework. To fully employ the richness of these performance data, all indicators are included in the measurement model for Business Statistics performance.

Participants

In order to disentangle true discipline related aspects in motivations from aspects related to students attracted by these disciplines, a research design is required focusing on students taking part in the education of a range of courses belonging to several disciplines, so that

Table 1 Partial outline of undergraduate program with courses and survey response

Period	Course names	SATS response	SATS and Big 5 response
Semester 1/2	Business Statistics	$N = 972$	$N = 522$
Semester 3	Business Strategy	$N = 368$	$N = 332$
Semester 3	Finance & Accounting	$N = 372$	$N = 287$
Semester 4	Marketing Management	$N = 291$	$N = 248$
Semester 4	Organization & HRM	$N = 304$	$N = 249$

one source of variation (the student) is kept constant, and measured differences are attributable to discipline differences only. The natural environment for such a research setup is provided in large undergraduate programs. Students, who have taken introductory courses in several disciplines, can be assessed in their approach to disciplines when taking subsequent courses at intermediate level before deciding upon their major. Therefore, in this study students are followed who participate in the second year of the program "International Business" of Maastricht University. The school offering that program is one of the less than 50 business schools in the world that possess a so-called 'triple accreditation': accredited by the AACSB, the Association to Advance Collegiate Schools of Business, the AMBA, the Association of MBAs, and the EQUIS, the European Quality Improvement System. That triple accreditation implies amongst other things that the program is congruent with main stream views of business education. The instructional context of the program is that of problem-based learning: a student-centered learning approach based on collaborative learning in small groups of students, steered by open-ended problems (Wilkerson and Gijselaers 1996). In their second year, students take required intermediate level courses in core business and auxiliary subjects before choosing a major. In four of these courses, three business cores and the economics oriented Finance & Accounting, a large majority of students participated in a survey on subject achievement motivations. Table 1 presents a partial outline of the curriculum of this undergraduate program, the timing, and the response of the motivation assessments.

Before entering the second year, these students, together with students of a parallel economics program, take required courses in the same subjects at introductory level, and some more service courses. Our research started in one of these service courses: the first year course in quantitative methods, a required introduction into mathematics and statistics for all business and economics students, with approximately 1000 students participating. In that course, the very first subject achievement motivations questionnaire is administered assessing achievement motivations for statistics, with 972 responses, and the personality survey, with 522 responses. Of those 972 respondents, 574 (59%) are male and 393 (40%) are female. Other relevant decompositions of the sample are: 522 students (54%) have a Dutch secondary school diploma, while 427 students (44%) have non-Dutch diplomas (most of them of German nationality).

All motivation surveys were administered in the very first session of each of the courses, to ensure that responses reflect students' beliefs and motivations toward the academic subject only and are not influenced by impressions of the educational process. All courses are intermediate level courses. Hence measured subject motivations may be regarded as students' motivations for subjects resulting from learning similar subjects at introductory level. The personality factors are measured once, in the first semester, and are therefore only available for students who take courses in the advised order, which is no requirement, what explains the lower numbers in the second column of Table 1.

Procedure

Classification of Business Subjects

In order to identify possible patterns in differences in subject motivations, a classification of these subjects is needed. One of the best-known classification schemes is the three dimensional scheme of Biglan, based on the Schommer-Aikins classification: hard–soft, pure–applied, and nonlife–life (see Biglan 1973a, b; Schommer-Aikins et al. 2003; Smart and Elton 1982). Of the five subjects in our study, statistics is the single mathematical

subject. Although not taking the polar position of mathematics, it is indisputably the most hard and pure subject in this study. The other extreme (relative in our study) is taken by the three business-oriented subjects that are grounded in behavioral science, namely Business Strategy, Marketing Management, and Organization & HRM. Due to the empirical focus of their central problems, these subjects satisfy most of the characteristics of the position of being soft & applied & life. In contrast, Finance & Accounting, the single economics based course under study, represent axiomatic based subjects, and for that reason demonstrates strong similarities to statistics with regard to all three dimensions hard versus soft, pure versus applied, and life versus non-life. Hence, given the choice of curriculum subjects in this study, we can reduce the three-dimensional scheme to a one-dimensional ordering (compare with, e.g., Burke and Moore 2003): hard & pure & non-life as one pole of the spectrum, against soft & applied & life as the other pole. In this scheme, the three business subjects take the polar position of being strongest ill-structured and complex. In contrast, the subject statistics takes the position of strongest well-structured, rule-based, with the subject accounting and finance at short distance.

Data Analysis

Parceling

We followed data analysis procedures as described by Schau et al. (1995), Dauphinee et al. (1997), and Hilton et al. (2004) in their empirical analyses of SATS data. That includes the adoption of item parceling based on balancing with respect to the positively and negatively worded items, size of parcel means, standard deviations, and skew (see Schau et al. 1995). The parceling scheme for the Big 5 data was based on the same mechanism of balancing positively and negatively worded items. Because items included in the Big 5 are in alternating order in terms of their wording, it was decided to parcel the ten items per subscale into five parcels each consisting of a pair of consecutive items (see Tempelaar et al. 2007, for a more elaborate discussion of this and other methodological issues).

Goodness of Fit

With large sample sizes as in our study, the χ^2 test statistic is prone to model rejection in virtually any formal test of significance (Byrne 1998; Marsh and Yeung 1996). Following the seminal work on cutoff criteria for fit indexes of Hu and Bentler (1999), emphasis is placed on the root mean square error of approximation (RMSEA), the standardized root mean squared residual (SRMR), and the Comparative Fit Index (CFI). The choice for a cutoff value close to 0.90 for CFI; a cutoff value close to 0.08 for SRMR; and a cutoff value close to 0.06 for RMSEA, appears to provide best guarantees for good fit (see the simulation studies performed by Hu and Bentler (1999)). The combination of these three cutoff criteria will therefore be used as the main method for model evaluation in this study. Since in empirical research in achievement motivations other researchers have used additional fit indexes, see for instance Marsh and Yeung (1996), and Hilton et al. (2004), three more indexes will be reported: the Non-Normed Fit Index (NNFI; termed Tucker-Lewis Index or TLI in Marsh and Yeung (1996)), the Goodness-of-Fit Index (GFI), and the Relative Fit Index (RFI, termed Relative Noncentrality Index or RNI in Marsh and Yeung (1996)).

