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Temperament in the Classroom

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Temperament in the Classroom

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Some students fare better than others, even when controlling for family background, school curriculum, and teacher quality. Variance in academic performance that persists when situational variables are held constant suggests that whether students fail or thrive depends not only on circumstance, but also on relatively stable individual differences in how children respond to circumstance. More academically talented children, for instance, generally outperform their less able peers. Indeed, general intelligence, defined as the “ability to understand complex ideas, to adapt effectively to the environment, to learn from experience, to engage in various forms of reasoning, to overcome obstacles by taking thought” (Neisser et al., 1996, p. 77) has a monotonic, positive relationship with academic performance, even at the extreme right-tail of the population (Gottfredson, 2004; Lubinski, 2009). Much less is known about how traits unrelated to general intelligence influence academic outcomes.

This chapter addresses several related questions: What insights can be gleaned from historical interest in the role of temperament in the classroom? What does recent empirical research say about the specific dimensions of temperament most important to successful academic performance? In particular, which aspects of temperament most strongly influence school readiness, academic achievement, and educational attainment? What factors mediate and moderate associations between temperament and academic outcomes? What progress has been made in deliberately cultivating aspects of temperament that matter most to success in school? And, finally, for researchers keenly interested in better understanding how and why temperament influences academic success, in which direction does future progress lie?

Temperament and Personality

We use the term *temperament* to refer to individual differences in behaving, feeling, and thinking which are relatively stable across time and situation and which reflect “the relatively

enduring biological makeup of the organism, influenced over time by heredity, maturation, and experience” (Rothbart & Rueda, 2005, p. 167). Our conception of temperament overlaps considerably with the construct of personality, but temperament, typically studied much earlier in the life course, is presumably shaped more by hereditary than environmental influences, reflecting basic biological processes more so than do the elaborated cognitive structures (e.g., goals, values, coping styles, schemas, metacognitive strategies) that form the basis of adult personality. Whereas the classical trait perspective holds that traits are *perfectly* stable over time, it is now well-recognized that temperament and personality traits do change. In fact, both mean-level and rank-order change in traits across the life course, despite substantial stability, is the rule, rather than the exception (Roberts & DelVecchio, 2000; Roberts, Walton, & Viechtbauer, 2006). Introverts do not become extraverts overnight, yet the cumulative effects of experience on temperament do leave their mark, and as we will discuss toward the end of this chapter, there is evidence that specific aspects of temperament can be deliberately cultivated through direct intervention.

Because formal schooling is a project which extends, for many individuals, well into early adulthood, many relevant studies employ measures of personality rather than temperament. The bridging of measurement systems for temperament and personality traits – which should permit synthesis of findings across the developmental span from preschool to adulthood -- is challenging for at least four reasons. First, the behavioral expression of a trait may qualitatively change during development: Sensation seeking at age four may manifest in jumping from the top of stairs, at seventeen in driving over the speed limit and experimenting with cigarettes, and in adulthood as risky and promiscuous sexual behavior. Second, certain dimensions of behavior, such as motor activity or regularity in sleeping and eating habits, demonstrate more between-

individual variability earlier in life than later, whereas more complex dimensions of behavior, such as conventionality and organization, do not emerge until later in the life course. Indeed, increasing complexity of individual differences over the life course in behaving, feeling, and thinking has led many researchers to conceive of temperament as the rudimentary building blocks from which more intricate structures, with life experience, gradually evolve. Third, the latent psychological processes that give rise to overt manifestations of temperament and personality are not directly observable, and while these latent processes may be constant across situation, their expression and activation surely vary in response to situational cues that may change markedly from childhood to adulthood.

A fourth challenge to linking temperament to personality is the lack of a consensual taxonomy for temperament traits. In contrast, there is reasonable agreement among personality researchers that a five factor organization -- conscientiousness, openness to experience, emotional stability, agreeableness, and extraversion -- describes personality traits at the broadest level of abstraction. The five-factor structure (often referred to as the Big Five) has also been identified in middle childhood and early adolescence (John, Caspi, Robins, Moffitt, & Stouthamer-Loeber, 1994; Soto, John, Gosling, & Potter, 2008), and both theoretical arguments and a limited body of empirical evidence have linked the Big Five factors to specific temperament traits (De Pauw & Mervielde, 2010; Evans & Rothbart, 2007).

