Psychological Correlates of University Students' Academic Performance:
A Systematic Review and Meta-Analysis

Abstract

A review of 13 years of research into antecedents of university students' grade point average scores (GPA) generated: (i) a comprehensive, conceptual map of known correlates of tertiary GPA, (ii) assessment of the magnitude of average, weighted correlations with GPA and (iii) tests of multivariate models of GPA correlates within and across research domains. A systematic search of psycINFO and web of knowledge databases between 1997 and 2010 identified 7167 English language articles yielding 242 datasets reporting 50 conceptually-distinct correlates of GPA including 3 demographic factors and 5 traditional measures of cognitive capacity or prior academic performance. In addition, 42 non-intellective constructs were identified from 5 conceptually-overlapping but distinct research domains: (1) personality traits, (2) motivational factors, (3) self-regulatory learning strategies, (4) students' approaches to learning, and (5) psychosocial contextual influences. 1105 independent correlations were retrieved and data were analyzed using hypothesis-driven, random effects meta analyses. Significant average, weighted correlations were found for 41 of 50 measures. Univariate analyses revealed that demographic, and psychosocial contextual factors generated, at best, small correlations with GPA. Medium-sized correlations were observed for high school GPA, SAT, ACT, and 'A' level scores. Four non-intellective constructs also showed medium-sized correlations with GPA, namely, need for cognition, academic self-efficacy, grade goal, and effort regulation. A large correlation was observed for performance self-efficacy which was the strongest correlate (of 50 measures) followed by high school GPA, ACT, and grade goal. Implications for future research, student assessment and intervention design are discussed.

Key terms: student, grade point average, self-efficacy, goal, meta analysis.

The psychology of individual differences originated in attempts to predict scholastic performance. Binet and Simon's (1916) work showed that children's individual cognitive capacities explained variability in educational performance and, in doing so, laid the foundations for extensive research into intelligence and intelligence testing (Neisser et al., 1996). Theoretical debate focused on the psychological nature of intelligence and applied research explored how differences in intelligence(s) can be most usefully assessed (e.g., Capenter, Just & Shell, 1990; Gardner, 1983; Spearman, 1927). Subsequent research has identified a variety of individual differences that predict scholastic performance and prompted construction of a wide range of assessment instruments. This diverse literature has not clarified how, and to what extent, separate measures of academic potential are related. Greater conceptual and methodological integration would help focus future research questions and facilitate optimal assessment of students' academic potential. In order to achieve this we reviewed 13 years of research into correlates of tertiary-level academic performance, where "tertiary-level" refers to post-school, undergraduate university or college education. We investigated (1) which individual differences are associated with better performance, (2) how strong these associations are, and (3) whether a parsimonious evidence-based, additive model of predictors can be constructed.

Distinct strands of evidence indicate that predictions of academic performance may be more accurate if they are based on assessment of a variety of individual differences, not just of past achievement and cognitive capacity. First, in tertiary education, student selection procedures reduce variation-in intelligence scores, especially at selective institutions (Furnham, Chamorro-Premuzic & McDougall, 2003). Consequently, at this level, factors others than intelligence may be critical to accurate prediction of performance. Second, and more generally, research has identified a variety of non-intellective factors associated with academic performance. For example, Ackerman and Heggestad (1997) provided an

informative analysis of relationships between intelligence, personality and interests while Poropat (2009) demonstrated that academic performance is associated with Five Factor personality traits. The latter review showed that the relationship between conscientiousness and academic performance was largely independent of intelligence and that when academic performance at secondary level (i.e., school) was controlled, conscientiousness added as much to the prediction of tertiary academic performance as did intelligence. Less stable tendencies including motivation, self-regulatory learning strategies and learning styles have also been found to predict academic performance, controlling for the effects of intelligence and personality (e.g., Chamorro-Premuzic & Furnham, 2008 and see Robbins, Lauver, Le, Davis, Langley, and Carlstrom, 2004 for a review).

In addition, traditional tests of cognitive ability have limitations. Following the construction of the Stanford-Binet intelligence test (Terman, 1916), the scholastic aptitude test was developed in 1925. This test is now referred to as the SAT and is the most widely used, standardized, college admissions test in north America (Everson, 2002). Yet, doubts have been raised regarding cultural and socioeconomic biases in the SAT and in a more recent test of academic reasoning, the ACT (e.g., Zwick, 2004). In combination, these findings suggest that development of comprehensive, accurate, predictive models of academic performance necessitates a broader representation of student capacities and tendencies. We aimed to provide a foundation for such work by presenting an integrative overview of the evidence supporting a wide range of predictors of tertiary educational performance. Our research focused on individual differences which have the potential to enhance the prediction of academic performance over and above that achieved by traditional measures of intelligence or cognitive capacity.

Measuring Student Performance

Predicting performance depends on being able to assess it. Tertiary, or undergraduate university, students' performance is usually expressed in terms of grade point average (GPA), that is, the mean of marks added over weighted courses contributing to assessment of the final degree. GPA is the key criterion for postgraduate selection and graduate employment and is predictive of occupational status (Strenze, 2007). As such, it is an index of performance directly relevant to training and employment opportunities (Plant, Ericsson, Hill, & Asberg, 2005) and is meaningful to students, universities and employers alike. GPA is also an objective measure with good internal reliability and temporal stability (e.g., Bacon & Bean, 2006; Kobrin, Patterson, Shaw, Mattern, & Barbuti, 2008). GPA is not without limitations with questions of reliability and validity arising as a result of grade inflation (Johnson, 1997) and institutional grading differences (Didier, Kreiter, Buri, & Solow, 2006). Nonetheless, no other measure of tertiary academic performance rivals the measurement utility of GPA. For example, behavioral measures such as time spent studying appear to be unrelated to, or weakly associated with GPA (rs range from -.02 to .12), regardless of assessment method (e.g., number of hours studied or time diaries; Hill, 1990; Shuman, Walsh, & Olson, 1985) or performance criterion (e.g., cumulative GPA or course GPA). Unsurprisingly then, GPA is the most widely studied measure of tertiary academic performance and was used as the primary outcome measure in this study.

Traditional Correlates of GPA: SAT, ACT, Intelligence, High School GPA, and 'A' Level Points

Measures of SAT, ACT, and high school GPA are central to university admissions in North America. Test developers conceptualized SAT as a test of scholastic aptitude and concordance studies show that the SAT and ACT are highly correlated (Dorans, Lyu, Pommerich, & Houston, 1997). There is considerable conceptual and empirical overlap

between these measures of scholastic aptitude and more general measures of intelligence (e.g., Raven's Advanced Progressive Matrices, 1998; Frey & Detterman, 2004). Surprisingly, however, studies have not included measures of intelligence together with SAT/ACT assessments when predicting GPA so it is difficult to determine whether these scholastic assessments add to, or substitute for, the predictive power of intelligence tests in relation to academic performance.

Interestingly, despite differences in course content and grading criteria, high school GPA is a stronger predictor of university GPA than SAT or ACT. All three measures have been found to explain unique variation in GPA (Bridgeman, Pollack & Burton, 2004; Ramist, Lewis & McCamley-Jenkins, 2001), collectively accounting for approximately 25% of the variance (Mathiasen, 1984; Mouw & Khanna, 1993; Robbins et al., 2004) so leaving substantial variance unexplained.

In Europe, there is no standardized university admission procedure (equivalent to SAT/ACT) but assessment of secondary school performance is normally central to student selection. In the UK, for example, the advanced general certificate of education ('A' level examinations) is usually taken at 18 and is equivalent to high school GPA. The number of cross-subject 'A' level points attained is the key entry criterion for most UK universities. A weighted mean r of .28 between 'A' level points and degree classification has been reported (Peers & Johnston, 1994) although few studies of this relationship have been conducted recently.

We refer to such established measures of academic potential and cognitive ability as "traditional" correlates of GPA to indicate that the incremental predictive utility of other (non-intellective) factors need to be demonstrated while controlling for these widely-used assessments. Thus, in the model tested here, we included five traditional correlates of GPA, namely SAT, ACT, intelligence, high school GPA and 'A' level points.

Psychological Correlates of GPA: A Brief Overview

Intelligence tests (e.g., Harris, 1940; Neisser et al., 1996) reflect cognitive capacities, including the ability to represent and manipulate abstract relations (Carpenter, Just & Shell, 1990). Such measures assess what an individual *can* do. Other correlates of GPA may clarify *how* individuals are likely to use their intellectual capacities (Barrick, Mount, & Strauss, 1993; Busato, Prins, Elshout & Hamaker, 1999). Identification of such non-intellective antecedents of academic performance has proliferated over the past 10-15 years (e.g., Eccles & Wigfield, 2002). We will review this research, over 13 years (1997-2010), and present a five-domain framework within which non-traditional correlates of GPA can be organized.

Many studies have assessed the role of personality in academic performance (Poropat, 2009). Dispositional personality traits are assumed, like intelligence, to exert a constant influence over performance across situations. Such traits are, in part, genetically determined and remain relatively stable over time (see Murphy & Alexander, 2000 for a conceptual review). For example, intelligence scores have heritability approximates of .50 –.80 (Plomin, 2001) while estimates of .72 have been reported for conscientiousness (Riemann, Angleitner & Strelau, 1997).

Research has also highlighted the importance of domain-specific, motivational variation to academic performance (Pintrich, 2004). Such research demonstrates that performance-relevant beliefs, values, and goals are "dynamic and contextually bound and that learning strategies can be learned and brought under the control of the student" (Duncan & McKeachie, 2005, p.117). As Zimmerman (1989) notes, self-regulated learners are "meta-cognitively, motivationally, and behaviourally active participants in their own learning process" (p.4). Consequently, models of academic performance may need to encompass expectancies, motivation, goals, and use of self-regulatory learning strategies (Eccles & Wigfield, 2002; Robbins et al., 2004). Unlike intelligence and personality, these predictors

are malleable and context-sensitive (e.g., Carver & Scheier, 1981; Wolters, Pintrich & Karabenick, 2003).

Research into students' approaches to learning (SAL; e.g., Biggs, 1987) developed using phenomenological methods and has acknowledged the impact of motivational and cognitive processes on learning (e.g. Diseth, Pallesen, Brunborg, & Larsen, 2010). Such research has resulted in over-arching characterizations of students' learning styles (e.g., surface versus deep) that imply particular constellations of motivation and self-regulatory control. In practice, however, students' performance may depend on changing combinations of motives and self-regulatory strategies across different tasks and contexts (Pintrich, 2004). Consequently, constructs drawn from motivational and self-regulatory research may facilitate more detailed and flexible characterizations of predictors of scholastic performance than SAL categorizations.

In addition to individual differences, academic performance may be determined by organization features of learning institutions and the interaction between individual learners and their learning context (Bean, 1980; Tinto, 1975). Tinto's work highlighted the role of institutional characteristics in shaping students learning and reducing student drop out while later models (e.g., Bean, 1985) emphasized the mediating role of psychological responses to contextual influences in optimizing academic performance. In general, institutional characteristics and contextual influences have been assessed in terms of learners' perceptions of their environment and their psychological responses to learning contexts.

In order to clarify which non-intellective factors are most useful in understanding academic performance we will consider constructs from five research domains (1) personality traits, (2) motivational factors, (3) self-regulatory learning strategies, (4) students' approaches to learning, and (5) psychosocial contextual influences (see Table 1). Table 2 presents illustrative items used to measure each of the constructs listed in Table 1.

Personality Traits

The orthogonal personality dimensions included in the Five Factor model represent the most comprehensive and widely applied approach to conceptualising and assessing personality (i.e., conscientiousness, extraversion, neuroticism, openness, & agreeableness; Costa & McCrae, 1992). All five traits, and especially *conscientiousness*, have been found to predict GPA (see Poropat, 2009 for a review). Measures of conscientiousness assess the extent to which individuals are dependable (e.g., organized) and achievement orientated (e.g., ambitious). Those high in conscientiousness are expected to be more motivated to perform well (Mount & Barrick, 1995) and to be more persistent when faced with difficult or challenging course materials.

Procrastination (Lay, 1986) is typically defined as a behavioural tendency to postpone tasks or decision making (Milgram, Mey-Tal & Levison, 1998; Van Eerde, 2003) which personality theorists have attributed to deficient impulse control (Mischel, Shoda, & Peake, 1988). Steel, (2007) has argued that procrastination is a central facet of conscientiousness and indicative of self-regulatory limitations. Consequently, students high in procrastination are likely to achieve less because, like those low in conscientiousness, they are less likely to persist with challenging work.

Students high in *openness* are expected to be more imaginative and willing to consider new ideas. These students may be better able to manage new learning essential to academic achievement (e.g., Vermetten, Lodewijks, & Vermunt, 2001; Zeidner & Matthews, 2000). Students high in openness and in *agreeableness* may be more likely to attend classes consistently (Lounsbury, Sundstrom, Loveland & Gibson, 2003) and those high in agreeableness may also show greater levels of cooperation with instructors. This could facilitate the process of learning (Lounsbury, Steel, Loveland, & Gibson, 2004; Vermetten, Lodewijks, & Vermunt, 2001). By contrast, *neuroticism* is associated with higher anxiety

(e.g., Watson & Clark, 1984) and test anxiety (Steel, Brothen & Wambach, 2001), that can

compromise performance on tests and examinations (Pekrun, Goetz, Perry, Kramer,

Hochstadt, & Molfenter, 2004; Zeidner & Matthews, 2000), as well as reduce motivation

(Watson, 2000). Chamorro-Premuzic and Furnham (2002) found that students high in

neuroticism were more likely to be absent from examinations due to illness and note that it is

possible that poorer attendance, more generally, may also undermine academic performance

among students high in neuroticism.

   Extraversion implies greater sociability and activity levels. Students with extravert

tendencies might be expected to achieve lower grades because they are more distracted and

more sociable than students with introvert tendencies who are likely to spend more of their

time learning and consolidating knowledge (Rolfhus & Ackerman, 1999). Thus, extraversion

may limit students' capacity to regulate their effort devoted to academic tasks (Bidjerano &

Dai, 2007). Moreover, extraverts have been found to reach cognitive decisions prematurely

(Matthews, 1997) which may curtail systematic consideration and checking required by many

academic tasks.

   Traits not easily encompassed by the Five Factor model have been found to predict

academic performance, in particular, *need for cognition* (NFC; Cacioppo, Petty & Kao, 1984)

and *emotional intelligence* (EI; Mayer, Salovery & Caruso, 2002). Higher NFC reflects

greater intrinsic motivation to engage in effortful cognitive processing with higher scores

linked to better academic outcomes. The nomological network (Cronbach & Meehl, 1955) for

NFC has not been specified but this construct, that originated in research into processes

underpinning message acceptance and persuasion, has many potential links. It has been

shown to be positively associated with fluid intelligence, openness, low neuroticism, and goal

orientation (Fleischhauer, Enge, Brocke, Ullrich, Strobel & Strobel, 2009) and may also be

related to self-regulatory learning strategies including use of meta cognition, elaboration, and deep learning.

Emotional intelligence has been assessed in terms of abilities to perceive emotions accurately, understand emotion, and use emotion to facilitate thinking (Mayer et al., 2002). Emotional intelligence has also been assessed in terms of happiness, stress tolerance, and self-regard (Bar-On 1997; Schutte et al., 1998). Both measures have been assessed alongside GPA, Consequently, we treat emotional intelligence as a constellation of emotional capacities and tendencies implying greater capacity to maintain positive emotion and interpret emotions in a manner that may facilitate learning and academic performance.