Statistical Analyses

This study integrates several techniques of structural equation modeling (SEM). In applications like this one, where all measurements take place through self-report questionnaires, measured scales of psychological constructs contain a measurement error component of an unknown size that is likely to vary over different instruments. If measurement error is present but not accounted for in the model estimation step, this might have serious consequences (Schumacker and Lomax 2004). Therefore, all constructs under study are assumed to contain measurement errors, making the SEM approach appropriate. Models were estimated with LISREL (version 8.72) using maximum likelihood estimation.

Full structural models are composed of measurement parts and structural parts. In agreement with the widely advocated two-step model building approach (see, e.g., Schumacker and Lomax 2004), the measurement models are estimated prior to the estimation of the structural model. Measurement models, both for achievement motivations and personality traits, can be characterized as correlated traits (CT), first-order confirmatory factor analysis (CFA) models. Gender effects in structural equation models are investigated through a sequence of invariance tests, whereby models excluding gender effects are compared with models including gender effects on the basis of differences in fit (Byrne 1998). Two main types of a breakdown of gender invariance can be distinguished: where levels of constructs demonstrate a gender effect, but the structural model itself is still invariant, and the case where gender effects are present in both levels and the structural model based on the covariance structure. Before investigating gender effects in the structural equation context, the presence of gender effects in levels will be analyzed with independent samples *t*-tests. From those tests, percentage differences, *t*-values, and *d*-values or Cohen effect-sizes will be reported. The advantage of *d*-values over *t*-values is that they are independent of sample size. *D*-values larger or equal to 0.8, 0.5, and 0.2, respectively, correspond to differences being large, medium, and small in size (Cohen 1988).

Results: Models for Achievement Motivations Across Domain Subjects

Genderedness of Achievement Motivations for Academic Subjects and its Determinants

The present study investigates the existence of gender effects in students' achievement motivations in a range of academic subjects that demonstrate stronger similarity than subjects investigated in most research: all our subjects are part of a business curriculum. In this section, we will focus on the analysis of gender differences in levels of achievement motivations, leaving gender effects in relationships of motivations to other variables to the third section. A level analysis of data available in our study indicates the generic research findings to become corroborated into business subjects. Along with traditional descriptive statistics, Table 2 describes the numerical outcomes of the several tests on gender effects, and Fig. 2 graphs the scale means of female and male students of all subject-specific achievement motivations. In Fig. 2, the order of academic subjects is chosen such that the two pure subjects, the economics based Finance & Accounting and the mathematics based Business Statistics, are grouped on the left hand side, whereas the three applied subjects, the business oriented courses Marketing Management, Business Strategy, and Organization & HRM, are grouped on the right hand side.

Table 2 Scale descriptives and measures of gender differences for achievement motivations

Likert 1–7 scales	Female mean	Male mean	SD	Cronbach α	% Gender difference	*t*-Value	*d*-Value
Affect							
Business Statistics	4.28	4.58	0.94	0.81	−6.50	−4.88	−0.32
Business Strategy	5.47	5.56	0.76	0.75	−1.60	−1.06	−0.12
Finance & Accounting	3.72	4.25	1.13	0.88	−12.41	−3.93	−0.48
Marketing Management	5.43	5.43	0.76	0.80	0.07	0.04	0.01
Organization & HRM	5.52	5.21	0.71	0.75	5.96	3.57	0.46
Cognitive Competence							
Business Statistics	4.57	4.94	0.81	0.72	−7.40	−7.07	−0.47
Business Strategy	5.50	5.75	0.70	0.75	−4.36	−3.34	−0.38
Finance & Accounting	4.19	4.68	0.95	0.84	−10.46	−4.40	−0.53
Marketing Management	5.34	5.49	0.73	0.81	−2.67	−1.52	−0.20
Organization & HRM	5.33	5.28	0.70	0.73	0.94	0.57	0.07
Value							
Business Statistics	5.03	5.07	0.73	0.78	−0.64	−0.68	−0.05
Business Strategy	5.62	5.53	0.71	0.81	1.70	1.21	0.14
Finance & Accounting	4.70	4.94	0.91	0.82	−4.84	−2.23	−0.27
Marketing Management	5.60	5.39	0.74	0.87	3.95	2.27	0.30
Organization & HRM	5.39	5.09	0.73	0.88	5.96	3.22	0.41
Difficulty							
Business Statistics	3.43	3.61	0.65	0.67	−4.81	−4.05	−0.27
Business Strategy	4.32	4.39	0.73	0.74	−1.66	−0.90	−0.10
Finance & Accounting	2.75	2.88	0.69	0.77	−4.58	−1.61	−0.20
Marketing Management	4.19	4.28	0.66	0.73	−2.00	−1.01	−0.13
Organization & HRM	4.53	4.53	0.68	0.76	0.08	0.04	0.01

From both exhibits, two conclusions are apparent. In the two pure subjects Business Statistics and Finance & Accounting, male students express more positive levels of achievement motivations than female students. Differences are largest and strongly statistically significant for Affect and Cognitive Competence, but still substantive for Value and (lack of) Difficulty. The pattern for the applied subjects Marketing Management, Business Strategy, and Organization & HRM, is mixed: gender differences are much smaller, and in both directions, indicating that, relative to male students, female students have higher motivation levels for applied business subjects, than for pure non-business subjects.

The next table, Table 3, contains corresponding descriptive statistics for personality traits and course performances.