Of particular relevance to academic performance, effortful control, the temperament factor conceptualized by Rothbart and colleagues as “the ability to inhibit a dominant response to perform a subdominant response, to detect errors, and to engage in planning...a major form of self-regulation...children’s ability to control reactions to stress, maintain focused attention, and interpret mental states in themselves and others” (Rothbart & Rueda, 2005, p. 169) is closely

related, both conceptually and empirically, to Big Five Conscientiousness (Rothbart, Ahadi, & Evans, 2000). In contrast to reactive (i.e., automatic, involuntary) dimensions of temperament (e.g., surgency, negative affectivity, behavioral inhibition), effortful control is intentional and voluntary. Indeed, the core function of effortful control seems to be goal-directed self-regulation of more reactive behavioral, attentional, and affective processes (Eisenberg, Smith, Sadovsky, & Spinrad, 2004). Generally not observed by caregivers until the toddler and preschool years, effortful control becomes more coherent (i.e., stable across situation and time) throughout early development (Kochanska & Knaack, 2003) and, generally, more pronounced throughout childhood and beyond (Rothbart, 2007). Because effortful control allows for flexible and deliberate inhibition over reactive tendencies, it is not surprising that effortful control predicts a range of positive developmental outcomes, including compliance, morality and conscience, and social competence (see Eisenberg, Smith, Sadovsky, & Spinrad, 2004 for a review).

The most commonly measured facets of effortful control include the ability to control attention, inhibit impulses, and initiate subdominant actions in flexible and adaptive ways (Rothbart, Sheese, & Posner, 2007). Recent theorizing by leaders in effortful control research suggests that these competencies depend upon a well-functioning executive attention network, whose function is to monitor and resolve conflicts between other brain networks (Rothbart & Rueda, 2005). Laboratory research studies employing a variety of so-called *executive function* tasks requiring control of attention and, inhibition of prepotent impulses, and/or working memory demonstrate reliable associations between task performance and caregiver ratings of effortful control (Duckworth & Kern, 2011), and independent measures of these two constructs demonstrate similar developmental trajectories, increasing monotonically through childhood (Best & Miller, 2010). Nevertheless, effortful control and executive function are not identical,

interchangeable constructs: correlations between effortful control and executive function are quite modest in magnitude (Duckworth & Kern, 2011), working memory is a facet of the latter but not the former (Liew, in press), and each provides independent predictive validity for academic outcomes (Blair & Razza, 2007).

Historical Interest in Temperament and Academic Performance

The notion that temperament in general, and aspects of effortful control in particular, play an important role in the classroom is not new. In a series of lectures addressed to Boston schoolteachers, William James (1899), opined that in “schoolroom work” there is inevitably “a large mass of material that must be dull and unexciting” (pp. 104-105). Further, “there is unquestionably a great native variety among individuals in the type of their attention. Some of us are naturally scatter-brained, and others follow easily a train of connected thoughts without temptation to swerve aside to other subjects” (p. 112). It follows, James argued, that a dispositional advantage in the capacity for sustained attention is tremendously beneficial in the classroom: “Our acts of voluntary attention, brief and fitful as they are, are nevertheless momentous and critical, determining us, as they do, to higher or lower destinies. The exercise of voluntary attention in the schoolroom must therefore be counted one of the most important points of training that takes place there” (p. 189).

Ironically, pioneers of intelligence testing were among the first to recognize the importance of self-regulation to academic performance. Alfred Binet (1916), architect of the first modern intelligence test, noted that performance in school --

admits of other things than intelligence; to succeed in his studies, one must have qualities which depend especially on attention, will, and character; for example a certain docility, a regularity of habits, and especially continuity of effort. A child, even if intelligent, will

learn little in class if he never listens, if he spends his time in playing tricks, in giggling, in playing truant (p. 254).

At about the same time, Charles Spearman, best known for his work on the factor structure of intelligence, and his student Edward Webb undertook studies of “character” because of “the urgency of its practical application to all the business of life” (Spearman, 1927; Webb, 1915, p.1). Spearman and Webb applied an early form of factor analysis to teacher ratings of several samples of male students, concluding that many positive aspects of character form a positive manifold, loading on a single factor which Spearman and Webb chose to call “persistence of motives,” meaning “consistency of action resulting from deliberate volition, or will.” They dubbed the factor *w* for will and emphasized its independence from *g*, the factor for general intelligence (Webb, 1915, p.60).