We have identified 8 distinct personality measures that may be associated with GPA. These are conscientiousness, openness, agreeableness, neuroticism, extraversion (the Big Five factors), need for cognition, emotional intelligence, and procrastination (which is closely related to conscientiousness).

Motivation Factors

Personality may affect achievement through motivation and, of course, motivation may be measured directly (Phillips, Abraham & Bond, 2003). There are many different theories of motivation (see Eccles and Wigfield, 2002 for a review) but only a limited number of motivational constructs have been repeatedly examined in relation to GPA. We will consider these in three groups, (i) attributions, optimism, pessimism, expectancies, and perceived control, (ii) sources of motivation, and (iii) goal types.

Attributions, optimism, pessimism expectancies, and perceived control.

Attributions refer to the way people explain causation (Heider, 1958; Weiner, 1986) and particularly, in this context, students' explanations of past academic failures. Some students tend to explain poor grades in terms of their own (internal) failings such as lack of effort and ability. Others tend to identify external causes such as bad luck or insufficient

teaching. Consequently, we can assess students' tendencies to make internal versus external attributions. Such tendencies are referred to as *locus of control* (Rotter, 1966). In addition to locus of control, attributions may differ in their stability and globality. A *pessimistic attribution style* (Peterson, Vaillant & Seligman, 1988) is characterised by internal, stable (unchanging), and global (cross-situational) attributions for past failures (e.g., "I am stupid"). By contrast, *optimistic* students are likely to make external, unstable, and specific attributions for past failures (e.g., "the examiner did not understand my work"), and internal, stable, global attributions for past successes (e.g., "I am capable and smart").

Outcome expectancies refer to perceptions of the association between behavior and outcome (e.g., "my studying hard will lead to good grades"). Optimistic attributions are associated with more positive outcome expectancies and stronger motivation (Abrahamson, Metalsky, & Alloy, 1989). Outcome expectancies can be distinguished from efficacy expectancies that refer to beliefs about personal capabilities (Bandura, 1997). This distinction is important because some students may believe that effort leads to good grades but see themselves as lacking the necessary skills to mobilise such effort. Others may believe in their capacity for effortful study but be uncertain whether such effort will lead to enhanced achievement.

Students who believe that they have the skills and abilities to succeed at academic tasks perform better than those with lower efficacy expectancies (Bandura, 1997). Efficacy expectations for any particular performance depend on students' experience with similar challenges. When challenges are familiar, students can draw upon past experiences to formulate expectations about specific performances. This has been referred to as *performance self-efficacy*. However, when challenges are unfamiliar performance must be anticipated on the basis of more generalised representations of relevant competencies. This is referred to as *academic self-efficacy* (Zimmerman, Bandura & Martinez-Pons, 1992).

Efficacy expectations refer to perceptions of personal capacities to perform. By contrast, *self-esteem* refers to the person's self-worth. One may have low performance self-efficacy and still have high overall self-worth. Consequently, self-esteem can be regarded as a trait-like construct. However, following Eccles and Wigfield, (2002), we have categorized academic self-esteem as a motivational construct because of its close links to academic attributions and the evaluation of academic success among students. According to self-worth theory (Covington, 1998), academic ability is a core, universal component of self-worth that individuals are motivated to maintain. For example, attributing failure to a lack of effort protects academic self-esteem but may also lead to a reduction in effort owing to fear of failure. Moreover, as a result of such attributional tendencies, students may differ in how much they value academic achievement (Harter, 1998) and constructing a more positive academic self concept is associated with enhanced achievement (Hattie, 1993).

Sources of motivation.

Rather than characterizing *how* motivated people are, self-determination theory (Ryan & Deci 2000) distinguishes between sources of motivation, or reasons for task engagement. The theory proposes that task engagement results in satisfaction of basic psychological needs, namely, autonomy, competence, and relatedness. Activities undertaken for pleasure inherent to the task (*intrinsic motivation*) are associated with optimal self-regulation involving autonomy and efficiency whereas tasks engaged in for instrumental reasons, such as the offer of a reward or avoidance of a punishment (*extrinsic motivation*), are linked to controlled motivation and volitional difficulties (deCharms, 1968). Self-determination theory proposes that intrinsic motivation is achieved and maintained through stimulating and challenging task engagement in which the actor feels competent and autonomous. It is proposed that intrinsic motivation facilitates optimal learning whereas extrinsic motivation may stifle motivation and performance.

Goal types.

The type of goal students pursue during academic study can affect their source and degree of motivation and, subsequently, their performance. It has been suggested, for example, that students' motivation may be improved by focusing on effort and self improvement (which are intrinsically-motivated goals) rather than on achievement and competition (which are extrinsically-motivated goals) (Covington, 1992). It is possible, therefore, to distinguish between students who are primarily oriented towards learning goals and those who are most focused on performance goals. Performance goals may be inherently extrinsically-motivated but can have differing effects on performance depending on whether they are performance approach goals, focused on anticipation of positive achievement, or performance avoidance goals directed towards escaping from anticipated failure or negative evaluation (Elliot & Harackiewicz, 1996). Performance avoidance goals have been found to be associated with reduced motivation and achievement (Elliot & Church, 1997) whereas performance approach goals may enhance academic motivation and evaluation of academic competence (Harackiewicz, Barron, Pintrich, Elliot & Thrash, 2002). We will, distinguish between *learning goal orientation*, *performance goal orientation* (referring to performance approach goals), and *performance avoidance goal orientation.*

 Goal theories (e.g., Locke & Latham, 1990) suggest that performance feedback is central to goal setting and goal striving. In an academic context, performance feedback usually consists of grades awarded for exams and assignments (Wood & Locke, 1987). Performance self-efficacy and grade expectancies are expected to stabilise as performance feedback is accumulated (Bandura, 1997; Lent & Brown, 2006) and, consequently, to be most strongly predictive of GPA among experienced students (Pajares & Miller, 1995). In this context we can define a *grade goal* (e.g., "I want to get 65% on this test") as a specific performance goal based on prior feedback.

Overall, then we have identified 12 distinct but closely related motivational constructs that may be correlated with GPA, namely, locus of control, pessimistic attributional style, optimism, performance self-efficacy, academic self-efficacy, self-esteem, intrinsic motivation, extrinsic motivation, learning goal orientation, performance goal orientation performance avoidance goal orientation, and grade goal.

Self-Regulatory Learning Strategies

Students regulate their cognitions, emotions, motivation behaviors, and environment (Boekaerts & Corno, 2005). The motivational factors we have considered do not encompass differences between students in their typical use of self-regulatory learning strategies. Yet the extent to which students employ such strategies may mediate (and moderate) the effects of dispositional characteristics (such as intellectual capacity and personality) and psychosocial contextual influences on academic performance.

Theorists have distinguished between motivation and volition, with motivation culminating in the formation of goals or behavioural intentions, and volition guiding the translation of goals into actions (Kuhl, 2000). According to Gollwitzer's (1990) 'rubicon' model, decisions about "why" one should act and "where" one should invest effort are part of the goal setting process that precedes goal commitment. Once a goal has been formulated, goal striving begins. In this phase, regulatory processes focus on *how* to best implement effort (Boekaerts & Corno, 2005). Students' use of distinct self-regulatory strategies may render such post-motivational, goal striving more or less effective, thereby, predicting performance. Thus assessment of self-regulatory strategies may facilitate greater accuracy in predicting academic performance (see Pintrich, 2004 and Wolters et al. 2003 for reviews).

Pintrich's (2004) model of self-regulated learning comprises the most comprehensive set of constructs assessing learning-related, self-regulatory strategies. Four areas of self-regulated learning are assessed, namely, motivation/affect, cognition, behaviour, and context.

This model has been assessed using the Motivated Strategies for Learning Questionnaire (MSLQ). This multi-measure assessment tool measures includes constructs discussed above but uses different labels to describe some of these constructs. Specifically, the MSLQ constructs of (i) intrinsic goals, (ii) extrinsic goals, (iii) task value, and (iv) self-efficacy map onto what we refer to as (i) learning goal orientation, (ii) performance approach motivation, (iii) intrinsic motivation, and (iv) academic self-efficacy, respectively.

The MSLQ also assesses *test anxiety*. This construct can be viewed as a trait related to neuroticism but can also be conceptualised as indicative of a specific form of affect control. Adopting the latter view, we grouped this construct with other self-regulatory capacities. In addition, the MSLQ measures control of learning beliefs but this construct has only rarely been included in studies assessing GPA and was, therefore, omitted from our analyses.

Cognitive strategies assessed by the MSLQ include rehearsal, elaboration, organizational, critical thinking and concentration strategies as well as more general measures of meta-cognitive self-regulation (Pintrich, 2004). *Rehearsal* strategies include "shallow" learning techniques such as rote learning which is learning through repetition whereas *organization* (e.g., note taking and organising points meaningfully), *elaboration* (e.g., summarizing material using one's own words) and *critical thinking* (e.g., questioning the validity of key texts and materials) reflect increasingly "deeper" learning strategies that are proposed to facilitate learning and achievement. *Concentration* (Weinstein, Zimmerman, & Palmer, 1988) refers to students' ability to direct and maintain attention during academic study.

Meta-cognition refers to a cluster of self-regulatory techniques utilised during learning (Wolters et al., 2003). These include planning (e.g., setting learning goals), self monitoring (e.g., of comprehension) and flexibility (e.g., selection and implementation of task appropriate learning strategies).

Assessment of behavioural self-regulatory capacities (Pintrich, 2004) includes a measure of *effort regulation* that encompasses self management of motivation or persistence when challenged by difficult work. Effort regulation is related to conscientiousness and academic self-efficacy. Achievement motivation and effort regulation are very closely related constructs and illustrate how different labels may be used for very similar predictors of scholastic performance in different research domains, in this case, studies of personality traits versus self-regulatory capacities. Pintrich (1999) also identifies *help seeking* as a behavioural strategy encompassing "other regulation" i.e., the actions of teachers and peers (Ryan & Pintrich, 1997; Wolters et al., 2003). Finally, the MSLQ includes measures of the regulation of the learning contexts (Pintrich, 2004) including a measure of *peer learning* which involves talking to peers about their learning whereas *time/study management* assesses use of study plans and the regulation of the learning environment (e.g., turning the television off while studying). Use of the MSLQ illustrates multi-measure research into the importance of volitional control of action to students' performance (Corno, 1989; 1993; Kuhl, 1994; 2000; Wolters et al., 2003) but it is unclear whether this inventory is comprehensive or optimal in its selection of predictors.

Like the MSLQ, the Learning and Study Strategy Inventory (LASSI; Weinstein, Zimmerman, & Palmer, 1988) is a multi-measure (10-scale) assessment inventory designed to identify tertiary-level students' strengths and weaknesses. The two inventories overlap substantially but use different nomenclature. For example, measures of (i) information processing, (ii) selecting main ideas, (iii) self testing, (iv) motivation, and (v) time management, in the LASSI map directly onto the MSLQ measures of (i) elaboration, (ii) organization, (iii) meta cognition, (iv) effort regulation, (v) and time/study management, respectively. The LASSI also assesses test strategies, study aids, and "attitude" but these have rarely been investigated as correlates of tertiary GPA and so are not included in our analyses.

To clarify the labelling of these self- regulatory measures we have provided a supplementary table (Table S1) listing measures, and labels used in the MSLQ, the LASSI and in this study.

Overall then, we have identified 11 distinct but related self-regulatory learning capacities that may be correlated with GPA, namely, test anxiety, rehearsal, organization, elaboration, critical thinking, meta cognition, effort regulation, help seeking, peer learning, time/study management, and concentration.

Students' Approach to Learning (SAL) Models

SAL models provide broader characterizations of learning tendencies than assessments of self-regulatory strategies (Pintrich, 2004). Three broad approaches to learning have been identified (Biggs, 1987; Craik & Lockhart, 1972; Entwistle, Hanley & Hounsell, 1979). The *deep* approach is characterized by learning strategies such as critical evaluation and information syntheses combined with an intrinsic motivation to learn. By contrast, *surface* approaches involve shallow cognitive strategies such as memorization, and rehearsal in combination with an extrinsic motivation. Finally, students' adopting a *strategic* approach are thought to use both 'deep' and 'surface' strategies depending on the importance and characteristics of the task. Deep strategies are assumed to promote optimal learning and enhanced performance although the relationship between SAL and achievement may be moderated by assessment method (Boyle, Duffy & Dunleavy, 2003), task (Dart, & Clarke, 1991) and teaching style (Duff, 1999; Ramsden, 1979; Richardson, 1995; Wilson, Smart & Watson, 1996) highlighting the importance of context and students' perceptions of context. SAL models encompass motivational and self-regulatory constructs. Thus the question arises as to whether these 3 approaches to learning (deep, surface and strategic) are redundant or useful additional characterizations of students' capacities and tendencies that facilitate prediction of GPA.

Psychosocial Contextual Influences

Prior to the work of Tinto (1975) and Bean (1980) research on student attrition and work persistence had focused on student characteristics. Tinto's educational persistence model focused on "the impact that the institution itself has, in both its formal and informal manifestations, on the withdrawal behaviors of its own students" (Tinto, 1982, p. 688). According to this model, university systems interact with student characteristics (e.g., sex, ethnicity, and values) and experiences (e.g., past achievement) to determine students' degree of interaction with social (e.g., peers), and academic systems (e.g., academic advisors and wider university systems). Optimal adjustment results in stronger *social, academic* and *institutional integration* as well as greater *goal commitment* (e.g., commitment to obtaining a degree) which supports students' persistence, and academic achievement. Students whose academic experiences create conflicts with previously-established beliefs and values may find integration challenging (Tinto, 1993) and, therefore, do less well. Similar research by Bean (1980) and colleagues (Bean & Metzner, 1985; Metzner & Bean, 1987; Elkins, Braxton, & James, 2000; Stoecker, Pascarella, & Wolfle, 1988) highlighted external influences on integration such as family support, finances, and hours of paid employment. These contextual influences are thought to shape students' responses to university life including affective responses such as *stress*, and *depression*, in addition to goal commitment, and value assessments which, in turn, affect integration and academic performance.

We have identified 8 psychosocial contextual influences. These include three aspects of organizational integration, namely (i) social, (ii) academic, and (iii) institutional integration and five other factors (iv) goal commitment, (v) social support, (vi) general stress, (vii) academic stress and, (viii) depression.

Demographic Correlates of GPA: Age, Sex and Socioeconomic Status

Population demographics and political positions on higher education have changed over time in the US and Europe resulting in more diverse student populations. It is important,

therefore, to explore the role of demographic influences on academic achievement. Recent trends show that, on average, students from higher socioeconomic backgrounds and women attain higher GPAs than their respective counterparts (e.g., Dennis, Phinney & Chuateco, 2005; LaForge & Cantrell, 2003; Robbins et al., 2004; Smith & Naylor 2001). It has been suggested that higher socioeconomic status facilitates effective academic and social adaption to university; however, questions remain about the gender gap in performance with course selection, assessment methods and psychological characteristics identified as possible influences. Older students are also expected to adapt better to university situations (Clifton, Perry, Roberts, & Peter 2008) but mixed findings are reported with some studies showing that older students achieve higher GPAs (Clifton, Perry, Roberts, & Peter 2008; Etcheverry, Clifton, & Roberts, 2001) but others failing to observe this association (Farsides & Woodfield, 2007; Ting & Robinson, 1998). Consequently, we included age, gender, and socioeconomic status in our analyses.

Which Correlates of GPA are most important?