Combining results from the two tables, some further conclusions can be drawn. The largest gender differences favoring male students are found in the competency belief Cognitive Competence. However, this self-reported confidence does not translate itself into better academic performance: female students outperform male students in all course performance measures, except two: the topic parts statistics and math of the final exam of the hard subject Business Statistics. The several partial course performance measures for Business Statistics demonstrate in themselves a clear pattern: both effort-based Homework

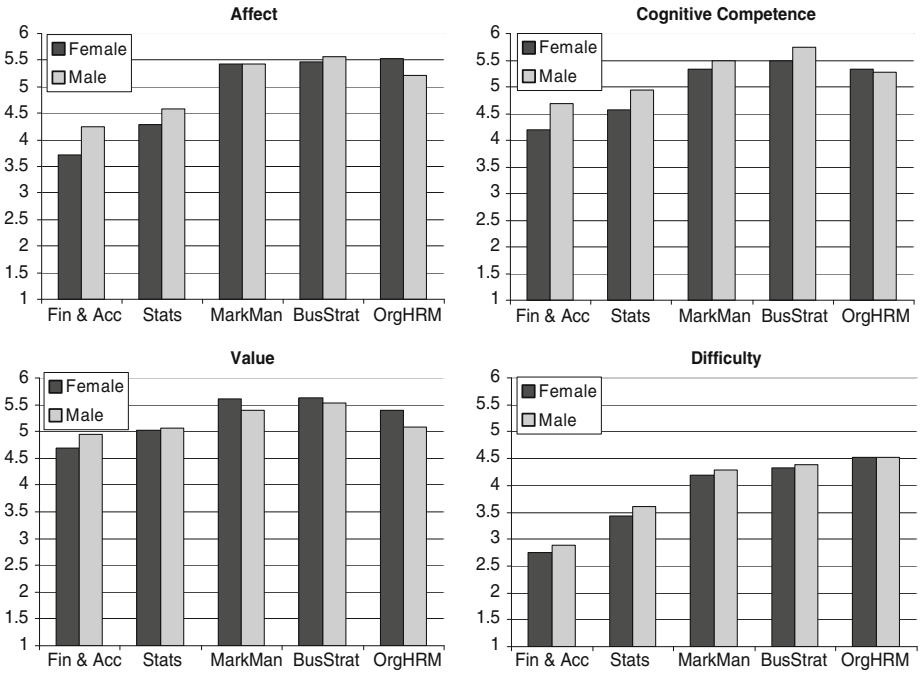

Fig. 2 Female and male mean attitudes scores of subjects Finance & Accounting, Statistics, Marketing Management, Business Strategy, and Organization & HRM

Table 3 Scale means and measures of gender differences for personality traits and course performance

	Female mean	Male mean	SD	Cronbach α	% Gender difference	*t*-Value	*d*-Value
Big 5 Personality (1–5)							
Extraversion	3.33	3.47	0.59	0.83	−4.03	−2.70	−0.24
Agreeableness	3.86	3.67	0.44	0.70	5.18	5.28	0.47
Conscientiousness	3.42	3.38	0.53	0.77	1.18	0.94	0.08
Emotional Stability	3.06	3.35	0.58	0.74	−8.66	−5.68	−0.51
Intellect	3.29	3.50	0.47	0.74	−6.00	−5.30	−0.47
Course performance (1–10)							
Math Exam	5.52	5.95	3.56		−7.13	−2.70	−0.24
Statistics Exam	6.62	6.97	2.82		−5.00	−2.80	−0.25
Statistics Quiz	5.75	5.63	1.35	0.99	2.22	1.05	0.09
Math Homework	6.58	6.29	1.21	0.73	4.72	2.89	0.26
Statistics Homework	5.11	4.80	1.48	0.72	6.52	3.03	0.27
Business Strategy	6.25	6.00	1.30		4.22	1.54	0.20
Finance & Accounting	5.81	5.73	1.80		1.50	0.36	0.05
Marketing Management	5.58	5.18	1.50		7.63	1.98	0.27
Organization & HRM	6.59	6.00	1.64		9.91	2.73	0.37

indicators demonstrate a gender effect favoring female students, the indicator Quiz a somewhat less pronounced gender effect, and both cognitive based Exam indicators demonstrate a gender effect of opposite direction. When performance indicators and competency belief measures are combined into one measure that expresses the gender effect in calibration or 'over-confidence' (subtracting percentage gender difference in Cognitive Competence from percentage gender difference in course performance), the resulting measure is remarkably stable over subjects: Business Statistics 9.62%, Business Strategy 8.58%, Finance & Accounting 11.96%, Marketing Management 10.30%, and Organization & HRM 8.97% (for Business Statistics, the quiz indicator was chosen to measure performance, that indicator taking the median position of gender difference in competency beliefs). So whilst competency beliefs and performance are both subject-dependent and gendered, the combined effect expressed as calibration gap is not subject dependent, but only gendered, and demonstrates minor fluctuations around a substantive 10% over-confidence of males relative to females. Finally, self-reported personality traits levels for males exceed those for females for Extraversion, Emotional Stability, and Intellect. The exception to the pattern is Agreeableness, with scores for Conscientiousness being rather similar.

In all, gender effects in subject-specific achievement motivations appear to be substantial. The investigation of gender effects is not an aim in itself, but serves to demonstrate that any pedagogy aiming to improve students' achievement motivations has its limitations in the non-malleability of its determinants. In the next section, we will demonstrate that gender is not the sole non-malleable determinant of achievement motivation: students' personality traits provide another example.

Structural Models for Personality Traits, Achievement Motivations, and Course Performance in a Range of Subjects

Before continuing the analysis of gender invariance in terms of covariance structures in the next section, we will derive covariance structure models for all subjects in this section. In agreement with the two-step approach of estimating structural equation models, measurement models for personality factors, subject-specific achievement motivations, and course performance are estimated prior to the estimation of the full structural model. We will focus on reporting of the full models in this paper, and refer to Tempelaar et al. (2007) for characteristics of the measurement models. All measurement models demonstrate adequate fit, and the measurement models for achievement motivations are non-invariant over subjects: Different subjects are described by different factor models, whereby especially the correlations between motivations depend on subjects. For that reason, full structural models were estimated for all subjects separately. Table 4 contains fit indices of all five subject models, indicating that all subject models have adequate fit, given the size of the models.