David Wechsler (1943), who several decades later helped usher intelligence testing into widespread clinical and educational practice, made similar observations about the unfortunate neglect of “non-intellective” factors that, in conjunction with general intelligence, determine intelligent behavior. In reviewing his own extensive data, Wechsler (1950) came to two conclusions:

First, that factors other than intellectual contribute to achievement in areas where, as in the case of learning, intellectual factors have until recently been considered uniquely determinate, and, second, that these other factors have to do with functions and abilities hitherto considered traits of personality. Among those partially identified so far are factors relating primarily to the conative functions like *drive, persistence, will, and perseverance*, or in some instances, to aspects of temperament that pertain to *interests and achievement* (emphasis added, p. 81).

Despite exhortations from prominent figures in the intelligence literature, the study of temperament and its role in academic achievement languished for much of the twentieth century. Happily, there has been very recently a renaissance of theoretical and empirical interest in the role of temperament and personality in determining success in and beyond school (Borghans, Duckworth, Heckman, & ter Weel, 2008; Duckworth, 2009; Duckworth & Seligman, 2005; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007).

Dimensions of Academic Performance

Academic performance has at least three distinct dimensions: school readiness, academic achievement, and educational attainment¹. School readiness refers to preparation for success in kindergarten and has been used, broadly, to encompass the physical, social, emotional, and cognitive resources that young children require to thrive in their first years of formal schooling. Academic achievement refers to mastery of material presented in school and is typically measured by course grades or standardized achievement test scores. Educational attainment refers to the quantity of formal education completed (e.g., graduation from high school, cumulative years of education). Put simply, readiness refers to *how prepared* a child is to embark upon the challenge of formal education, achievement refers to *how well* a student performs when in school, and attainment refers to *how much* education a student ultimately attains. Both the

¹ Prosocial behavior, including kindness and consideration of others and compliance with classroom rules has long been an explicit goal of formal education, particularly in primary school (Dewey, 1909; Franklin, 1747) and, indeed, prosocial classroom behavior predicts life outcomes even when controlling for course grades and standardized achievement tests (Segal, 2011). However, considering prosocial behavior as an outcome raises concerns about tautology (i.e., that ratings of temperament based in part by observed behavior in the classroom are then used to predict an outcome based on the same criteria). Thus, our narrow focus in this review is the empirical evidence linking aspects of temperament to school readiness, academic achievement, and educational attainment.

quantity and quality of formal education predict long-term outcomes. For instance, years of schooling and graduation from high school both predict earnings, employment, and health in adulthood (Hanushek & Woessmann, 2008; Sum et al., 2007). Likewise, standardized achievement tests and teacher-assigned course grades predict the same outcomes (Currie & Thomas, 2001; Kuncel, Hezlett, & Ones, 2004; Sackett, Borneman, & Connelly, 2008).

School Readiness

The transition to formal schooling, typically in kindergarten for American schoolchildren, marks a dramatic change in the way young children spend time, expectations for self-regulation and compliance with authority, and consequences for their meeting these expectations. There is now considerable evidence that aspects of effortful control, more so than other temperament traits, set children up for success during this transition. Martin and colleagues (1989) were among the first to demonstrate, in a series of small-sample studies, that teacher and parent ratings of early childhood persistence, (low) distractibility, and (low) activity prospectively predict both course grades and standardized achievement test scores in the first years of primary school. More recently, in a sample of preschool children from low-income homes, parent and teacher ratings of effortful control accounted for unique variance in standardized achievement test scores in kindergarten, even after controlling for general intelligence (Blair & Razza, 2007). In a cross-sectional study of a comparable sample of low-income preschoolers, ratings of children's resilience, including capacity for self-control and adaptive engagement with their environment, from structured interviews with preschool teachers, were associated with performance on individually administered tests of children's knowledge of colors, letters, numbers, sizes, comparisons, and shapes (Munis, Greenfield, Henderson, & George, 2007). Similarly, teacher and parent ratings of kindergartners' effortful control predicted performance on standardized

achievement tests six months later, and this association held when controlling for both verbal intelligence and family socioeconomic status (Valiente, Lemery-Chalfant, & Swanson, 2010). Likewise, performance at the start of kindergarten on the Head-Toes-Knees-Shoulders (HTKS) task, which requires young children to perform the opposite of a dominant response (e.g., to touch their heads when the experimenter says “touch your toes”) (Ponitz et al., 2008) correlates positively with parent ratings of attentional focusing and inhibitory control and predicts higher levels of academic achievement in the spring as well as better teacher-rated classroom self-regulation (McClelland et al., 2007).