Previous reviews have considered predictors of undergraduate GPA drawing upon subsets of the literature we have considered. The most comprehensive by Robbins et al. (2004) reviewed a range of motivational, skill and contextual factors. These authors found that achievement motivation, here referred to as effort regulation (Pintrich, 2004), and academic self-efficacy were the best predictors of GPA and that women students and those from higher socioeconomic status backgrounds attained high GPA scores.

In a meta analyses of relationships between Five-Factor personality traits and GPA, O'Connor & Paunonen (2007) report a small to medium effect size for conscientiousness and very small effects for extraversion, neuroticism, openness and agreeableness. This pattern was largely confirmed in a comprehensive meta analyses by Poropat (2009) who also found support for a predictive role for conscientiousness over and above that of intelligence.

Similarly, a review by Steel (2007) found that procrastination was moderately and negatively associated with GPA. Measures of need for cognition and emotional intelligence have also been shown to have small effects on GPA (Cacioppo & Petty, 1982; Parker, Duffy, Wood, Bond & Hogan, 2005a).

Evidence for other academic goals and GPA is less clear. A review by Payne, Youngcourt and Beaubien (2007) found a very small negative relationship between performance avoidance goals and GPA and little evidence of a relationship between performance approach goals and GPA. Yet, in a similar review, Linnenbrink-Garcia, Tyson, and Patall (2008) found evidence of small positive relationships between GPA and both performance approach goals and learning goals. However, Pekrun, Elliot, and Maier (2009) concluded that the effect of learning goals is weak and may disappear when controlling for the effects of other academic goals.

The Present Study

Our review identified 5 traditional correlates of tertiary GPA (intelligence, SAT, ACT, high school GPA and 'A' level points) and 3 demographic factors (sex, age and socioeconomic status). In addition, we identified 42 non-intellective constructs that have been identified as potentially useful correlates of tertiary GPA. We grouped these into 5 conceptually overlapping research areas: personality traits (8 constructs), motivational factors (12 constructs), self-regulatory learning strategies (11 constructs), students' approaches to learning (3 constructs) and psychosocial contextual influences (8 constructs) (see Table 1). As the direction of an effect cannot be reliably inferred from cross-sectional measurement, study design was explored as a moderator, i.e., prospective design measuring the predictor prior to the assessment of GPA versus cross-sectional association at the same point of time.

This diverse literature raises a series of questions answerable by quantitative analysis: (i) how strong are the univariate associations between these diverse constructs and

GPA, (ii) are observed correlations moderated by cross-sectional versus prospective study designs, (iii) which constructs are most important within the five research domains we have identified, (iv) do non-intellective constructs explain additional variance in GPA controlling for traditional correlates [as defined above], and (v) can we construct a comprehensive but parsimonious model of factors that most strongly influence university students' academic attainment.

Method

Searches and Inclusion Criteria

A systematic search was undertaken in three stages to locate primary articles. Search terms contained adjectives or derivatives of "determinants", "academic achievement" and "undergraduate student" that were combined using a series of Boolean and/or operators and wildcards (see Supplementary Table S2). These combinations were used to search psycINFO and the Web of Knowledge databases between 1997 and 2010. Only English language journals were considered and studies conducted outside Europe or North America were excluded because so few studies were located. This search yielded a total of 7167 records that were exported into a reference citation manager where titles and abstracts were screened for relevance.

At stage 2, studies were included if they reported an association between a measure of GPA and a measure of at least one non-intellective construct listed in Table 2. At stage 3; ancestry (searching the references of included articles) and descendency (searching articles citing included articles using Web of Knowledge) searches were conducted to locate further primary articles of potential relevance. These were then screened using the stage 2 inclusion criterion. This process continued cyclically until no new articles emerged. More than 400 papers were read. However, relevant data were not obtainable for many. After duplicate

datasets were excluded this process generated 217 papers that contained 242 unique datasets (55 in Europe and 186 in North America).

The effect size *r* was used to represent the direction and strength of associations between GPA and its correlates because it is the most common effect size measure used in studies of academic performance. GPA measures included students' overall degree marks, quarter, semester, course or test marks. Where papers reported demographic constructs, namely age, sex and socioeconomic status and the following intellective constructs; SAT, ACT, 'A' level points, high school GPA and general intelligence these were also included. Where data were missing, authors were contacted and when authors did not respond, data were transformed into *r* wherever possible; *t, F* (for 2 groups), and X^2 values were transformed (see e.g. Hunter & Schmidt, 1990, for formulae). Papers from which data were extracted are marked with an asterisk in the reference section.

Measures and Data Extraction

Measures of cumulative GPA over semester(s) or year(s) (GPA_{cum}) provide the most reliable proxy of undergraduate achievement while GPA over a shorter time span (e.g., a single course or test situation) (GPA_{course}) contain less information. To obtain a reliability coefficient for GPA_{course}, *r*s between GPA_{cum} and GPA_{course} were meta analysed. Results showed a true score correlation of .59 ($k = 9$, $N = 1581$) for GPA_{cum}/GPA_{course} combinations. Consequently, a reliability coefficient of 1 was assigned to measures of GPA_{cum} and a coefficient of .6 assigned to measures of GPA_{course}.

Table 2 shows representative measures and items used to assess the 42 non-intellective constructs considered in this study. Where standardised measures were not used, data were only coded if illustrated items or clear definitions were provided that corresponded to the definitions listed in Table 2. In combination with the demographic (age, sex and socioeconomic status) and traditional constructs (SAT, ACT, high school GPA &

intelligence) 50 constructs were considered. Measures of socioeconomic status typically

assessed income and educational levels (e.g., Robbins, Allen, Casillas, Peterson & Le, 2006)

while intelligence was measured using validated assessment instruments such as the revised

Wechsler Adult Intelligence Scale (Wechsler, 1981). The following data were coded from

each primary article where present:

(a) full reference details

(b) study location [Europe/North America]

(c) GPA type [GPA_{cum}/GPA_{course}]

(d) construct(s)

(e) internal reliability of construct(s)

(f) correlation type (g) correlation effect size and direction

(h) effect size N

(i) study design [prospective/cross-sectional/mixed/unknown].

Correlations were reversed scored where necessary so that higher scores represented

higher levels of the defined construct. Prospective data were extracted when possible and is

identified here using the abbreviation 'pro' while data measured concurrently is identified as

'cs' (cross-sectional). For some correlations the data were a mixture of cross-sectional and

prospective data (e.g., where cumulative GPA was a combination of future and past behavior)

and is identified as 'mixed'. In other studies it was not possible to determine the design from

the report. In these cases the data is identified as 'notk' (not known). Information on study

design was collated for the non-intellective factors only as traditional correlates and

demographic information were generally retrospective rather than self reported in real time;

measures of intelligence were an exception but it is well known that test scores are fairly

stable over time (Jones and Bayley, 1941)

Following Hunter and Schmidt's (2004) recommendations, no more than two conceptually equivalent construct/GPA combinations from any one study entered the analysis. When three or more measures of GPA criterion and/or conceptually equivalent constructs were reported data were combined to create a composite. Where multiple measures of GPA were not independent only the most reliable measure of GPA (that is GPA$_{cum}$) was extracted. In such instances, composite correlations were calculated where possible using Hunter and Schmidt's (2004) formula; otherwise, correlations were averaged. The sample N was reported in all cases (Hunter & Schmidt, 2004). Where psychological composites were calculated the Spearman-Brown formula (see Hunter & Schmidt, 2004) was used to calculate corresponding internal reliabilities and the reliabilities of averaged correlations were averaged . All remaining correlations were either bivariate rs as reported in the original source or data that were transformed into a correlation coefficient from information contained in the report; corresponding alpha reliability coefficients were recorded wherever possible. When reliability estimates were not provided, such information was obtained from the inventories' manuals and/or previous articles that had reported the reliability of corresponding scales. The reliability of demographic variables, SAT, ACT, 'A' level points, high school GPA and intelligence were assumed to be 1 unless information contained in the report stated otherwise.

Inter-Rater Reliability

Prior to analysis, 54 (25%) distinct datasets were selected at random and coded by two independent, doctoral, psychology students according to the construct definitions provided in Table 2. Constructs were identified as being present or absent for each dataset resulting in 54 Kappa scores. Perfect agreement is indicated by a score of 1.0. Observed scores ranged from .62 – 1.0 with 47/54 (87%) recorded as 1.0.

Analytic Strategy

Hypotheses were examined in three analytic steps. First meta-analyses were conducted to generate average weighted correlations (r^+) between GPA and each other separate construct. Second, moderator analyses using study design (prospective versus cross-sectional) were conducted where sufficient data were available. Third, a series of regression analysis were conducted to test which particular constructs (for which data were available) were the best predictors of GPA. GPA was regressed onto all relevant constructs within each of the five non-intellective domains. Regression analyses was also conducted to explore which of the best predictors of GPA (for which data were available) explained variation over and above the traditional assessment methods already used in practice. Colleges in North America typically use either the SAT or ACT, so these were treated as a single construct in the regression models alongside high school GPA. A further regression model examined a cross-domain integrative model of academic performance that included the most significant measures of GPA.

Meta Analyses

Meta analyses were conducted using a random effects model because accumulated evidence suggested heterogeneity in effect sizes (National Research Council, 1992). Following Hedges and Olkin, (1985) correlations were first transformed into Fisher's Z and then back transformed to provide mean observed (r^+) effect size. Corresponding 95% confidence intervals were also calculated. To assess the residual variance I^2 and Q statistics were calculated. Cochran's (1954) Q statistic reflects the total amount of variance in the meta analysis whereas Higgins and Thompson's (2002) I^2 value indexes the proportion of variance that is due to between-study differences and unlike the Q statistic, it is not sensitive to the number of associations considered. A statistically significant Q statistic indicates substantial heterogeneity whereas I^2 values range from 0 to 100% and it has been suggested that values of 25%, 50%, and 75% indicate low, moderate and high heterogeneity, respectively

(Higgins, Thompson, Deeks & Altman, 2003). In addition, rho correlations were calculated in which observed correlations were corrected for measurement error in the GPA criterion and the predictor variable using the Hunter and Schmidt (2004) approach. Credibility intervals of 95% around the mean rho correlations and corresponding χ^2 was also calculated (Hunter & Schmidt, 2004) to assess the validity of generalizing from calculated mean effects.

Our analyses were inspected after the removal of outliers and influential cases to identify when our conclusions would be substantially altered by their omission. Following Viechtbauer and Cheung (2010), 3 indices were drawn on; studentized deleted residuals; DFFITS and Cook's distance. Viechtbauer and Cheung (2010) suggest some rules of thumb for when these indices indicate that the effect of possible outliers or influential cases may require some further scrutiny. In terms of the studentized deleted residuals, they suggest that finding more than k/10 residuals greater than ± 1.96 would be unusual. For the DFFITS$_i$ measure, Viechtbauer (2011) suggests that, for a random effects model, a value greater than $3\sqrt{1/(k-1)}$ where k is the number of effects, require closer inspection. For the Cook's distance measure, he suggests inspecting cases where the resulting value exceeds the value of χ^2, df = 1, that cuts off 0.5 in the lower tail area. We have used all three criteria in evaluating the effect of outlying studies on our results.

Publication of statistically significant results is more probable (e.g., Greenwald, 1975) and this increases the likelihood of type 1 errors (and an over estimation of the mean effect size) in meta analysis. To examine this potential bias, we applied Duval and Tweedie's (2000) "trim-and-fill" procedure which first estimates the number of studies that may be missing due to publication bias. Missing studies are subsequently imputed and the effect size recalculated. The package 'Metafor' in R (Viechtbauer, 2010), Field and Gillett's (2010) macros, and Cheung's (2009) LISREL syntax generator were used for all the analyses.

Results

Data Description

A total of 1105 independent correlations were analyzed (911 relating to non-intellective constructs, 59 to demographics, and 135 to traditional constructs, i.e., SAT, ACT, high school GPA, 'A' level points, and intelligence). Of these, 768 and 337 were correlations with measures of GPA_{cum} and GPA_{course}, respectively. Of the non-intellective associations, 400 were prospective, 228 were cross-sectional, and 108 were of mixed design. The design of 175 correlations could not be determined. Table 3 details the design and GPA criterion information for each construct separately.

Meta analyses of the following constructs were based on five or less independent correlations: UK 'A' level points, need for cognition, performance self-efficacy, peer learning, and academic-related stress (Ns ranged from 933 to 1418; ks from 4 to 5). Other correlations were based on good sample sizes (Ns ranged from 1026 to 75000) drawn from larger numbers of samples (ks ranged from 6 to 69).

Table 4 presents the meta-analytic results for each correlate and includes details of sample size (N) and the number of independent correlation coefficients (k) that each mean, weighted correlation is based on. For each construct, the mean, weighted correlation (r^+) and corresponding 95% confidence intervals (CIs), I^2 and Q statistics are reported. The rho (ρ) correlations are reported together with 95% credibility intervals (CVs) and finally, based on r^+, an estimation of the number of studies missing due to publication bias is reported and where this is greater than 0, the corresponding adjusted effect size is also reported. Figure 1 details r^+ and corresponding 95% CIs of the 42 non-intellective constructs.

We applied Cohen's (1992) useful guidelines on interpretation of the magnitude of sample-weighted average correlations (r^+). According to Cohen, $r^+ = .10$ is 'small', $r^+ = .30$ is 'medium' and $r^+ = .50$ is 'large'.

Demographics (Sex, Age, Socioeconomic Status) and Traditional Factors (SAT, ACT,

High School GPA, 'A' Level Points and Intelligence)

Correlations between GPA and socioeconomic background, sex and age, indicated that,

in general, students from higher socioeconomic backgrounds (r^+ = .11, 95% CI [.08, .15]),

older students (r^+ = .08, 95% CI [.03, .13]) and female students (r^+ = .09, 95% CI [.15, .04])

obtained higher grades. These demographic effect size estimates were small.

Measures of high school GPA (r^+ = .40, 95% CI [.35, .45]), SAT (r^+=.29, 95% CI [.25,

.33]), and ACT (r^+ =. 40, 95% CI [.33, .46]) were, as expected, positive, medium-sized

correlates of GPA. 'A' level points in the UK, (r^+ = .25, 95% CI [.12, .38]) and measures of

general intelligence (r^+ = .20, 95% CI [.16, .24]) revealed small, positive, average

correlations with GPA.

Personality Traits

As expected, conscientiousness, (r^+ = .19, 95% CI [.17, .22]) was the strongest

correlate of GPA among the Big Five personality factors. None of the remaining Big Five

Factors were important correlates of GPA (agreeableness, r^+ = .07, 95% CI [.04, .09],

openness, r^+ = 09, 95% CI [06, .12], extraversion, r^+ = -.04, 95% CI [-.07, -.02], and

neuroticism r^+ = -.01, 95% CI [-.04, .01]). CIs for neuroticism crossed zero.

Need for cognition (r^+ =.19, 95% CI [.04, .33]) and emotional intelligence (r^+ = .14,

95% CI [.10, .18]) showed small positive, significant correlations with GPA whereas

procrastination was found to have a small, negative, average correlation with GPA (r^+ = .22,

95% CI [-.27, -.18]) which was marginally larger than the conscientiousness/GPA

correlation.

Motivation Factors

Measures of optimism, locus of control and self-esteem were found to have small

correlations with GPA (r^+s = .11, 95% CI [.04, .17], .13, 95% CI [.04, .22] and .09, 95% CI

[.05, .13], respectively) whereas pessimistic attributional style (for negative academic events) was unrelated to GPA (r^+ = .01, 95% CI [-.12, .13]). With the exception of pessimistic attributional style, CI intervals did not cross zero indicating that these effects were statistically different from zero.