In the remainder of this section, all five subject models will be discussed, starting with the applied business subjects. Figure 3 describes the structural equation model for the subject Organization & HRM. The left hand side of the exhibit contains the measurement model of students' personality traits; that part is identical in all subject models. Curved arrows in the left part indicate that latent traits are correlated, with especially Intelligence demonstrating strong correlations with Extraversion and Agreeableness. Not all pairs of traits are however correlated: correlations between Extraversion and Conscientiousness, and between Agreeableness and Emotional stability, are not statistically different from zero, and are therefore restricted to zero in all final models. The right hand side of Fig. 3

Table 4 Fit indices of four-factor confirmatory factor models for five subjects

	χ^2	df	RMSEA	SRMR	GFI	NNFI	CFI	RFI
Business Statistics	1997	1043	0.044	0.062	0.86	0.95	0.95	0.89
Business Strategy	35	22	0.041	0.036	0.98	0.99	0.99	0.97
Finance & Accounting	892	540	0.050	0.080	0.83	0.94	0.94	0.85
Marketing Management	849	539	0.047	0.077	0.83	0.94	0.95	0.85
Organization & HRM	912	538	0.052	0.076	0.82	0.92	0.93	0.83

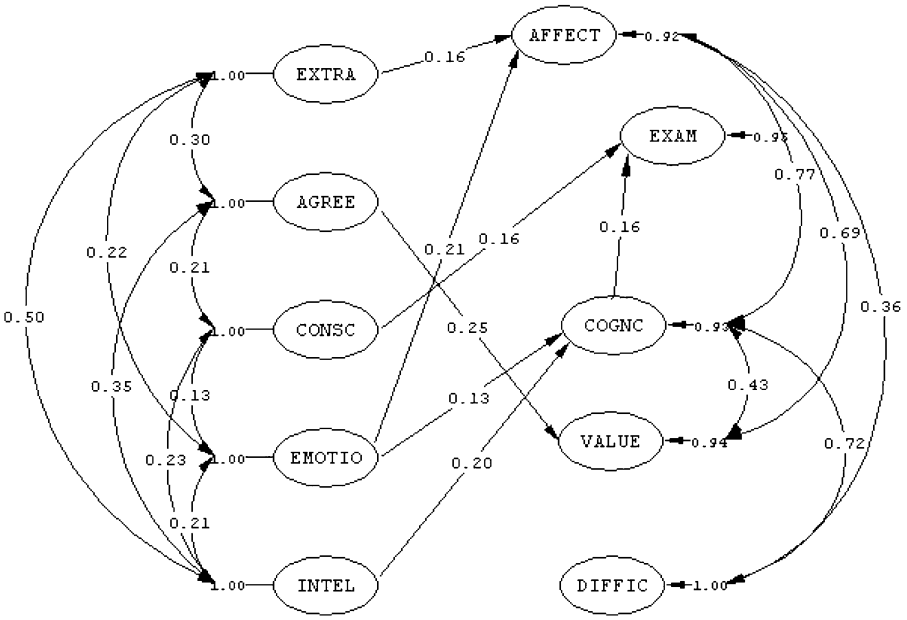

Fig. 3 Structural equation model for Organization & HRM. Values are standardized parameter estimates. All values shown are statistically significant, $p < 0.05$. *EXTRA* Extraversion, *AGREE* Agreeableness, *CONSC* Conscientiousness, *EMOTIO* Emotional Stability, *INTEL* Openness, *DIFFIC* Difficulty, *AFFECT* Affect, *COGNC* Cognitive Competence, *VALUE Value*, *EXAM* Course Performance

contains the measurement model of students' achievement motivations, and the single indicator for course performance. Again, latent motivation factors are correlated, except for one pair: Value appears to be unrelated to (lack of perceived) Difficulty, for all subjects. Strong correlations are present amongst the three constructs Affect, Cognitive Competence, and Value, and in the pair Cognitive Competence and (lack of) Difficulty. Both measurement models are composed of relationships that are statistically highly significant: *p*-values of correlations between latent factors are below 0.001, with the exception of the Conscientiousness–Emotional stability correlation, that is only significant at the 0.05 level. Significance levels in the measurement parts in the other subject models are similar, with *p*-values always being lower than 0.001, except for the specified correlation; for that reason, no further details on significance of relations being part of measurement models will be provided.