Suggestive evidence points to effortful control as more critical than social competence to success in the classroom. For instance, in a representative sample of Baltimore first graders, teacher ratings of attention span-restlessness, but not cooperation-compliance, predicted both course grades and standardized achievement test scores four years later (Alexander, Entwisle, & Dauber, 1993). Likewise, in a longitudinal study of French children, preschool teacher ratings of children’s attention, but not conduct problems, unsociability, or hyperactivity, independently predicted performance on reading tasks in first grade (Giannopulu, Escolano, Cusin, Citeau, & Dellatolas, 2008). Similarly, Schoen and Nagle (1994) found that kindergarten children rated by their teachers as showing superior attention span and persistence on learning tasks scored higher on a standardized test of school readiness, whereas, teacher ratings of adaptability in novel social situations and emotional intensity did not incrementally predict school readiness. Perhaps most definitively, a meta-analysis by Duncan and colleagues (2007) in which effects from six large, longitudinal datasets were synthesized determined that attention skills at the beginning of formal schooling, measured variously by task and questionnaire measures, prospectively predicted later math and reading achievement test scores years later, even when controlling for math and

reading skills at school entry, but there was no evidence for the predictive validity of either externalizing or internalizing behaviors.

Course Grades in Primary, Secondary, and Post-Secondary Education

Once children have transitioned to primary school, traits conceptually related to effortful control continue to predict academic achievement, particularly as assessed by higher report card grades. Poropat (2009) completed a definitive meta-analysis of Big Five personality factors and course grades, in which cumulative sample sizes ranged to over 70,000. As shown in **Figure 1**, in primary school, all five personality factors are related to report card grades, though the cross-sectional associations between course grades and the personality factors of emotional stability and extraversion are markedly weaker than those between course grades and conscientiousness, openness to experience, and agreeableness.

As children progress through secondary and post-secondary education, associations between individual differences and course grades markedly diminish, with the notable exception of conscientiousness, whose association with course grades incrementally *increases* as students progress to higher levels of education. Interestingly, associations between course grades and cognitive ability decline markedly over the same period, a pattern consistent with the speculation of intelligence researchers (e.g., Jensen, 1980) that diminishing predictive validity estimates reflect increasing restriction on range. If indeed students who do poorly in their courses selectively drop out of research samples and, as a consequence, the traits that determine course grade performance are progressively restricted in terms of variance in the population, then range-corrected associations between course grades and conscientiousness, which do not shrink, are in fact stronger at more advanced levels of education than observed correlations suggest.

Why might traits related to conscientiousness and effortful control matter more and more

to earning high marks from teachers as students progress through the formal education system? One plausible explanation is that the task demands of formal schooling change as students mature. Compared to primary school students, older students are expected to spend more hours studying and completing homework outside the classroom, to independently regulate their attention while in the classroom, and to otherwise take responsibility for their learning with decreasing support from teachers (Zimmerman, 2002).

A handful of prospective, longitudinal studies have confirmed the predictive validity of more narrowly defined temperament and personality traits for later course grades while controlling for baseline course grades. In general, these prospective studies support the conclusions of more numerous, less rigorously controlled studies. For instance, effortful control predicted report card grades when controlling for baseline grades in a sample of Chinese primary school children (Zhou, Main, & Wang, 2010). Similarly, self-control predicted final report card grades, controlling for first marking period grades as well as general intelligence, in a sample of American middle school students (Duckworth & Seligman, 2005). Likewise, within-individual changes in self-control predicted subsequent within-individual changes in report card grades over a four-year period in a different sample of American middle school students (Duckworth, Tsukayama, & May, 2010).

Overlap – and Divergence – between Course Grades and Standardized Achievement Tests

In addition to course grades, effortful control predicts performance on standardized achievement tests. For instance, in a sample of over 1,000 children from 55 schools, teacher ratings of inattention at the beginning of the fourth grade predicted standardized achievement test scores at the end of the school year (Finn, Pannozzo, & Voekle, 1995). Even more impressive because more than a decade separated the measurement of temperament and test performance,

the number of seconds four-year old children delayed gratification in order to receive a preferred treat predicted their performance on the SAT college admission test more than a decade later (Mischel, Shoda, & Rodriguez, 1989). In a separate sample of older children, adaptive attentional strategies (e.g., not staring at the treat which, if consumed immediately, forfeits the preferred but delayed treat) had a direct, positive effect on delay behavior, underscoring the importance of attention regulation to voluntary regulation of behavior in the presence of temptations (Rodriguez, Mischel, & Shoda, 1989).