As expected, intrinsic motivation (r^+ =.17, 95% CI [.12, .23] was a small, significant, positive correlate of GPA whereas extrinsic motivation (r^+ =.01, 95% CI [-.06, .08]) was not significantly associated with GPA. Learning goal orientation (r^+ =.10, 95% CI [.09, .13]) and performance goal orientation (r^+ = .09, 95% CI [.06, .12]) were found to have small, positive correlations with GPA whereas performance avoidance goal orientation showed, as expected, a small negative association with GPA (r^+ = -.14, 95% CI [-.18, -.09]). Medium correlations were observed between GPA and academic self-efficacy (r^+ = .31, 95% CI [.28, .34]) and grade goal (r^+ = .35, 95% CI [.28, .42]). Grade goal was the second largest correlate of GPA. Performance self-efficacy was strongly associated with GPA (r^+ = .59, 95% CI [.49, .67]) and was the largest effect observed.

Self-Regulatory Learning Strategies

Four information processing strategies namely, meta cognition (r^+ = .18, 95% CI [.10, .26]), critical thinking (r^+ = .15, 95% CI [.11, .18]), elaboration (r^+ = .18, 95% CI [.11, .24]) and concentration (r^+ = .16, 95% CI [.14, .19]) that represent deep learning were found to have small, significant, positive correlations with GPA. By contrast, measures of organization and rehearsal learning were not significantly associated with GPA (r^+ = .04, 95% CI [= -.06, .15] and r^+= .01, 95% CI [-.07, .10], respectively).

Considering measures of behavioral self-regulation, we found that time/study management, (r^+ = .22, 95% CI [.14, .29], help seeking (r^+ = .15, 95% CI [.08, .21]) and peer learning (r^+ = .13, 95% CI [-.06, .31]) were small positive correlates of GPA, although the CI intervals around peer learning crossed zero. Effort regulation (r^+ = .32, 95% CI [.29,

.35]) showed a medium, positive correlation with GPA where test anxiety (r^+ = -.24, 95% CI [-.29, -.20]) showed a small, negative correlation with GPA.

Students' Approaches to Learning

The relationship between 'surface' learning and GPA was small and negative *(r^+ = -.18, 95% CI [-.25, -.10])* where as 'deep' (r^+ = .14, 95% CI [.09, .18]) and 'strategic' (r^+ = .23, 95% CI [.17, .30]) approaches to learning were found to have small, positive associations with GPA.

Psychosocial Contextual Influences

Goal commitment was the strongest correlate of GPA from Tinto's (1975) student dropout model but was found to have only a small, positive association with GPA (r^+ = .15, 95% CI [.07, .22]). Social (r^+ = .04, 95% CI [-.02, .10]), academic (r^+ = .07, 95% CI [-.00, .14]), and institutional (r^+ = .04, 95% CI [.01, .08]) showed very small associations and CIs for social and academic integration crossed zero, indicating that these effects were not significantly different from zero. Measures of psychological health and social support were correlated with GPA in the expected direction with small, negative effects of general stress (r^+ = -.13, 95% CI [-.19, -.06]) and academic stress, (r^+ = -.12, 95% CI [-.21, -.02]) and a small, positive effect of social support (r^+ = .08, 95% CI [.03, .12). Depression was found to have a small, negative association (r^+ = -.10, 95% CI [-.17, .02]) that was not statistically significant as indicated by the CI crossing zero.

Outliers and Influential Cases

The number of outliers did not exceed k/10 (rounded up to the nearest integer value) in any of our analyses. When either the DFFITS value was greater than $3\sqrt{1/(k-1)}$ or the Cook's distance exceeded χ^2, df = 1, we re-ran the analysis to recalculate the average effect size with that study excluded. Analyses were re-run for 22 of the 50 constructs;   for all except one analysis, only one outlier needed to be excluded according to these criteria. In one

analysis, two outliers were, separately, excluded. The effect of excluding the outlier was trivial in all but one analysis. The average correlation computed excluding the outlier did not differ by more than 0.05 from that obtained with the outlier included, and in none of these cases did this small discrepancy affect the direction or effect size interpretation. In one analysis; the peer learning/GPA combination, the discrepancy was a little larger that the others (.08) but this association was non-significant with and without outliers as indicated by CIs that crossed zero.

Publication Bias

Duval and Tweedie's trim and fill analyses led to a difference $>$ 0.05 in two of the 50 constructs tested; ACT ($r = .40$ before and $r = .50$ after missing studies imputed; $k = 21$) and meta cognition ($r = .18$ before and $r = .12$ after missing studies imputed; $k = 9$) indicating that publication bias may be a problem for these measures leading to an underestimation of the effect of ACT and an overestimation of the effect of meta cognition on GPA. As most colleges accept SAT and/or ACT scores, following Robbins et al., (2004) these measures were combined, $r = $ 0.34   95% CI [.30, .38] in the cross-domain multivariate models (see below).

Moderator Analysis

Nine of 42 non-intellective constructs obtained a non-significant $r+$ as indicated by CIs that crossed zero (neuroticism, pessimistic attributional style, academic extrinsic motivation, rehearsal, organization, peer learning, social integration, academic integration and depression). Of the remaining non-intellective constructs, with the exception of procrastination, emotional intelligence, optimism, critical thinking, effort regulation, concentration, stress (in general) and academic stress the associated Q statistics were significant, and I^2 values large. Additionally, the credibility intervals around the rho correlations were relatively wide indicating that there is substantial variation in the individual

correlations across the studies. Study design (prospective vs. cross-sectional measurement) was examined as a potential moderator where there was sufficient data to support these analyses ($k > 5$ in each sub-group; Borenstein, Hedges, Higgins, & Rothstein, 2008); sufficient data for 14 constructs were available   For the moderation analyses, sub-group analysis was performed by grouping the associations by study design (prospective vs. cross - sectional measurement) and assessing heterogeneity between groups using the between-group Q statistic within a random effects model. Results revealed no moderating effect for the relationships between GPA and conscientiousness, neuroticism, openness, agreeableness, performance goal orientation, avoidance goal orientation, test anxiety, social integration or social support. Significant between-group Q statistics were found for relationships between GPA and extraversion, academic self-efficacy, self-esteem, learning goal orientation and intrinsic motivation. Table 5 presents the findings of the moderator analyses. When extraversion was examined concurrently with the GPA criterion lower weighted averages were obtained than in prospective studies (mean difference = .09, between-group Q = 7.16, p < .01); however the CI intervals in the cross-sectional sub-group crossed zero making these effects difficult to interpret. As expected, significantly lower weighted average effect size estimates were obtained for prospective versus cross-sectional studies for relationships between GPA and academic self-efficacy (mean difference =.12, between-group Q = 23.49, p < .001), self-esteem (mean difference =.12, between-group Q = 6.62, p < .05), learning goal orientation (mean difference =.06, between-group Q = 4.64, p < .05) and intrinsic motivation (mean difference =.15, between-group Q = 6.68, p < .05) although with exception of academic self efficacy and learning goal orientation the CI intervals crossed zero in the prospective sub groups limiting the interpretation of these findings.

Regression Analysis

Cheung and Chan's (2005; 2009) two stage structural equation modeling (TSSEM) was used to examine regression models *within* each domain (i.e., personality, motivation, self-regulatory learning, students' approaches to learning, and psychosocial contextual influences). Stage 1 estimates the pooled correlation matrix and its asymptotic covariance matrix while Stage 2 fits the proposed model to the pooled correlation matrix. Where constructs obtained a significant $r^+ > .10$ with GPA and where relevant data were reported in the primary manuscripts, multivariate models were conducted. Table 6 reports the beta coefficients and model statistics for the regression analyses. The table also reports the number of matrices each analysis was based on and how many of these contained all of the focal constructs. The pooled correlation matrixes can be obtained from the first author on request.

Personality trait regression models.

Four trait measures obtained $r^+ > .10$ (conscientiousness, procrastination, need for cognition and emotional intelligence) although no study reported data including all of these measures. However, data for conscientiousness/procrastination, conscientiousness/NFC and conscientiousness/emotional intelligence combinations were available. Conscientiousness ($\beta = .13$) and procrastination ($\beta = -.17$) accounted for 7% of the variance in GPA whereas both conscientiousness ($\beta = .17$) and need for cognition, ($\beta = .09$) and conscientiousness ($\beta = .18$) and emotional intelligence ($\beta = .11$) account for 5% of the variation in GPA.

Motivation factors regression models.

Seven constructs obtained $r^+ > .10$; locus of control, optimism, academic self-efficacy, performance self-efficacy, intrinsic motivation, avoidance goal orientation and grade goal. No studies contained all seven measures but a model including 3 constructs (locus of control, academic self-efficacy and grade goal) was tested. In this model 14% of the variance in GPA

was explained with small beta coefficients for locus of control ($\beta = .02$) and larger

coefficients for academic self-efficacy ($\beta = .10$) and grade goals ($\beta = .31$).

Self-regulatory learning strategies regression model.

Among the self-regulatory strategies, test anxiety and several cognitive (elaboration,

critical thinking, meta cognition and concentration), and behavioral (effort regulation, help

seeking, and time/study management) constructs obtained an $r^+ > .10$. No study included

all of these measures but a model combining cognitive and behavioral constructs could be

tested. Results show that effort regulation ($\beta = .32$) was the most important predictor of

GPA while βs for the remaining factors ranged from .02 to .07 collectively accounting for 10

% of the variance.

Students' approaches to learning regression models.

All three SAL constructs met the inclusion criteria. The following Beta coefficients

were obtained for 'deep', ($\beta = .06$), 'surface' ($\beta = -.14$) and 'strategic' ($\beta = .23$) learning and

combined accounted for 9% of the variance.

Psychosocial contextual influences regression models.

Of the psychosocial contextual constructs, stress (in general), stress relating to

academia, and goal commitment obtained r^+ s $>.10$; however no study contained all three

constructs so no models were tested.

Cross-Domain Regression Models

We tested a cross-domain model in three stages. First, the predictive utility (meant here

in a statistical sense) of each relevant non-intellective predictor was examined separately,

after controlling for the traditional correlates (high school GPA and SAT/ACT). Second, non-

intellective predictors were entered into a hierarchical regression model in separate steps in

accordance with a theoretically-specified model proposing that more global and invariant

personality traits influence behavior through proximal processes (Burmudez, 1999; Chen,

Gully, Whiteman, & Kilcullen, 2000; Lee, Sheldon & Turban, 2003; Phillips & Gully, 1997; Roberts & Wood, 2006; Vallerand & Ratelle, 2002). Third this hierarchical regression model was tested again after first adding high school GPA and SAT/ACT.

Five psychological constructs (conscientiousness, academic self-efficacy, grade goals, test anxiety and effort regulation) were included because (i) their average relationship with GPA was relatively strong (ii) they were identified as important predictors in the within group analyses, and (iii) there was sufficient data available to test these associations. Table 7 shows the inter correlations between these constructs, GPA, high school GPA and SAT/ACT.

Table 8 shows that conscientiousness (β = .14), effort regulation (β = .22), test anxiety (β = $-$.13), academic self-efficacy (β = .18), and grade goal (β = .17) were each, individually, significant predictors of GPA in separate regressions controlling for high school GPA and SAT/ACT.

In building the hierarchical regression model, we initially entered conscientiousness, followed by the more-situated, proximal measure of effort regulation. Test anxiety, academic self-efficacy and grade goals were added sequentially. Conscientiousness explained significant additional variance but the coefficient was reduced in size after effort regulation was added to the model. In addition to effort regulation, test anxiety, academic self efficacy and grade goal accounted for a unique proportion of variance in GPA collectively accounting for 20% of the variance.

Table 9 shows the results of this regression model after first controlling for traditional correlates by entering high school GPA and SAT/ACT as initial steps followed by the non intellective constructs in the order specified above. High school GPA and SAT/ACT collectively explained 22% of the variance in GPA. Addition of these tradition correlates reduced the effects of test anxiety and conscientiousness to non-significance and that of grade

goal to marginal statistical significance. Thus in the final model, effort regulation ($\beta = .17$), academic self-efficacy ($\beta = .11$) and grade goal ($\beta = .08$) explained an additional 6% of the variance over and above high school GPA and SAT/ACT, so that the five-step model (including high school GPA, SAT/ACT, effort regulation, academic self-efficacy and grade goal) accounting for 28% of the variance in GPA.

To control for possible publication bias we ran the same models again; first using the adjusted SAT/ACT score, $r = .41$ (versus the unadjusted score, $r = .34$) and second removing ACT scores and controlling for high school GPA and SAT only. The effect of grade goals was reduced to non-significance ($\beta = .06$) controlling for the adjusted SAT/ACT score; otherwise the pattern of results remained the same. The effect of grade goals was restored ($\beta = .10$) in the model controlling for SAT and high school GPA. Self-efficacy ($\beta = .13$) and effort regulation ($\beta = .15$) retained statistically significance.

Discussion

This review synthesized 13 years of research into the antecedents of university Students' grade point average scores. More than 400 papers were read. These yielded 242 datasets including correlations between tertiary GPA and 50 conceptually-distinct constructs. In addition to 3 demographic factors (age, gender and socioeconomic status) and 5 traditional measures of cognitive capacity or prior academic performance (SAT, ACT, intelligence, SAT, ACT, high school GPA, and 'A' level points), 42 distinct non-intellective constructs were identified. A conceptual analysis of theoretical models and hypotheses underpinning studies of non-inellective constructs highlighted 5 conceptually-overlapping but broadly distinct research domains, namely investigations of: (1) personality traits, (2) motivational factors, (3) self-regulatory learning strategies, (4) students' approaches to learning, and (5) psychosocial contextual influences. In the discussion below we; (i) review the magnitude of

average, weighted correlations with tertiary GPA both within and across these 5 research domains, (ii) examine moderation of such associations by cross sectional versus prospective study design, (iii) consider multivariate models accounting for cumulative variance within research domains, (iv) discuss cross-domain, multivariate models of tertiary students' potential and the implications for development of assessment inventories, (v) compare our findings to those of pervious reviews, (vi) identify limitations of this review, (vii) reflect on the design and evaluation of interventions to optimize tertiary student potential and, finally (viii) highlight key conclusions for research and practice.

Magnitude of Average, Weighted, Bivariate Correlations with Tertiary GPA

Drawing upon 1105 independent correlations, hypotheses-driven, random effects, meta analyses revealed that 41 of 50 constructs were significantly associated with GPA.

Consistent with previous findings (e.g., Smith & Naylor, 2001), female students and those from higher socioeconomic backgrounds obtained higher GPA as did older students; however, these effects were small (rs = .08 - .11).

Measures of general intelligence had a small positive association with GPA but, confirming previous findings (e.g., Robins et al., 2004), high school GPA, SAT and ACT were, or approached, medium-sized positive correlates (rs = .29 - .40). Interestingly, ACT was a stronger predictor of GPA than SAT especially after imputation of missing studies due to potential publication bias; further research including examination of the grey literature is needed to validate this finding.

In UK data, a small correlation was observed between 'A' level points and university GPA (r = .25), again reflecting previous findings (Peers & Johnson, 1994). It may be that use of more standardized national assessments (compared to North America) and higher overall grade attainment has attenuated the school-university performance association in the UK (McDonald, Newton, Whetton & Benfield, 2001).

Focusing on the largest, average non-intellective correlates by research domain, we found that, of 8 personality measures, procrastination, conscientiousness and need for cognition were the largest, albeit small, correlates of GPA (rs = .19 - .22).