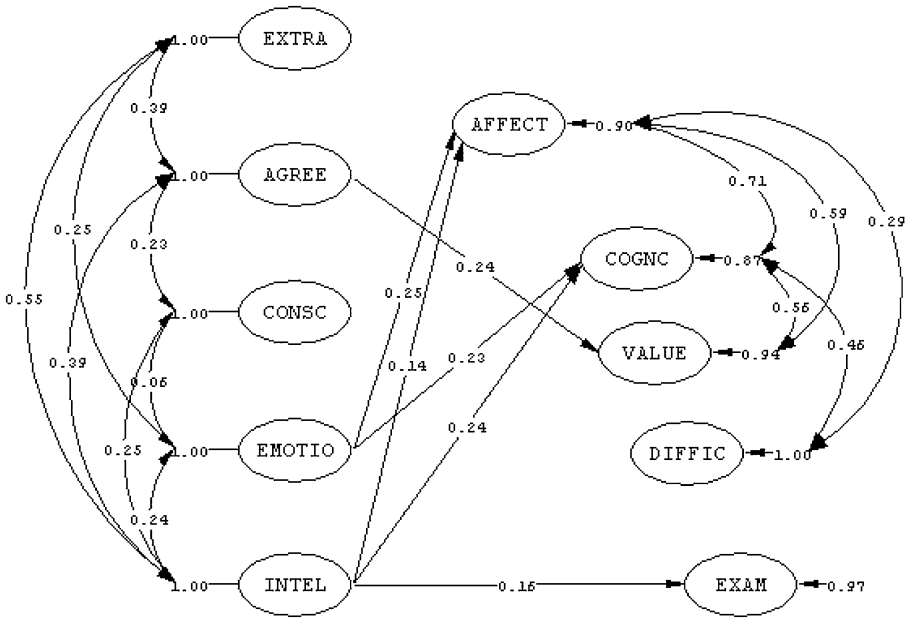

Fig. 4 Structural equation model for Marketing Management. Values are standardized parameter estimates. All values shown are statistically significant, $p < 0.05$. *EXTRA* Extraversion, *AGREE* Agreeableness, *CONSC* Conscientiousness, *EMOTIO* Emotional Stability, *INTEL* Openness, *DIFFIC* Difficulty, *AFFECT* Affect, *COGNC* Cognitive Competence, *VALUE* Value, *EXAM* Course Performance

The structural part of the model contains five statistically significant paths from personality to motivations. The strongest relationships are those between Intellect and the competency belief Cognitive Competence, between Agreeableness and task Value, and between Emotional Stability and Affect (all $p < 0.001$). If we compare the model for Organization & HRM with the second model, that of Marketing Management depicted in Fig. 4, there exists a strong degree of similarity. Measurement models are similar, and the same three paths are found as dominant relationships between personality factors and motivations. However, other paths are different; e.g. in Organization & HRM, a path from Extraversion is present ($p < 0.01$), which is absent in the Marketing Management model. The strongest difference is however in the explanation of course performance: where both Conscientiousness and Cognitive Competence explain Exam for Organization & HRM, be it at the lower significance level of $p < 0.05$, it is only Intellect that explains course performance for Marketing Management (again, $p < 0.05$).

Extending the analysis to the third business subject, Business Strategy generates a similar pattern: see Fig. 5. Measurement models and the three dominant paths between Intellect and Cognitive Competence, between Agreeableness and task Value, and between Emotional Stability and Affect remain unchanged (all with significance level $p < 0.001$). However, the Business Strategy model contains weaker relationships in the sense that beyond this common part, only a fourth weak path is present between Intellect and Value ($p < 0.01$), but no path providing any explanation for course performance indicator EXAM. For Business Strategy, there appears to be no statistically significant relationship between personality factors and motivations as explanatory variables of course

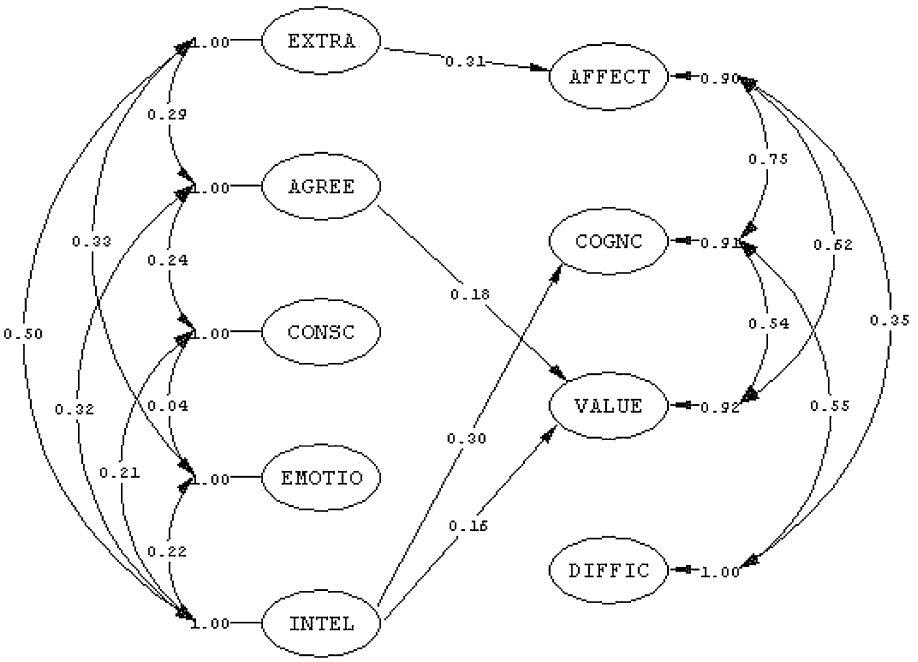

Fig. 5 Structural equation model for Business Strategy. Values are standardized parameter estimates. All values shown are statistically significant, $p < 0.05$. *EXTRA* Extraversion, *AGREE* Agreeableness, *CONSC* Conscientiousness, *EMOTIO* Emotional Stability, *INTEL* Openness, *DIFFIC* Difficulty, *AFFECT* Affect, *COGNC* Cognitive Competence, *VALUE* Value

performance. In all models, task difficulty, expressed as lack of perceived Difficulty, is the only motivational variable being unrelated to any personality trait.

When switching to the pure subjects, the models depicted in Fig. 6 for Finance & Accounting, and in Fig. 7 for Business Statistics, demonstrate clear departures from the models for the business subjects. A first difference is in the right hand side of the models, the measurement model of achievement motivations. The differences are concentrated in the correlations between latent factors Value and Affect, and Value and Cognitive Competence. In the last subsection, we have noticed that subject-differences in Affect and Cognitive Competence are much larger than those in Value, and all in the same direction: pure subjects are characterized by lower motivational levels than applied subjects. To this we can now add that correlations between Value and Affect are much lower for pure subjects (0.48, 0.24) than for applied subjects (0.69, 0.59, 0.62). And similarly, correlations between Value and Cognitive Competence are lower for pure subjects (0.48, 0.30) than for applied subjects (0.43, 0.56, 0.54), be it that this effect is less univocal. Apparently, the liking of a subject and valuing it, and feeling competent in it, are more or less two sides of the same coin in the case of the business subjects, whereas students are better able to attach value to the pure subjects without liking them. The largest subject differences were found in (lack of) Difficulty; not surprisingly, this variable is not correlated at all with Value. So for all subjects, students can value the subject, whether or not they regard the subject as difficult.

In terms of the relationship between personality traits and achievement motivations, the Intelligence construct plays a far stronger role in the pure subjects, than in the applied

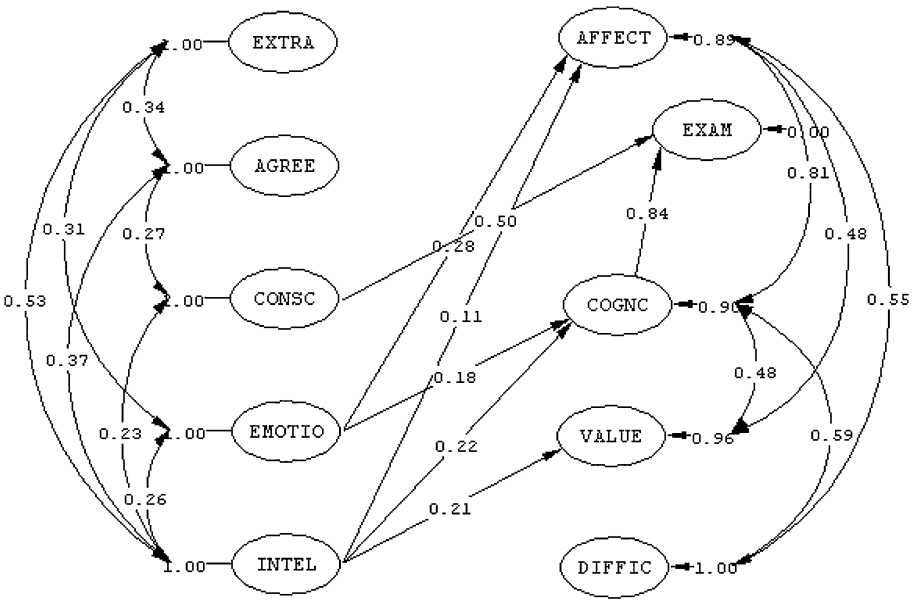

Fig. 6 Structural equation model for Finance & Accounting. Values are standardized parameter estimates. All values shown are statistically significant, $p < 0.05$. *EXTRA* Extraversion, *AGREE* Agreeableness, *CONSC* Conscientiousness, *EMOTIO* Emotional Stability, *INTEL* Openness, *DIFFIC* Difficulty, *AFFECT* Affect, *COGNC* Cognitive Competence, *VALUE* Value, *EXAM* Course Performance

subjects. Whereas the path to Cognitive Competence is the only robust one in the applied business subjects, Intelligence explains all motivations for Business Statistics, and all but Difficulty for Finance & Accounting. For Business Statistics, Intelligence is in fact the only predictor of the several motivation factors (with *p*-values all below 0.001), except for path between Conscientiousness and (lack of) Difficulty ($p < 0.01$), which path has a negative coefficient, indicating that the more conscientious students regard statistics as more demanding than the less conscientious students. For Finance & Accounting, the significance of the paths is somewhat weaker, with the exception of Intelligence–Cognitive Competence path. Another difference between pure and applied subjects is that Extraversion and Agreeableness are unrelated to any motivational construct for the pure subjects, different from the applied ones.

As a consequence of the existence of a portfolio of course performance indicators for Business Statistics, the structural equation model for this course allows for some additional conclusions. The most powerful predictor of course performance is the personality trait Conscientiousness. However, it is especially powerful for the strongly effort dependent homework scores, already less powerful for the quiz scores, and least powerful for the score in the final exam (with math final exam score even being unrelated to it). Math homework is determined in two separate ways by Conscientiousness: directly, and indirectly through Difficulty. Conscientious students regard the subject as more demanding, and students who regard the subject as more demanding, score higher on math homework.

It is remarkable how different the two most important personality traits behave in all subjects models. Conscientiousness has, except for the weak relationship with (lack of) Difficulty in the model for Statistics as explained above, no impact on any motivational