Of 12 motivational factors, medium positive correlations were observed for academic self-efficacy (r = .31) and grade goal (r = .35) while a large positive correlation was found for performance self-efficacy (r = .59). Performance self-efficacy and grade goal were the strongest of the 42 non-intellective associations tested. Of 11 measures of self-regulatory capacities, only effort regulation obtained a medium sized association (r =.32) with test anxiety being the next strongest correlate (r = -.24).

Small average correlations were observed for measures of 3 approaches to learning and 8 psychosocial contextual factors, with the strategic approach, general stress and academic stress showing the largest associations (rs = .23 - -.15 - & -.12, respectively).

Discounting small correlations, performance self-efficacy, grade goal, effort regulation and academic self-efficacy emerged as the strongest correlates of tertiary GPA, alongside traditional assessments of cognitive capacity and previous performance. This pattern of findings emphasizes the importance of specific, potentially-modifiable cognitions and self-regulatory competencies. Measures of relatively more stable individual characteristics (e.g., intelligence, conscientiousness and procrastination), approaches to student learning (superficial, deep or strategic) and psychosocial contextual factors (e.g., general and academic stress) were *not* found to have medium or large average correlations with GPA.

Small correlations can, however, be important, especially if they represent population-relevant effects. Consequently, models of GPA antecedents should not necessarily overlook the 22 small-sized correlates identified here (see Table 2 for definitions). For clarity, these are listed by research domain below.

1. Personality traits; procrastination (negatively correlated), conscientiousness, need for cognition, and emotional intelligence.

2. Motivational factors; locus of control, optimism, and intrinsic motivation, learning goal orientation, and avoidance goal orientation (negatively correlated).

3. Self-regulatory learning strategies; elaboration, critical thinking, use of meta cognition, help seeking, time/study management, concentration and, test anxiety (negatively correlated).

4. Approaches to learning; having a strategic, deep, or surface (negatively correlated) approach.

5. Psychosocial contextual influences; goal commitment, experiencing general stress or stress relating to university work (both negatively correlated).

Whether these small associations are of practical importance to the assessment of university students' potential or the design of cost effective interventions to optimize such potential is likely to depend on the extent to which they uniquely explain variance in GPA over and above medium and large correlates.

Moderation by Study Design

Available data strictly limited the extent to which we could test moderation effects. Cross-sectional correlations were found to overestimate associations with GPA, compared to prospective tests of academic self-efficacy and learning goal orientation. The same pattern was found for self-esteem and academic intrinsic motivation, although confidence intervals crossed zero in the prospective sub group. Similarly, cross-sectional studies of the extraversion-GPA relationship appeared to underestimate the predictive capacity of this personality trait (relative to prospective studies) but confidence intervals in the cross-sectional sub-group crossed zero. These findings emphasize the importance of measuring predictors of academic GPA using prospective (rather than cross-sectional or retrospective)

designs. We also recommend that future research is designed to test the potential moderation effects of demographic factors and degree and institutional characteristics.

Within-Domain Multivariate Models

Where possible, we conducted regression analyses to explore the extent to which multivariate models explained cumulative variance in GPA within the five identified research domains. Procrastination, arguably a facet of conscientiousness (Steel, 2007) explained somewhat greater variance in GPA than conscientiousness itself suggesting that procrastination may be primarily, although not necessarily exclusively, responsible for the effect of conscientiousness on tertiary GPA. These measures combined accounted for 7% of the variance. Two separate models revealed that need for cognition and emotional intelligence explained additional variance controlling for conscientiousness. Both models accounted for 5% of the variance in GPA. Although personality measures showed only small-sized associations with GPA, these results demonstrate that traits other than those specified by the Five Factor model may be important to assessing students' potential.

A model of 3 motivational constructs (academic self-efficacy, grade goal and locus of control) explained 14% of variance in GPA with grade goal being the strongest predictor followed by academic self efficacy. Locus of control was not a useful predictor in this multivariate model, underlining the importance of goal setting and self-efficacy.
In the self-regulatory learning domain, a model including 6 behavioral and cognitive learning strategies accounted for 11% of the variance. Effort regulation was the strongest predictor followed by meta cognition; the remaining measures (elaboration, critical thinking, help seeking and time/study management) had negligible effects.

The three learning styles deep, strategic and surface (negatively correlated) accounted for 9% of the variance and were found to be independent of one another in a multivariate model with strategic learning identified as the strongest predictor.

Collectively, these within-domain, multivariate models indicated that, in addition to the four medium-sized non-intellective correlates of GPA (i.e., , effort regulation, academic self-efficacy, performance self-efficacy and grade goals), aspects of conscientiousness, procrastination, need for cognition, emotional intelligence, , meta cognition, deep, surface, and strategic learning styles *may* be independent predictors of GPA.

Cross-Domain Multivariate Models and Assessment Inventories

Ideally we would have drawn upon multiple, multivariate, prospective studies including the strongest correlates of tertiary GPA. Unfortunately, over 13 years of research, few such studies have been reported. Consequently, our cross-domain regression analyses were severely limited. We conclude that available data do not permit testing of a comprehensive and parsimonious model of factors that most strongly influence university students' academic attainment (the fifth research challenge we identified). Consequently, at present, construction of integrative, cross-domain, theories modeling predictors of GPA lacks empirical foundation.

Our analyses indicated that, after controlling for traditional intellective constructs an additional 7% of the variance in GPA was explained by effort regulation, academic self-efficacy and grade goals. Conscientiousness and test anxiety did not explain additional variance. Interestingly, when traditional predictors were excluded, grade goal was the strongest predictor among non-inellective measures; however, controlling for SAT/ACT and high school GPA, effort regulation became the strongest predictor and test anxiety was reduced to non-significance, indicating potential overlap between the latter measures. This emergence of effort regulation may emphasize the importance of students' volitional capacities in addition to performance-related cognitions (Gollwitzer, 1990; Kuhl, 2000). Academic self-efficacy and grade goal measures may be strongly shaped by performance feedback (Locke & Latham, 1990) which, in academia, is mainly constituted by grade

attainment on assignments and exams (Wood & Locke, 1987). Consequently, these cognitions are expected to stabilise with university experience and to have greater predictive validity once skills and performance levels are established (Bandura, 1997; Lent & Brown, 2006). This may mean that self- efficacy and grade goal measures are more closely related to measures of cognitive ability (such as SAT/ACT) than effort regulation. If so, this could limit the effectiveness of interventions focusing on grade goal setting and academic self-efficacy enhancement but experimental data is needed to test these hypotheses.

The additional variance in GPA explained by effort regulation, academic self-efficacy and grade goal may be augmented by other constructs we could not include. For example, we could not include performance self-efficacy (the largest average bivariate correlate of GPA) in cross-domain models so the relationship between these self predictions of grade attainment and more general measures of academic self-efficacy remains unclear. Similarly, evaluation of the theoretical and practical importance of the 22 small-sized correlates identified here requires further multivariate, prospective research. For example, the effects of learning styles which, arguably, assess more stable aspects of motivation and self regulatory capacities, may be mediated by more specific motivation and self regulatory constructs (e.g., critical thinking, elaboration, and meta cognition).

Despite the limitations of the available evidence, practical implications are evident. Our results indicate that a combination of motivation (academic self efficacy, performance efficacy, grade goal) and self regulatory capacity (effort regulation) predict tertiary GPA. Supplementary Table 2 shows how measures in two current multi-measure assessment inventories, the MSLQ and LASSI, map onto constructs included in our analyses (as listed in Table 1). The MSLQ includes 2 of the four strongest correlates identified here (academic self efficacy and effort regulation) whereas only effort regulation is included in the LASSI. Of the 22 small correlates of GPA identified in the current review 8 are included in the MSLQ and 5

in the LASSI; the LASSI comprises mainly cognitive (e.g., elaboration) and behavioral (e.g., effort regulation) self-regulatory strategies whereas equal emphasis is given to self-regulatory and motivational factors in the MSLQ. Our findings strongly suggest that inclusion of further measures, especially performance-related cognitions, could enhance the predictive utility of these tests. Different sets of constructs may be important to (i) the assessment and (ii) the enhancement of students' potential because even when cognitions or capacities cannot be easily modified they may add to the prediction of students' performance over and above that achieved by traditional predictors (such as high school GPA or SAT/ACT).

Development of an improved multi-measure assessment instrument would provide more parsimonious and reliable assessments for students and teachers. Moreover, administration of such an instrument among large, representative student samples in prospective studies could greatly advance theory development in this field.

Comparison with Previous Reviews

Our results confirmed Robbins et al. (2004) conclusions that effort regulation and academic self-efficacy are important correlates of tertiary GPA. In addition, the data show that that cognitions specific to academic performance, that is, performance self-efficacy and grade goal were the strongest correlates of GPA so emphasizing the importance of goal setting and task-specific self-efficacy. Like Robbins et al., we also found that measures of social integration (academic, social and institutional integration, goal commitment, stress and social support) showed only small associations with GPA. Thus the literature offers little support for Tinto's (1975) interactionist account of student motivation.

In a meta analytic review of the Five Factor model of personality and academic performance, Poropat (2009) found that conscientiousness was the only useful predictor of tertiary GPA, controlling for high school GPA (see too O'Connor & Paunonen, 2007). Our results support this conclusion, emphasizing that procrastination may be especially

handicapping for tertiary-level students. However, our findings also highlight the potential influence of non-Five-Factor traits, specifically, need for cognition and emotional intelligence which explained unique variance in GPA, controlling for conscientiousness.

Poropat found that conscientiousness added slightly more to GPA prediction than intelligence and concluded that, conscientiousness was a "*comparatively important predictor*" (p.330). Yet in our cross-domain model, combining correlates identified by Robbins et al. and Poropat neither conscientiousness nor test anxiety added to the variance explained. The effect of conscientiousness was attenuated once effort regulation was added to the model while test anxiety ceased to predict unique variance once academic self-efficacy was added. A large correlation was observed between conscientiousness and effort regulation ($r = .53$) and the correlation between test anxiety and academic self efficacy was medium-to-large ($r = -.48$). These correlations suggest potential mediation models (Richardson & Abraham, 2009) and future studies could explore whether effort regulation and test anxiety are most usefully conceptualized as self regulatory strategies (as in our review) or regarded as domain-specific facets of conscientiousness and neuroticism. The latter proposal is consistent with Roberts and Wood's (2006) neo-socioanalytic theory which provides a distal-proximal framework for integrating personality, motivation, and ability factors at different levels of abstraction. Such distal-proximal, cross-domain, construct relationships can be specified when constructs are correlated and defined so as to relate to common, theoretically-specified mechanisms (Fleeson, 2001; Hooker & McAdams, 2003; Roberts & Wood, 2006). Future multivariate, prospective studies are required to test such models.

Contrary to previous reviews of goal orientation (e.g., Payne et al., 2007), our results indicate that performance avoidance goals (not learning orientation goals) are most strongly related to GPA. Consistent with Payne et al. (2007) performance approach orientation was found to be a relatively unimportant predictor. Recent research has indicated that associations

with goal orientation constructs differ depending on the measures employed and the socio-demographic characteristics of the sample. Measures of performance-approach goal orientation comprising mainly normatively-referenced measures have been found to be positively correlated with GPA whereas measures comprised mainly of appearance and evaluative items are negatively correlated (Hulleman, Schrager, Bodmann and Harackiewicz, 2010). We concur with Hulleman et al.'s call for greater theory-measurement consistency. Our attempt to integrate this literature has highlighted how a lack of correspondence between theoretically-specified mechanisms and corresponding measures impedes evidence synthesis and may slow the resolution of key research questions.

Limitations of this review

Systematic search techniques were employed to overcome the problem of selection bias but, unavoidably, 5 of the univariate analyses were based on five or less independent correlations so restricting the generalisability of findings. The decision to include only published studies could have artificially inflated effect size estimates (Rosenthal, 1979) but Duval and Tweedie's (2000) trim and fill analysis indicated that, in general, publication bias is not a problem for these data.

Range restriction was not coded so findings may only generalize to students already at university. This coincides with the aim of developing assessment instruments for university students but findings may not be directly applicable to university admissions decisions. Moreover, few studies sampled students in their first year so the feasibility of long-range GPA prediction, including that focusing on university applicants, remains to be demonstrated by future, prospective studies.

Insufficient data prevented examination of additional methodological and theoretical moderators including student characteristics (e.g., race, age, gender and socioeconomic status) and contextual factors (e.g., institutional type). Many confidence intervals and critical

values were wide or crossed zero so the identification of moderators is an important goal for future research.

Regression analyses examining the relative contribution of non-intellective factors required synthesizing correlation matrices despite substantial missing data. Few studies included all the independent variables, and many included only one. Substantial missing data in pooled correlation matrices is likely to result in bias, especially where, under a random effects model, variability in population effect sizes is expected. However, the magnitude and direction of this bias, and its effects on the regression analyses cannot be determined.

Our review and the specification of mechanistic models of tertiary-level students' performance is limited by the nature of theoretical and empirical work in this area. A wide range of constructs have been investigated in small subsets in many separate studies. Constructs appear to have been defined by researchers working in particular domains, for example, those focusing on motivational or personality theories, without specification of cross-domain mechanisms. This has resulted in considerable conceptual and item-content overlap across measures. Our evidence synthesis was also hampered by use of variable descriptions of the same constructs across studies. Moreover, several separate measures have been used to assess some constructs (see table 2) with only a few derived from a rigorous psychometric development process. Overall, the current range of potential antecedents of tertiary GPA is indicative of a proliferation of measures representing fewer underlying mechanistic constructs. This makes theoretical integration difficult (Eccles & Wigfield, 2002). We conclude that the challenge for researchers in this field is to distil available constructs and measures into a parsimonious, mechanistic model of antecedents of tertiary GPA represented by reliable, standardized measures that enable short- and long-term prediction of university performance.

Developing Interventions to Enhance University Students' Performance

Until theoretical models are supported by prospective and experimental data, the design of interventions to optimize students' performance will remain a project of invention rather than applied science. Nonetheless, the research reviewed here suggests some potentially-effective strategies.

Measures of students' grade goals were among the largest correlates of GPA, suggesting that goal setting interventions could be effective. Goal theory (Locke and Latham, 1990) recommends setting goals that are specific, challenging and located within time and context. In a brief goal setting intervention, Latham and Brown (2006) report that GPA was significantly higher among students who self set learning goals relative to students' who set distal performance goals. However, students who set proximal goals (including grade goals), in addition to distal outcome goals, achieved higher GPAs than those who only set distal goals or those who were urged to do their best. Students might also be encouraged to set goals relating to other correlates. For example, goals relating to help-seeking from teachers, avoiding procrastination and establishing study routines.

Goal setting may also boost effort regulation (another of the strongest correlates) in the form of plans to persist when tasks are difficult. Even if effort regulation and test anxiety are conceptualized as traits rather than learnt competencies, evidence suggests that personality traits may be modifiable (e.g., Mroczek & Spiro, 2003) and lower-level dispositions may be more malleable (Roberts & Wood, 2006). Hence interventions to boost effort regulation and to develop self management competencies to reduce test anxiety may be effective, especially if targeted on the basis of student screening.

Academic and performance self-efficacy were important predictors. Self-efficacy enhancement may be an especially important target because self-efficacy beliefs are partially mediated by measures of grade goal (Chen et al., 2000) and deemed to be modifiable at a relatively low cost. Bandura (1997) specifies four methods for raising self-efficacy including

the facilitation of vicarious learning, mastery experiences, re-attribution of responses to physiological sensations and persuasive communication. More detailed specifications of effective self-efficacy enhancement techniques are also available (Abraham, 2011; Ashford, Edmunds & French, 2010). Teachers' behaviours are likely to be important to boosting and maintaining students' self-efficacy. Setting graded tasks, providing feedback on successful performance and lowering students' anxiety and stress about coursework, exams and presentations promote mastery experiences and, thereby, increase self-efficacy (Stock & Cervone, 1990).

Interventions early in students' university career may be most effective because the strongest correlates identified here, performance self efficacy and grade goals are likely to be more fluid during the early stages of skill development (Lent & Brown, 2006; Chen et al., 2000). However, the malleability of these key correlates of performance remains to be established by intervention trials. For example, if grade goal is dependent on previous feedback which, in turn, is predicted by cognitive ability, then setting grade targets may not be an effective performance-enhancement technique. This remains an empirical question.

Multifaceted interventions may be more effective (Hattie, Biggs & Purdie, 1996) but interventions targeting specific cognitive changes, for example, elevated grade goals, increased effort regulation, reduced test anxiety, reduced procrastination and enhanced self-efficacy could be more cost effective. Moreover, experimental evaluation of such interventions with appropriate measurement of potentially mediating constructs would provide empirical tests of hypothesized relationships between key predictors of tertiary GPA, thereby advancing our understanding of underlying mechanisms.

Finally, while caring for students' wellbeing is a worthwhile aim in itself, our results suggest that performance-focused interventions are more likely to enhance students'

academic achievement e.g., reducing text anxiety rather than more general counseling or stress management services.

Conclusions

This review of 13 years of research into the correlates of tertiary-level GPA highlights the wealth of theoretical elaboration and empirical testing that has been devoted to understanding why some undergraduates perform better than others. We hope that our integration and synthesis of this work will provide a foundation for more focused research and intervention. To this end, we conclude with 4 recommendations for future research.

Defining measures

Theoretical and intervention development will be best served by cross-domain collaboration to test standardized, reliable measures derived from clearly-specified process models. We recommend that researchers work towards establishment of distinct constructs identified by consensually-accepted labels and measured using scales that have been tested for their psychometric properties. We believe that this focus would result in identification of fewer key predictors of GPA.

The present findings suggest improvements to current assessment inventories, especially inclusion of the strongest correlates of tertiary GPA. Whether or not key correlates of GPA are subject to effective intervention, they may be useful, independent predictors of subsequent performance.

Conducting multivatiate prospective studies

Further prospective studies testing multivariate models with large samples are needed. Ideally, these would include applicants (before arrival) and first year students followed up through their student careers. Such studies should control for prior educational attainment (at school) and include a range of previously tested cross-domain predictors. Neo socioanalytic theory, goal theory and social cognitive theory provide useful theoretical

frameworks upon which integrative model-testing could be based. It is also critical that research reports provide sufficient detail to facilitate exact replication and allow synthesis of findings in meta analyses. Such research has the capacity to clarify the strongest predictors controlling for a range of correlates and so identify mediating processes.

Exploring Moderators

Equal attention should be paid to identification of conditions that facilitate operation of predictive models of tertiary-level GPA. Research on methodological and theoretical moderating factors exploring *when*, and *for whom* particular processes or changes influence academic achievement would be theoretically and practically informative.

Testing specific, process-focused interventions

Finally, our review and others have identified a series of potentially modifiable medium-to-large correlates of tertiary GPA, in particular, academic and performance self-efficacy, grade goal setting and effort regulation. It would be valuable to have experimental data on how easily such cognitions and self-regulatory capacities can be changed, for whom, over what time period, and to what extent do such changes impact on GPA scores. Investment in precisely-targeted, theoretically-based, interventions could help student' optimize their potential and would provide empirical tests of proposed process models of tertiary achievement.

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Table 1

Non-inellective Correlates of GPA Grouped by Distinct Research Domains

Personality traits	Motivation factors	Self-regulatory learning strategies	Students' approach to learning	Psychosocial contextual influences
Conscientiousness	Locus of control	Test anxiety	Deep	Social integration
Procrastination	Pessimistic attributional style	Rehearsal	Surface	Academic integration
Openness	Optimism	Organization	Strategic	Institutional integration
Neuroticism	Academic self-efficacy	Elaboration		Goal commitment
Agreeableness	Performance self-efficacy	Critical thinking		Social support
Extraversion	Self-esteem	Meta cognition		Stress (in general)
Need for cognition	Intrinsic motivation	Effort regulation		Academic stress
Emotional intelligence	Extrinsic motivation	Help seeking		Depression
	Learning goal orientation	Peer learning		
	Performance goal orientation	Time/study management		
	Performance avoidance orientation	Concentration		
	Grade goal			

Table 2

Categorisation of Measures Included in the Meta Analyses

Construct	Definition/attributes, representative measures & representative items
Personality traits[a]	
Conscientiousness	Attributes: self disciplined & achievement orientated. *Representative measures*: Revised neo personality inventory (NEO-PI-R) (Costa & McCrae, 1992), Big five inventory (BFI-V44) (John, Donahue, & Kentle, 1991), Cattell 16 personality factor (16pf) (Cattell, Cattell & Cattell, 1993), Trait descriptive adjectives (TDA) (Goldberg, 1992), Big five inventory (BFI) (Benet-Martinex & John, 1998), Resource associates' adolescent personal Style Inventory (APSI) for college students (Lounsbury, Saudargas & Gibson, 2004), Form E of Jackson's (1984) personality research form (PRF), general achievement motivation scale from the international personality item pool (Goldberg, 1999), work mastery subscale from the work and family orientation Questionnaire (Spence & Helmreich, 1983) *Representative items*: "makes plans and follows through with them", "the desire to do one's best in whatever one undertakes"
Procrastination	Definition: A tendency to delay working on tasks and goals. *Representative measures*: Lay's (1986) general procrastination scale. *Representative items*: "I generally delay before starting on work I have to do"
Openness	Attributes: active imagination and insight, intellectual curiosity, and openness to new experiences. *Representative measures*: (see personality inventories reported for conscientiousness) *Representative Item:* "is sophisticated in art, music or literature"
Neuroticism	Attributes: anxious, depressed, inability to delay gratification and vulnerability to environmental stressors. *Representative measures*: (see personality inventories reported for conscientiousness) plus the Eysenck personality questionnaire EPQ (Eysenck & Eysenck, 1975), negative affect from the positive and negative affect schedule (PANAS) (Watson, Clark & Tellegen, 1988). *Representative item:* "is depressed, blue"
Agreeableness	Attributes: trusting, empathetic and compliant in social situations. *Representative measures*: (see personality inventories reported for conscientiousness) *Representative item:* "likes to cooperate with others"
Extraversion	Attributes: assertive, positive, & seeks stimulation from others (e.g., social contact) *Representative measures*: (see personality inventories reported for conscientiousness) plus the Eysenck personality questionnaire (EPQ) (Eysenck & Eysenck, 1975), positive affect from the positive and negative affect schedule (PANAS) (Watson, et al., 1988). *Representative item:* "is full of energy"
Need for cognition	*Definition: general tendency to enjoy activities involving effortful cognition* *Representative measures*: typical intellectual engagement (TIE) (Geoff & Ackerman, 1992), need for cognition (NFC) (Cacioppo et al., 1984) *Representative items:* "I would prefer complex to simple problems", "almost every section of the newspaper has something in it which interests me"

(Table continues)

Construct	Definition/attributes, representative measures & representative items
Emotional intelligence	Definition: ability to accurately perceive emotion in self and others' to facilitate thinking, coping, decision making and social interaction. *Representative measures*: emotional quotient short form (EQ-I) (Bar-On, 2002), Toronto alexithymia scale (TAS-20; Bagby, Parker, & Taylor, 1994); Mayer, Salovery, Caruso, emotional intelligence test (MSCEIT) (2002). *Representative items*: None available
Motivation factors[b]	
Locus of control	Definition: perceived control over events and life outcomes *Representative measures*: locus of control (Levenson, 1974), Rotter Internal–External Locus of Control (I-E) Scale (Rotter, 1966). *Representative items*: none available
Pessimistic attributional style	Definition: belief that negative academic events are due to uncontrollable (internal, stable and global) factors. *Representative measures*: Academic attributional style questionnaire (AASQ) (Peterson & Barrett, 1987). *Representative items*: students' are presented with 12 negative academic situations (e.g., "you fail a final exam") and asked to identify and rate its cause on three dimensions: internal/external, stable /unstable, global/specific. Pessimistic attributional style is represented by internal, stable and global ratings (higher scores)
Optimism	Definition: a general belief that good things will happen *Representative measures*: Revised life orientation test (LOT-R) (Scheier, Carver, & Bridges, 1994). *Representative items*: "in uncertain times, I usually expect the best"
Academic self-efficacy	Definition: self beliefs of academic capability *Representative measures*: Academic self confidence subscale from the SRI (Le et al., 2005), Academic control (Perry, Hladkyj, Pekrun, & Pelletier, 2001), Academic self concept (Reynolds, Ramirez, Magrina, & Allen, 1980). *Representative items*: "I know how to schedule my time to accomplish my academic tasks", "I know how to take notes", "I am a fast learner", "I have a great deal of control over my academic performance in my courses", "most courses are very easy for me" ,"I am satisfied with the class assignment that I turn in"
Performance self-efficacy	Definition: perceived academic performance capability *Representative measures*: performance capability (Shell & Husman, 2001) *Representative items*: "what is the highest GPA that you feel completely certain you can attain"
Self-esteem	Definition: general perception of self-worth. *Representative measures*: Rosenberg (1965), Pinel, Warner, & Chua's (2005) self-liking scale. *Representative items*: "I feel that I have a number of good qualities", "I am inclined to feel that I am a failure"(reversed), "I feel comfortable with myself"
Academic intrinsic motivation	Definition: inherent self interest, and enjoyment of academic learning and tasks *Representative measures*: Autonomous motivation (Sheldon & Elliot, 1998), academic intrinsic motivation (Vallerand & Bissonnette, 1992), task value (Pintrich & DeGroot, 1990). *Representative items*: "I go to college because I experience pleasure and satisfaction while learning new things", "In a class like this, I prefer course material that arouses my curiosity, even if it is difficult to learn"

(Table continues)

Construct	Definition/attributes, representative measures & representative items
Academic extrinsic motivation	Definition: external motivation for learning that resides outside of the self (e.g., to satisfy others expectations). *Representative measures*: Academic extrinsic motivation (Vallerand & Bissonnette, 1992), Controlled motivation (Sheldon & Elliot,1998). *Representative items*: "university is a way for me to get into an interesting and satisfying career", "I feel that I ought to work for my degree"; "I work because I would feel ashamed, guilty, or anxious if I didn't"
Learning goal orientation	Definition: learning to further one's knowledge/mastery in a relevant domain *Representative measures*: Button, Mathieu & Zajac, (1996), Roedel, Schraw, & Plake, (1994), Harackiewicz, Barron, Carter, Lehto & Elliot (1997), Elliot & Church, (1997), Vandewalle, (1997), intrinsic learning (Pintrich & DeGroot,1990), *Representative items*: "I prefer to work on tasks that force me to learn new things", "I enjoy challenging school assignments", "I feel most satisfied when I work hard to achieve something", "I want to learn as much as possible in this class", "in a class like this, I prefer course material that really challenges me so I can learn new things" , "I like the material in this class best when it really makes me think", "I am willing to select challenging courses that I can learn a lot from"
Performance goal orientation	Definition: achieving to demonstrate competence relative to others *Representative measures*: Button et al. (1996), Roedel et al. (1994), Harackiewicz et al. (1997), Elliot & Church (1997), Vandewalle, (1997), extrinsic motivation Pintrich & DeGroot, 1990) *Representative items*: "I prefer to do things that I can do well rather than things that I do poorly'', "it is important to me to get better grades than my classmates", "the main reason I do my work in this class is because we get grades", "I want to do well in this class to show my ability to my family, friends, advisors, or others", ''I like to show that I can perform better than others''
Avoidance goal orientation	Definition: avoiding goals that may demonstrate low ability, and achievement. *Representative measures*: Button et al. (1996), Roedel et al. (1994), Harackiewicz, et al. Elliot (1997), Elliot & Church, (1997), Vandewalle, (1997). *Representative items*: "my fear of performing poorly in this class is often what motivates me", "my goal in this class is to avoid performing poorly", "I want to do as little work as possible in this class"
Grade goal	Definition: self-assigned minimal goal standards (in this context, GPA) *Representative measures*: self-assigned goals (Locke & Latham, 1990 – see Diefendorff, 2004); grade expectation (Lane & Gibbons, 2007). *Representative items*: "what is the minimum (i.e. the least you would be satisfied with) percentage grade goal for the next test (on a scale of 0% to 100%)"
Self-regulatory learning strategies	
Test anxiety	Definition: negative emotionality relating to test taking situations *Representative measures*: state trait anxiety inventory (STAI) (Spielberger et al., 1970), test anxiety subscale from the MSLQ (Pintrich & DeGroot, 1990), anxiety (Weinstein, et al., 1987). *Representative items*: "I am so nervous during a test that I cannot remember facts I have learned", "worrying about doing poorly interferes with my concentration on tests"
Rehearsal	Definition: learning through repetition *Representative measures*: rehearsal (Pintrich & DeGroot, 1990). *Representative items*: "When I study for this class, I practice saying the material to myself over and over"

(Table continues)

Construct	Definition/attributes, representative measures & representative items
Organization	Definition: ability to select key information during learning situations *Representative measures*: selecting main ideas (Weinstein et al., 1987), organization (Pintrich & DeGroot, 1990). *Representative items*: "often when studying I seem to get lost in details and can't see the forest for the trees", "I have difficulty identifying the important parts in my reading"
Elaboration	Definition: ability to synthesise information across different sources *Representative measures*: information processing (Weinstein et al., 1987), elaboration (Pintrich & DeGroot, 1990). *Representative items*: "When I study for this class, I pull together information from different sources, such as lectures, readings, and discussions"
Critical thinking	Definition: critical analyses of course material *Representative measures*: critical thinking (Pintrich & DeGroot, 1990). *Representative items*: "I often find myself questioning things I hear or read in this course to decide if I find them convincing"
Meta cognition	Definition: self-regulation of learning/understanding of course material *Representative measures*: self testing (Weinstein et al., 1987), meta cognition (Pintrich & DeGroot, 1990). *Representative items*: "When reading for this course, I make up questions to help focus my reading"
Effort regulation	Definition: persistence and effort when faced with challenging academic pursuits *Representative measures*: Motivation (Weinstein et al., 1987), work drive (Lounsbury & Gibson, 2002), effort regulation (Pintrich & DeGroot, 1990) *Representative items*: "when work is difficult, I either give up or study only the easy parts"
Help seeking	Definition: help seeking from instructors and friends when experiencing difficulties with academic work. *Representative measures*: Seeking help from teacher (Larose & Roy, 1995), Assistance from peers (Larose & Roy, 2005), Help seeking (Pintrich & DeGroot, 1990) *Representative items*: "I ask the instructor to clarify concepts I don't understand well" "When I'm sure that I don't understand a problem or an idea, I ask other students for help as soon as possible"
Peer learning	Definition: Use of study groups and friends to aid learning *Representative measures*: Peer learning (Pintrich & DeGroot, 1990) *Representative items*: "I try to work with other students from this class to complete the course assignments"
Time/study management	Definition: self-regulation of time and study related activities *Representative measures*: Time management (Weinstein et al., 1987), Time/study environmental management (Pintrich & DeGroot, 1990). *Representative items*: "I find it hard to stick to a study schedule", "I set aside more time to study the subject(s) that are difficult for me", "I usually study in a place where I can concentrate on my course work", "I make good use of my study time for this course"
Concentration	Definition: task focus or attention during academic tasks. *Representative measures*: Quality of attention (Larose, & Roy, 1995), concentration subscale from the LASSI (Weinstein et al., 1987). *Representative items*: "while studying, I have too many other things on my mind to fully concentrate" , "I find that during lectures I think of other things and don't really listen to what is being said"