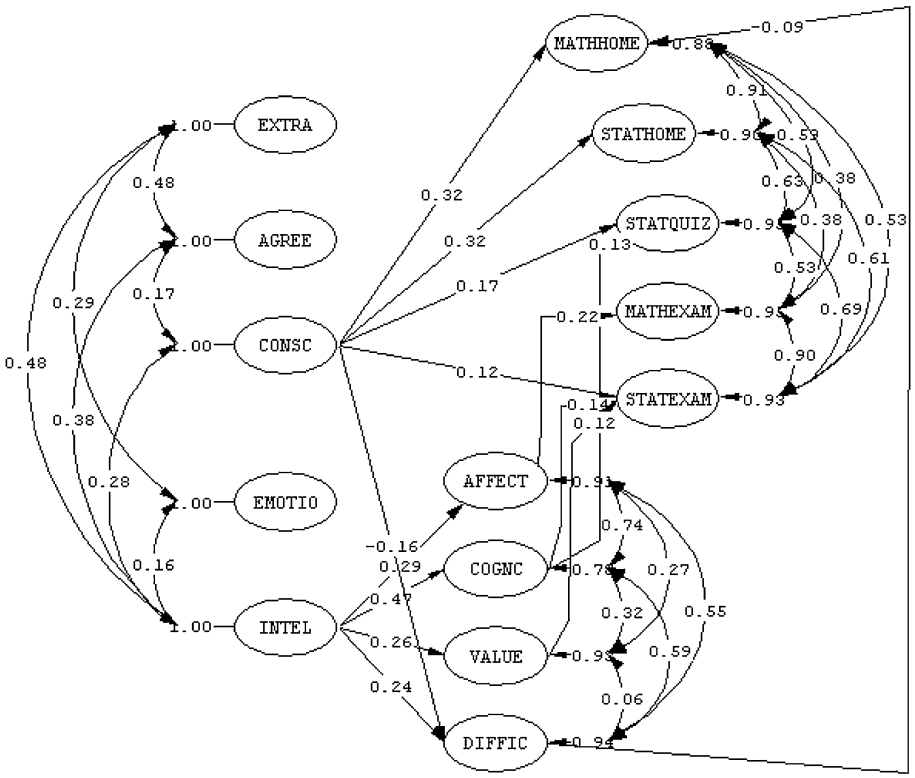

Fig. 7 Structural equation model for Business Statistics. Values are standardized parameter estimates. All values shown are statistically significant, $p < 0.05$. *EXTRA* Extraversion, *AGREE* Agreeableness, *CONSC* Conscientiousness, *EMOTIO* Emotional Stability, *INTEL* Openness, *DIFFIC* Difficulty, *AFFECT* Affect, *COGNC* Cognitive Competence, *VALUE* Value, *MATHHOME* Homework Mathematics, *STATHOME* Homework Statistics, *STATQUIZ* Quiz statistics, *MATHEXAM* Final Exam Mathematics, *STATEXAM* Final Exam Statistics

variable, but at the same time is the strongest direct predictor of course performance in the several subjects. In contrast, Intellect is the personality trait with strongest relationships to motivations but has, except for the subject Marketing Management, no direct impact on course performance.

In terms of explained variation, the relationships between gender and personality factors and achievement motivations, and between all these three factors and course performance, are of moderate strength. Gender explains a median 4% of variation in subject-specific achievement motivations, with a maximum of 7% for Cognitive Competence in Finance & Accounting. On top of that, personality traits explain a further median 8% of variation in motivations, with a maximum of 22% for Cognitive Competence in Business Statistics. From a pedagogical point of view, the moderate power of the structural models is reassuring: the greatest part of variation cannot be explained by the deterministic factors incorporated in our study, thereby leaving enough space for pedagogy to influence achievement motivations. But beyond this positive outcome, the structural models also make clear that the challenge of pedagogic will be a tough one. First, personality factors important for achievement motivations, primarily Intellect, are very different from

personality factors important for course performance: primarily Conscientiousness. Second, the relationship between achievement motivations and course performance is very weak, or even totally absent, in the applied business subjects. Taking both facts together implies that the two educational goals of the creation of positive subject motivations and the achievement of good course performances might be less compatible than often hypothesized.

Gender Invariance of Structural Models for Achievement Motivations and Course Performance

After establishing strong gender effects in levels of achievement motivations and course performance, and finding that structural equation models that explain achievement motivations and course performance out of personality factors are not subject-invariant, the last research question refers to the possibility that these subject-specific structural models are gender-invariant. Investigations into gender-invariance of structural models starts with invariance checks applied to measurement models of Big 5 personality factors and the measurement models of course specific achievement motivations. These models appear to be gender-invariant, except for two motivation models: Finance & Accounting, and Marketing Management, demonstrate a break-down of gender invariance in the correlation matrix of latent achievement motivations. In Finance & Accounting, the rejection of invariance is marginal, and concentrated in two correlations: for female students, the correlation between Value and Cognitive Competence and Value and Affect is much stronger than for males. This lower correlation for males contains the clue to explain how the large gender gap in Value is compatible with smaller gender gaps in Affect and Cognitive Competence. Female students tend to value the subject especially if they feel cognitive competent and possess positive affect; in male students, these two circumstances are much less a condition for positive valuation. The breakdown in gender-invariance for Marketing Management is primarily in the correlation between Affect and Cognitive Competence. In females, that correlation is so strong as to make the two factors empirically non-distinguishable. In males, the correlation is strong (0.70), but factors still are clearly distinguishable.

Testing for gender-invariance in the complete structural model results in similar outcomes. Structural models for subjects Business Statistics, Business Strategy, and Organization & HRM are gender-invariant, except for obvious differences in latent means. The variation by gender of the motivations measurement models for the subjects Finance & Accounting, and Marketing Management, also has an impact on the structural models for these subjects. For Finance & Accounting, the breakdown of invariance is limited to the correlation matrix of latent motivation factors. Gender invariance cannot be rejected for path coefficients relating personality traits with achievement motivations for this subject. For the subject Marketing Management, however, gender invariance in both the motivations correlations and the paths coefficients must be rejected. It appears that gender specific path coefficient matrices are complementary: all five paths coefficients of the model estimated on the complete sample, see Fig. 3, are either significant in the female sub-sample, but not in the male sub-sample, or vice versa. For males, Emotional Stability is the single personality factor predicting Affect and Cognitive Competence. Both these variables are predicted by Intellect for females, as is Value by Agreeableness.

Taking both types of gender effects together, the gender effect in levels clearly dominates the gender effect in terms of covariance structures. All subjects demonstrate strong level effects, whereas three out of five subjects are characterized by invariant structural

models. Two out of five structural models exhibit significant gender effects; however, these are located in only a few parameters.

Discussion

Subject matter matters a lot for the motivation of students. In this paper the results of Tempelaar et al. (2007) are extended, by demonstrating the existence of strong subject-specific gender effects in levels of achievement motivations for subjects taught in a business program. In and of itself, the result of clear subject-specific gender effects in the present paper may not come as a surprise: other evidence exists of subject-specificity of achievement motivations and the role of gender in it from empirical research using both expectancy-value based models of achievement motivations, and models based on attribution theory (Meece et al. 2009). Most empirical research has however focused on subjects that are very different in nature, like e.g. math and reading, sports and music. The contribution of this paper is to show that subject matter appears to be crucial even within a relatively homogeneous group of subjects, namely all belonging to one and the same bachelors' program.

We have explicitly selected gender and personality factors to demonstrate subject-specificity of motivations, as the most stable individual difference factors one can think of. These two non-malleable students' characteristics together explain 10–20% of variation in achievement motivations, with strong variation over types of motivation and academic subjects. The set of stable students' characteristics that influence learning can easily be extended beyond gender and personality. Preferred learning styles may serve as a further example of a rather stable students' characteristic that has a pronounced impact on student learning. As a consequence, student learning in business subjects depends to a substantial extent on non-malleable students' characteristics. This imposes limits on the attainability of instructional aims related to improving student motivations.

The non-malleability of important determinants of the learning process is but part of the problem. Further constraints on the perspectives of pedagogy result from the properties of the estimated subject-specific structural models. In the applied business subjects, course performance is rather unrelated to students' achievement motivations. And in all subjects, personality traits that explain students' motivations, primarily Intellect, are very different from personality traits that best explain course performance: primarily Conscientiousness. As a consequence, the compatibility of the instructional aims of achieving knowledge mastery as well as creating positive motivation and attitudes might be much lower than often assumed. This suggests being at odds with most motivation for achievement literature, such as Alderman (2004), which builds on the assumption that fostering motivation for students at all levels of performance is essential to effective teaching. Even in a student-centered learning context, as the problem-based learning one on which this study is based, teachers might be confronted with achievement and motivation being—in part—conflicting goals, lacking an obvious optimum motivation, that is a level of student motivation that provides the best learning performances.

In addition to the issue of motivations being to some degree non-malleable, the structure of achievement motivations plays a crucial role in education, as is clear from recent debates in business education. In Tempelaar et al. (2007), a distinction was made between characteristics that are subject-specific, and those that are generic for a range of subjects. Distinguishing between these two components is of great relevance to recent discussions on 'integrative pedagogy' in business education. In an attempt to meet the critics of the

'break down the silos' movement (Stover et al. 1997; Bennis and O'Toole 2005), implying that programs in (undergraduate) business schools focus too much on isolated business functions and lack cross-functional integration, Campbell et al. (2006) recently propose to distinguish between a focus on pedagogy and a focus on curriculum. They argue that the problem with business education is not with *what* is taught in business courses, but with *how* it is taught. Therefore, they conclude, the proper response to criticisms of business programs is not to change the curriculum, but rather to adopt a more integrative pedagogy. But such an integrative pedagogy is strongly built on the assumption that important determinants of students learning, such as learning motivations, can be influenced on a generic, not subject-specific, level. However, both the decomposition of motivational factors into generic and subject-specific components, and the differences in subject-specific motivation models, make clear that the perspectives of an integrated pedagogy are limited: the far greater part of student motivations is of subject specific type, and only a modest part is of generic type. In order to improve students' motivations in the most malleable part of the spectrum, those that are strongly context dependent, it is hard to imagine that a pedagogy that does not address these context specific issues can play a large role. For that reason, breaking down the silos has indeed its restrictions, both from the curriculum, and the pedagogic perspective.

Subject matters, and gender-effects appear to be instrumental in demonstrating how strong variation amongst subjects can be. But gender-effects can also be helpful in unmasking phenomena that on first eye may look much stronger subject specific than they in reality are. Gender-typing of academic tasks and domains is such an example. On the basis of gender differences in competence perceptions of students, in some studies combined with gender differences in learning performance, gender-typing achieves a classification of subjects according size of the gender gap (see e.g. Alderman 2004; Alexander 2006; Hyde and Durik 2005; Meece et al. 2009; Pintrich and Zusho 2007). Gender-typing generally produces a classification that is very similar to the reduced-Biglan classification of subjects, with pure & hard & non-life as one, male pole, and applied & soft & life as the other, female pole. The aim of gender-typing is invariably to find subjects with the largest gender stereotypes, in order to design educational interventions directed at diminishing gender differences in these specific subjects. A representative example within the domain of business education is the Shotick and Stephens (2006) study that compares female and male students' self-efficacy ratings for a large number of computer tasks. Mean differences range from neutral in some tasks, to a significant gender gap favoring males in the other tasks. On the basis of these findings, the authors conclude that schools must find ways to strengthen female students' confidence levels in some specific areas. But the question is if interventions based on these gender-typing outcomes represent the most fruitful approach to address gender differences in education.

An alternative approach might be one grounded in concepts as over-optimism, self-serving bias, and calibration, stemming from attribution theory and self-efficacy theory (Hacker and Bol 2004; Haynes et al. 2006; Perry et al. 2001; Zimmerman and Moylan 2009). Realizing that both competence perceptions and actual performance in different subjects demonstrate similar gender patterns, that approach focuses on the gap between these two indicators. In the context of our study, gender-typing of the five subjects on the basis of the reduced Biglan classification has a straightforward outcome: the subjects Business Statistics and Finance & Accounting belong to the male-typed pole, whereas the other three subjects fall into the female-typed side. The choice of majors by female and male students, levels of achievement as depicted in Fig. 2, and course performance data as provided in Table 3, all corroborate this classification. But if we do not focus on

performance or competence perception in isolation, but instead on the gap between competence perception and performance, subject-specificity disappears—at least within the rather homogeneous range of business oriented subjects in this study. What remains after summing the percentage point gender difference in self-perceived competence and percentage point underachievement, is a remarkably stable 10% gender gap for all academic subjects, suggesting that males' overconfidence or calibration gap is a rather stable characteristic independent of the academic subject. Such an outcome seems to justify the label of 'manifestation of response bias' that Pintrich and Zusho (2007) use to describe this over-confidence: 'males have a tendency to over-inflate their ratings of confidence levels, while females have a tendency toward modesty' (Pintrich and Zusho 2007, pp. 787–788). In our context, this tendency appears to be uniform, that is, not subject-specific. The question of gender-typing of this over-confidence level, rather than the perceived competence, seems to be an intriguing one: do other educational contexts, in settings where subjects demonstrate some but no extreme variability, confirm the relative stability of over-confidence levels? It is especially intriguing, since the instructional implications of subject-specific competency beliefs being the product of a rather constant calibration gap or 'over-confidence' gender effect, and subject-specific mastery levels, are very different from the implications of gender-typing competency beliefs. Diminishing this generic male/female overconfidence gap might be a far more effective instructional aim than quests for subjects or even tasks with the largest differences in self-efficacy or self-perceived competence levels between males and females and trying to address these subject-specific gaps.

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