(Table continues)

Construct	Definition/attributes, representative measures & representative items
Students approaches to learning	
Deep approach to learning	Definition: deep information processing and an intrinsic motivation to learn. *Representative measures*: approaches to studying inventory (ASI) (Entwistle & Ramsden, 1983), revised approaches to study questionnaire (RASI) (Fox, McManus, & Winder, 2001), *Representative items*: "When i'm working on a new topic, I try to see in my own mind how all the ideas fit together"
Surface approach to learning	Definition: shallow information processing and an extrinsic motivation to learn. *Representative measures*: see approaches to learning inventories reported for deep approach to learning. *Representative items*: "I often have trouble making sense of the things I have to remember"
Strategic approach to learning	Definition: efficient and organized learning and a motivation for success *Representative measures*: see approaches to learning inventories reported for deep approach to learning. *Representative items*: "I would see myself basically as an ambitious person and want to get to the top, whatever I do"
Psychosocial contextual influences	
Social integration	Definition: perceived social integration, and ability to relate to other students *Representative measures*: interaction with peers (Roberts & Clifton, 1992), social integration (Cabrera, Nora, &Castañeda, 1993; Baker & Siryk, 1984), social activity (Le et al., 2005). *Representative items*: "I find it easy to get to know other students"
Academic integration	Definition: perceived support from professors *Representative measures*: interaction with professors (Roberts & Clifton, 1992), academic integration (Mannan, 2001) *Representative items*: "my professors seem to be really committed to teaching", "professors care about what I think", "teachers give us the opportunity to ask questions"
Institutional integration	Definition: commitment to university. *Representative measures*: academic integration (Pascarella & Terenzini, 1979), social connection (Le et al., 2005), institutional commitment (Baker & Siryk, 1984), college adaptation questionnaire (Crombag, 1968) *Representative items*: "I am involved in campus activities", "I feel part of this college", "I am glad that I came here to study"
Goal commitment	Definition: commitment to staying at university and obtaining a degree. *Representative measures*: Desire to finish college (Allen, 1999), commitment to college (Le et al., 2005). *Representative items*: " I am strongly dedicated to finishing college no matter what obstacles get in my way", "I am motivated to get a college degree"
Social support	Definition: the availability of social support from family members and/or significant others. *Representative measures*: availability of strong support person (Tracey & Sedlacek, 1984). *Representative items*: "If I run into problems concerning school, I have someone who would listen to me and help me"
Stress (in general)	Definition: overwhelming negative emotionality resulting from general life stressors *Representative measures*: perceived stress scale (PSS) (Cohen, Kamarack, & Mermelstein, 1983). *Representative items*: "In the past month, how often have you felt that difficulties were piling up so high that you could not overcome them?"

(Table continues)

Construct	Definition/attributes, representative measures & representative items
Academic Stress	Definition: overwhelming negative emotionality resulting directly from academic stressors *Representative measures*: Maslach and Jackson's (1981) intensity scale, perceived Stress (Cabrera, 1988). *Representative items*: "I feel frustrated by college"
Depression	Definition: low mood, pessimism and apathy over an extended period of time *Representative measures*: Depression inventory (Beck, Ward, Mendelson, Mock, & Erbaugh, 1961). *Representative items*: participants are asked to indicate how sad they are on the following scale: "I do not feel sad, I feel sad, I am sad all the time and I can't snap out of it, I am so sad and unhappy that I can't stand it"

[a]The self control, independence, anxiety, extraversion and tough mindedness traits from the 16PF were coded as conscientious, agreeableness, neuroticism, extraversion and openness respectively.

[b]Consistent with Payne et al. (2007), when a two-dimensional measure of goal orientation was reported (e.g., Button et al., 1996) the correlations involving performance goal orientation were coded as performance approach goal orientation).

Table 3

Summary of Data in Meta Analyses

Measures	Prospective data $N(k)$	Cross-sectional data $N(k)$	Mixture $N(k)$	not reported $N(k)$	Total $N(k)$	Combinations with cumulative GPA	Combinations with course GPA
Personality traits							
Conscientiousness	8090(30)	15160(15)	2744(10)	1881(14)	27875(69)	52	17
Procrastination	401(3)	1335(6)	0	130(1)	1866(10)	6	4
Openness	4947(18)	14507(13)	1246(17)	2396(14)	23096(52)	41	11
Neuroticism	4818(20)	14582(14)	1246(7)	3013 (17)	23659(58)	45	13
Agreeableness	3916(15)	14251(12)	1121(6)	2446(14)	21734(47)	39	8
Extraversion	5102(21)	14600(14)	1246(7)	2782(16)	23730(58)	46	12
Need for cognition	296(2)	138(1)	0	984(2)	1418(5)	2	3
Emotional intelligence	2525(4)	378(1)	137(1)	1984(8)	5024(14)	14	0
Total (Personality traits)	30095(113)	74951(76)	7740(38)	15616(86)	128402(313)	245	68
Motivation factors							
Locus of control	648(3)	1019(6)	0	459(4)	2126(13)	8	5
Pessimistic attributional style	403(3)	379(3)	0	244(2)	1026(8)	4	4
Optimism	689(3)	153(1)	0	522(2)	1364(6)	4	2
Academic self-efficacy	35171(29)	6151(20)	3883(12)	1365(6)	46570(67)	47	20
Performance self-efficacy	0	345(3)	0	1002(1)	1348(4)	4	0
Self-esteem	1117(5)	2889(13)	408(1)	381(2)	4795(21)	18	3
Intrinsic motivation	3500(6)	1826(6)	1009(6)	1079(4)	7414(22)	17	5
Extrinsic motivation	1080(3)	285(2)	341(3)	633(2)	2339(10)	10	0
Learning goal orientation	10033(37)	3086(12)	553(1)	4643(10)	18315(60)	22	38
Performance goal orientation	10261(36)	2772(12)	690(2)	4643(10)	18366(60)	25	35
Avoidance goal orientation	6663(22)	1606(6)	553(1)	1891(2)	10713(31)	14	17
Grade goal	2670(13)	0	0	0	2670(13)	0	13
Total (Motivation factors)	72235(160)	20511(84)	7437(26)	16862(45)	115698(315)	173	142
Self-regulatory learning strategies							
Test anxiety	7122(16)	5367(8)	486(3)	522(2)	13497(29)	12	17
Rehearsal	1728(5)	608(2)	631(2)	237(2)	3204(11)	6	5
Organization	5076(4)	219(1)	0	115(9)	5410(6)	4	2
Elaboration	6374(6)	608(2)	787(2)	237(2)	8006(12)	7	5
Critical thinking	1532(3)	219(1)	1958(4)	115(1)	3824(9)	5	4

(Table continues)

Measures	Prospective data $N(k)$	Cross-sectional data $N(k)$	Mixture $N(k)$	not reported $N(k)$	Total $N(k)$	Combinations with cumulative GPA	Combinations with course GPA
Meta cognition	5445(5)	411(2)	234(1)	115(1)	6205(9)	5	4
Effort regulation	5914(7)	1924(7)	264(1)	760(4)	8862(19)	15	4
Help seeking	954(4)	419(2)	684(2)	0	2057(8)	7	1
Peer learning	0	219(1)	918(3)	0	1137(4)	3	1
Time/study management	4982(3)	634(3)	0	231(1)	5847(7)	7	0
Concentration	6476(10)	200(1)	122	0(1)	6798(12)	9	3
Total (self-regulatory learning strategies)	45603(63)	10828(30)	6084(18)	2332(15)	64847(126)	80	46
Students' approach to learning							
Deep learning style	1993(9)	689(3)	1105(5)	1424(6)	5211(23)	7	16
Surface learning style	1993(9)	1039(2)	505(3)	1301(8)	4838(22)	10	12
Strategic learning style	1320(5)	305(2)	146(1)	1003(7)	2774(15)	4	11
Total (students' approach to learning)	5306(23)	2033(7)	1756(9)	3728(21)	12823(60)	21	39
Psychosocial contextual influences							
Social integration	16260(7)	2299(7)	469(1)	0	19028(15)	14	1
Academic integration	5826(4)	1365(3)	684(2)	5880(2)	13755(11)	11	0
Institutional integration	18582(11)	540(4)	182(2)	469(1)	19773(18)	17	1
Goal commitment	11191(6)	1150(2)	288(1)	469(1)	13098(10)	9	1
Social support	4467(7)	1077(5)	296(2)	0	5840(14)	13	1
Stress (in general)	184(1)	230(1)	1172(5)	150(1)	1736(8)	8	0
Academic stress	287(2)	185(1)	0	469(1)	941(4)	3	1
Depression	905(3)	4204(8)	985(4)	241(2)	6335(17)	16	1
Total (psychosocial contextual influences)	57702(41)	11050(31)	4076(17)	7678(8)	80506(97)	91	6
Total (non-inellective correlates)	210941(400)	119373(228)	27093(108)	46216(175)	403623(911)	610	301

Table 4

Results of the Primary Meta Analysis

Measures	N	k	r^+	CI$_{r+}$ 95%	I^2	Q	ρ	SD	CV, 80% L	CV, 80% H	Duval & Tweedie's (2000) trim and fill k^a	Duval & Tweedie's (2000) trim and fill r^{+b}
Demographics												
SES	75000	21	0.11	0.08, 0.15	92.53%	221.26**	0.15	0.00	0.08	0.22	0	n.a.
Sex[c]	6176	21	0.09	0.04, 0.15	80.43%	121.90***	0.04	0.01	0.11	-0.19	5	0.05
Age	42989	17	0.08	0.03, 0.13	91.85%	353.49**	0.03	0.01	-0.08	0.14	2	0.09
Traditional correlates												
High school GPA	34724	46	0.40	0.35, 0.45	96.19%	1368.25**	0.41	0.03	0.20	0.63	9	0.45
SAT	22289	29	0.29	0.25, 0.33	85.15%	258.59**	0.33	0.01	0.21	0.45	1	0.30
ACT	31971	21	0.40	0.33, 0.46	97.67%	314.49***	0.40	0.01	0.30	0.49	7	0.50
'A' level points	933	4	0.25	0.12, 0.38	73.63%	12.07**	0.31	0.01	0.19	0.43	0	n.a.
Intelligence	7820	35	0.20	0.16, 0.24	71.78%	117.94**	0.21	0.01	0.08	0.34	5	0.22
Personality traits												
Conscientiousness	27875	69	0.19	0.17, 0.22	65.25%	165.12**	0.23	0.00	0.16	0.30	3	0.19
Procrastination	1866	10	-0.22	-0.27, -0.18	5.04%	13.77ns	-0.25	0.00	-0.33	-0.17	0	n.a.
Openness	23096	52	0.09	0.06, 0.12	61.76%	118.60**	0.09	0.00	0.01	0.17	8	0.07
Neuroticism	23659	58	-0.01	-0.04, 0.01	68.81%	163.70**	0.01	0.01	-0.09	0.11	0	n.a.
Agreeableness	21734	47	0.07	0.04, 0.09	60.16%	103.05**	0.06	0.00	-0.02	0.13	6	0.05
Extraversion	23730	58	-0.04	-0.07, -0.02	66.09%	137.35**	-0.03	0.00	-0.12	0.05	2	-0.05
Need for cognition	1418	5	0.19	0.04, 0.33	86.43%	22.08**	0.17	0.01	0.03	0.31	0	n.a.
Emotional intelligence	5024	14	0.14	0.10, 0.18	32.53%	21.37ns	0.17	0.00	0.10	0.23	0	n.a.
Motivation factors												
Locus of control	2126	13	0.13	0.04, 0.22	77.81%	44.85**	0.15	0.02	-0.02	0.32	0	n.a.
Pessimistic attributional style	1026	8	0.01	-0.12, 0.13	73.71%	26.89**	-0.01	0.03	-0.22	0.20	0	n.a.
Optimism	1364	6	0.11	0.04, 0.17	32.51%	7.46ns	0.13	0.00	0.06	0.20	2	0.14
Academic self-efficacy	46570	67	0.31	0.28, 0.34	90.94%	497.07**	0.28	0.01	0.14	0.41	0	n.a.

(Table continues)

Measures	N	k	r^+	CI_{r+} 95%	I^2	Q	ρ	SD	CV, 80%		Duval & Tweedie's (2000) trim and fill	
									L	H	k^a	r^{+b}
Performance self-efficacy	1348	4	0.59	0.49, 0.67	70.91%	10.63*	0.67	0.00	0.61	0.74		
Self-esteem	4795	21	0.09	0.05, 0.13	47.06%	40.54**	0.12	0.01	0.04	0.20	4	0.11
Academic intrinsic motivation	7414	22	0.17	0.12, 0.23	83.30%	137.81*	0.16	0.02	-0.03	0.35	2	0.15
Academic extrinsic	2339	10	0.01	-0.06, 0.08	59.05%	21.91*	0.00	0.01	-0.11	0.11	3	0.05
Learning goal orientation	18315	60	0.09	0.08, 0.13	48.08%	114.25*	0.12	0.00	0.03	0.21	12	0.08
Performance goal orientation	18366	60	0.09	0.06, 0.12	72.49%	184.97**	0.14	0.01	0.02	0.26	1	0.09
Avoidance goal orientation	10713	31	-0.14	-0.18, -0.09	79.20%	113.73**	-0.14	0.01	-0.29	0.01	4	0.11
Grade goal	2670	13	0.35	0.28, 0.42	74.39%	37.75**	0.49	0.01	0.36	0.62	2	0.38
Self - regulatory learning												
Test anxiety	13497	29	-0.24	-0.29, -0.20	79.33%	93.40**	-0.21	0.01	-0.31	-0.11	0	n.a.
Rehearsal	3204	11	0.01	-0.07, 0.10	81.43%	45.57**	0.05	0.02	-0.12	0.22	0	n.a.
Organization	5410	6	0.04	-0.06, 0.15	69.45%	18.38**	0.20	0.00	0.09	0.20	0	n.a.
Elaboration	8006	12	0.18	0.11, 0.24	83.54%	58.00**	0.14	0.01	0.03	0.25	0	n.a.
Critical thinking	3824	9	0.15	0.11, 0.18	0.00%	5.39ns	0.16	0.00	0.16	0.16	0	n.a.
Meta cognition	6205	9	0.18	0.10, 0.26	76.60%	30.18**	0.14	0.00	0.05	0.22	3	0.12
Effort regulation	8862	19	0.32	0.29, 0.35	22.81%	21.20ns	0.35	0.00	0.31	0.39	0	n.a.
Help seeking	2057	8	0.15	0.08, 0.21	56.62%	15.71*	0.17	0.01	0.07	0.28	0	n.a.
Peer learning	1137	4	0.13	-0.06, 0.31	90.16%	28.60**	0.20	0.02	0.01	0.39	0	n.a.
Time/study management	5847	7	0.22	0.14, 0.29	68.80%	17.10**	0.20	0.00	0.15	0.25	0	n.a.
Concentration	6798	12	0.16	0.14, 0.19	0.01%	12.77ns	0.18	0.00	0.17	0.20	1	0.17
Students' approach to learning												
Deep approach to learning	5211	23	0.14	0.09, 0.18	60.24%	54.82**	0.03	0.00	-0.03	0.10	0	n.a.
Surface approach to learning	4838	22	-0.18	-0.25, -0.10	86.31%	190.31*	-0.19	0.07	-0.52	0.14	4	-0.13
Strategic approach to learning	2774	15	0.23	0.17, 0.30	69.61%	50.09**	.31	.02	.11	.50	0	n.a.
Psychosocial contextual *influences*												
Social integration	19028	15	0.04	-0.02, 0.10	92.53%	111.98**	0.03	0.01	-0.07	0.13	0	n.a.

(Table continues)

Measures	N	k	r^+	CI$_{r+}$ 95%	I^2	Q	ρ	SD	CV, 80%		Duval & Tweedie's (2000) trim and fill	
									L	H	k^a	r^{+b}
Academic integration	13755	11	0.07	-0.00, 0.14	93.10%	134.96**	0.13	0.01	0.00	0.26	3	0.11
Institutional integration	19773	18	0.04	0.01, 0.08	72.00%	51.42**	0.03	0.00	-0.03	0.09	7	0.01
Goal commitment	13098	10	0.15	0.07, 0.22	92.01%	53.03**	0.12	0.00	0.06	0.17	0	n.a.
Social support	5840	14	0.08	0.03, 0.12	60.39%	36.26**	0.09	0.00	0.03	0.14	3	0.07
Stress (in general)	1736	8	-0.13	-0.19, -0.06	41.21%	12.03ns	-0.14	0.00	-0.21	-0.08	1	-0.14
Academic stress	941	4	-0.12	-0.21, -0.02	47.74%	5.89ns	-0.11	0.00	-0.18	-0.04	0	n.a.
Depression	6335	17	-0.10	-0.17, 0.02	84.41%	92.91**	0.03	0.01	-0.07	0.13	4	-0.05

Note. $r+$ = observed correlation corrected for sampling error; k = number of independent associations; ρ = true construct correlation corrected for measurement error; CI = confidence interval; Q = Cochran's (1954) measure of homogeneity; I^2 = Higgins and Thompson's (2002) measure of heterogeneity; CV = credibility interval; L = lower lower bound of 80% credibility interval; H = higher bound of 80% credibility interval;
[a] number of missing studies using Duval and Tweedie's (2000) trim and fill procedure;
[b] observed correlation after missing studies imputed
[c] 1 = female;
* p < .05, ** p < .01, *** p < .00.

Table 5

Moderator Analyses: Prospective versus Cross-Sectional Psychological/GPA Associations

Measures	N	k	r^+	CI_{r+} 95%	I^2	Q	between-group Q
Extraversion (all)	19702	35	-0.04	-0.12, 0.04	63.27%	92.58***	
Extraversion (prospective)	5102	21	-0.08	-0.12, -0.04	56.15%	45.61**	7.16**
Extraversion (cross-sectional)	14600	14	0.01	-0.04, 0.05	63.42%	35.54**	
Academic self-efficacy (all)	41322	49	0.29	0.17, 0.41	86.52%	355.96***	
Academic self-efficacy (prospective)	35171	29	0.23	0.20, 0.26	76.76%	120.48***	23.49***
Academic self-efficacy (cross-sectional)	6151	20	0.35	0.32, 0.39	81.58%	103.15***	
Self-esteem (all)	4006	18	0.07	-0.05, 0.18	55.45%	38.16**	
Self-esteem (prospective)	1117	5	0.00	-0.08, 0.08	3.21%	4.13ns	6.62*
Self-esteem (cross-sectional)	2889	13	0.12	0.07, 0.17	43.31%	21.17*	
Learning goal orientation (all)	13119	49	0.11	0.05, 0.17	46.93%	90.45***	
Learning goal orientation (prospective)	10033	37	0.15	0.10, 0.20	37.16%	57.29*	4.64*
Learning goal orientation (cross-sectional)	3086	12	0.09	0.06, 0.11	58.44%	26.47**	
Intrinsic motivation (all)	5326	12	0.14	-0.01, 0.28	85.697%	76.91***	
Intrinsic motivation (prospective)	3500	6	0.21	0.13, 0.29	86.63%	37.40***	6.68*
Intrinsic motivation (cross-sectional)	1826	6	0.06	-0.02, 0.14	00.00%	4.03ns	

Note. GPA = grade point average; k = number of independent associations; CI = confidence interval; Q = Cochran's (1954) measure of homogeneity; I^2 = Higgins and Thompson's (2002) measure of heterogeneity

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

Table 6

Within Domain Regression Models of Academic Achievement

Variable(s)	Personality			Motivation	Self regulatory learning strategies	Students' approaches to learning
	C; need for cognition	C; procrastination	C ; emotional intelligence	Locus of control; ASE; grade goal	E; CT; MC; ER;HS; T/SM	Deep; Surface; Strategic.
β	.17***	.13***	.18***	.02***	.04***	.06***
β	.09***	-.17***	.11***	.10***	.06***	-.14***
β	n.a.	n.a.	n.a.	.31***	.07***	.23***
β	n.a.	n.a.	n.a.	n.a.	.32***	n.a.
β	n.a.	n.a.	n.a.	n.a.	.05***	n.a.
β	n.a	n.a	n.a	n.a.	.02***	n.a.
β	n.a.	n.a.	n.a.	n.a.	n.a.	n.a.
R²	.05	.07	.05	.14	.11	.09
No of correlation matrices	73	78	76	86	40	24
No of correlation matrices including all constructs	1	2	6	1	1	5

Note. Cheung and Chan□s (2005; 2009) two stage analyses takes into account the varying number of studies and sample sizes; no single n is used in the analysis; constructs entered the model in the order that they are listed; C = conscientiousness; ASE = academic self efficacy; E = elaboration; CT = critical thinking; MC = meta cognition; ER = effort regulation; HS = help seeking; T/SM = Time/study management; matrices = correlation matrix
*** $p < .001$.

Table 7

Mean Inter-Correlations between Study Variables.

		1	2	3	4	5	6	7	8
1	GPA	1	27875(69)	13497(29)	8862(19)	46570(67)	2670(13)	54260(50)	34724(46)
2	Conscientiousness	.19	1	749(3)	2188(8)	1267(5)	487(2)	2083(8)	2196(8)
3	Test anxiety	-.24	-.02	1	4805(1)	725(4)	599(3)	2649(5)	4942(2)
4	Effort regulation[a]	.32	.53	-.15	1	244(2)	177(1)	2654(4)	4805(1)
5	Academic self efficacy	.31	.23	-.48	.30	1	453(3)	10362(7)	5890(9)
6	Grade goal	.35	.14	-.30	.34	.40	1	588(3)	108(1)
7	SAT/ACT[b]	.34	-.05	-.16	.03	.31	.37	1	8579(17)
8	High school GPA	.40	.21	-.23	.37	.21	.37	.24	1

Note. N = 628; lower diagonal triangle: mean correlations among variables; upper diagonal triangle: sample size and number of samples (in parentheses) from which the means were derived; GPA = grade point average.

[a] data for the effort regulation/grade goal combination was obtained from an unpublished study conducted at the university of the third author because these data were unavailable in the reviewed studies.

[b] SAT and ACT scores were combined for the cross-domain analyses

Table 8

Regression Models Examining the Predictive Validity of Non-intellective Correlates of Grade Point Average (GPA) Controlling for High School GPA and SAT/ACT Scores

Step	Variable(s) Entered	Conscientiousness β	Effort regulation β	Test anxiety β	Academic self-efficacy β	Grade goal β
1	SAT/ACT	.27***	.27***	.25***	.21***	.21***
	High school GPA	.31***	.25***	.31***	.31***	.29***
	Focal non-intellective predictor	.14***	.22***	-.13***	.18***	.17***
	R²	24	26	24	25	25
	Model *F*	66.26***	74.59***	65.25***	69.96***	67.34***

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

Table 9

A Hierarchical Regression Model Examining the Incremental Validity Estimates of Non-inellective Correlates on Grade Point Average Controlling for High School GPA and SAT/ACT Scores

Step	Variables Entered	β	β	β	β	β	β	β (without conscientiousness and test anxiety
1.	SAT/ACT	.26***	.27***	.28***	.26***	.24***	.22***	21***
	High school GPA	.34***	.31***	.25***	.23***	.24***	.22***	23***
2.	Conscientiousness		.19***(.14***)	.03ns(.05ns)	05ns(.06ns)	.02ns(.04ns)	.04ns(.05ns)	n.a.
3.	Effort regulation			.31***(.19***)	.27***(.18***)	.23***(.16***)	.18***(.15**)	20***(.17***)
4.	Test anxiety				-.20***(-.12**)	-.11**(-.08*)	-.09*(-.07ns)	n.a.
5.	Academic self efficacy					.19***(.09*)	.14*(.07ns)	16**(.11**)
6.	Grade goal						.20***(.08^m)	22***(.08*)
	R^2	.22	.04(.24)	.10(.27)	.14(.28)	.16(.28)	.20(.29)	19(.28)
	F^{Δ}	89.78***	23.45*** (15.17***)	46.60*** (20.41***)	28.04*** (10.85**)	16.34*** (4.38*)	25.72*** (3.60^m)	28.67*** (4.16*)
	Model F	89.78***	23.45*** (66.26***)	35.88*** (56.35***)	34.30*** (47.96***)	30.44*** (41.91***)	30.46*** (35.73***)	48.77*** (49.03***)

Note. Coefficients controlling for high school GPA and SAT/ACT; model without Step 1 reported in parentheses;
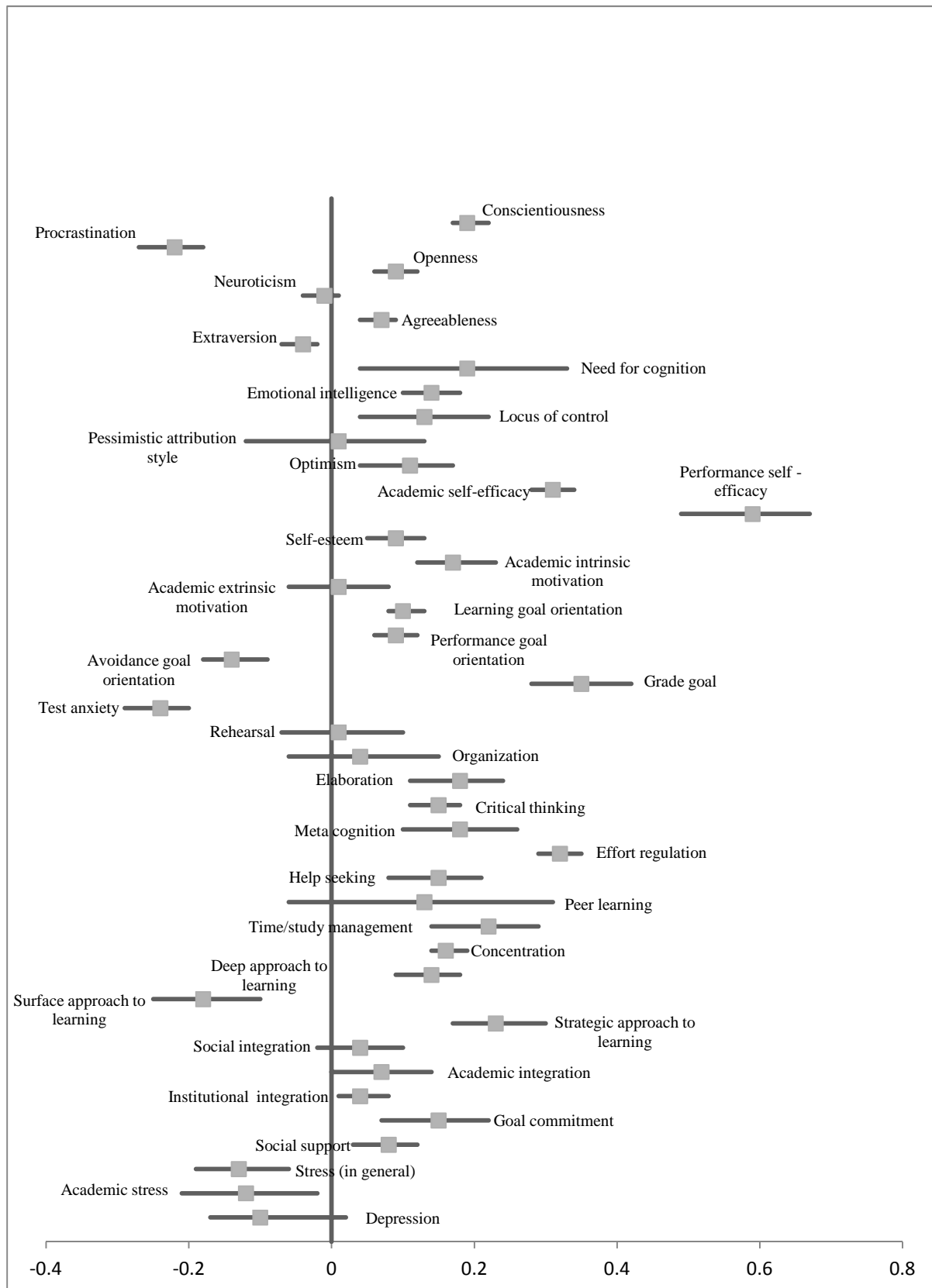^{m}p < .07, * p < .05, ** p <.01,*** p < .001.

Figure 1. Results of the Primary Meta Analysis: r^+ and 95% confidence intervals

Supplementary Table 1 (SP1).

Motivated Strategies for Learning Questionnaire (MSLQ), Learning and Study Skills Inventory (LASSI), and the Study Measures

MSLQ (15 scales, 81 items)	Construct	LASSI (10 scales, 77 items)	Construct
Rehearsal	Rehearsal		
Elaboration	Elaboration	Information processing	Elaboration
Organization	Organization	Selecting main ideas	Organization
Critical thinking	Critical thinking		
Meta-cognitive self-regulation	Meta cognition	Self-testing	Meta cognition
Effort regulation	Effort regulation	Motivation	Effort regulation
Time/study management	Time/study management	Time management	Time/study management
Peer learning	Peer learning		
Help seeking	Help seeking		
Task value	Intrinsic motivation		
Intrinsic goal orientation	Mastery goal orientation		
Extrinsic goal orientation	Performance approach orientation		
Control of learning beliefs	"it is my own fault if I don't learn the material in this course"		
Self-efficacy for learning & performance	Academic self-efficacy		
Test anxiety	Test anxiety	Anxiety	Test anxiety
		Attitude	"I do not care about getting a general education, I just want to get a good job"
		Concentration	Concentration
		Study aids	"my underlining is helpful when I review text material"
		Test strategies	"I review my answers on essay tests to make sure I have made and supported my main points"

Note.
Cognitive study skills = [ ]   Behavioural factors = [ ]   Motivational factors = [ ]

Supplementary Table 2 (SP2)

Computer-based searches were conducted to search PsychINFO and Web of Knowledge; in each search, derivatives of "undergraduate student", "academic achievement" and "predictors" were combined using AND Boolean operators.

 The following search terms were used:

 "undergraduate student"

 (Freshman or undergraduate* or sophomore*) or (junior student*) or(senior student*)or(upper division student*)or(university student*)

 "Academic achievement"

(GPA or GPAs or grade or grades or mark or marks)or(academic outcome) or(grade point average*) or (academic achievement*)or(academic performance*)or (cumulative grade point average*) or(associate* degree*)or(college perform*) or(college achievement*)

"determinants"

 (determin* or factor or factors or variabl* or parameter* or reason* or caus* or correlat* or antecedent* or predictor or predictors).