Course grades and standardized test scores are generally highly correlated (Willingham, Pollack, & Lewis, 2002), but the former may be more sensitive to individual differences in traits related to effortful control. In two longitudinal, prospective studies of middle school students, IQ predicted changes in standardized achievement test scores over time better than did self-control, whereas self-control predicted changes in report card grades over time better than did IQ (Duckworth, Quinn, & Tsukayama, 2011). These findings are consistent with those of Willingham, Pollack, and Lewis (2002), who examined data from $N = 8,454$ high school seniors in the National Education Longitudinal Study (NELS). Conscientious behaviors, including attending class regularly and promptly, participating in class activities, completing work on time, and avoiding drug and gang activity were more strongly associated with course grades than with standardized achievement test scores. Likewise, Oliver, Guerin, and Gottfried (2007) found that parent and self-report ratings of distractibility and persistence at age 16 predicted high school and college course grades, but not SAT test scores, and several cross-sectional studies of college students have shown that Big Five Conscientiousness is more strongly associated with GPA than with SAT scores (Conard, 2005; Nofle & Robins, 2007; Wolfe & Johnson, 1995).

Interestingly, Bowen, Chingos and McPherson (2009) found that cumulative high school GPA predicts class rank and successful graduation dramatically better than do SAT/ACT scores. In an analysis of about 80,000 University of California students followed over four years, Geiser and Santelices (2007) reached the same conclusion. Bowen and colleagues (2009) have speculated that aspects of conscientiousness seem *differentially* essential to earning strong course grades because of what is required of students to earn them: “[High school grades] reveal qualities of motivation and perseverance—as well as the presence of good study habits and time management skills... Getting good grades in high school, however demanding (or not) the high school, is evidence that a student consistently met a standard of performance” (p. 124). Indeed, it seems likely that effortful control enables students to regulate impulses and urges that conflict with teacher-endorsed goals and standard.

Graduation from High School

Whereas course grades and standardized achievement tests reflect the *quality* of academic performance, the *quantity* of education students obtain is also an important predictor of later life outcomes. Unfortunately, about one in four American students drops out of formal schooling before receiving a high school diploma (Heckman & LaFontaine, 2007). Research on the General Educational Development (GED) testing program suggests that many high school dropouts are sufficiently intelligent to graduate with their classmates and that aspects of temperament may contribute to their failure to complete high school training. The GED was originally designed to certify veterans who interrupted their high school education to serve in World War II. Since its inception, the GED has evolved into a second-chance program for high school dropouts to certify they have mastered the same skills and knowledge as typical high school graduates. GED recipients have the same measured intelligence as high school graduates

who do not attend college, but when controlling for measured ability, GED recipients have lower hourly wages and annual earnings and attain fewer years of education, suggesting they may “lack the abilities to think ahead, to persist in tasks, or to adapt to their environments (Heckman & Rubinstein, 2001, p. 146). Indeed, several prospective studies have found that personality traits related to Big Five Conscientiousness (e.g., self-control, distractibility) and Big Five Neuroticism (e.g., external locus of control) predict successful graduation from high school (Bowman & Matthews, 1960; Gough, 1964; Hathaway, Reynolds, & Monachesi, 1969; Janosz, LeBlanc, Boulerice, & Tremblay, 1997; Kelly & Veldman, 1964; Whisenton & Lorre, 1970).

Only a handful of longitudinal studies have examined the predictive validity of temperament traits measured very early in life for graduation from high school. Overall, these studies have identified either attentional control or (lack of) aggression as predictors of high school graduation. Duncan and Magnuson (in press) found that parent ratings of persistent behavior problems, but not persistent attention problems, measured across middle childhood, uniquely predicted high school completion and college attendance. Likewise, Fergusson and Horwood (1998) found that teacher and parent ratings of conduct problems at age 8 (inversely) predicted high school completion at age 18. Conversely, Vitaro et al. (2005) examined $N = 4,340$ individuals in a population-based sample of Quebec children and found that kindergarten teacher ratings of hyperactivity-inattention (inversely) predicted completion of high school *better* than did aggressiveness-opposition.

Cumulative Lifetime Years of Education

While related, the number of years an individual pursues formal schooling and whether they graduate from high school are distinct outcomes. In the U.S., for example, about 68% of students accumulate additional years of schooling beyond high school. Two published studies

using large, representative samples have examined cross-sectional relationships between Big Five factors and years of education. Goldberg et al. (1998) found in a representative sample of $N = 3,629$ American working adults aged 18 to 75, openness to experience ($r = .31$) was most strongly associated with years of education, whereas associations with conscientiousness ($r = .12$), agreeableness ($r = -.08$), extraversion ($r = -.04$), and neuroticism ($r = -.03$) were more modest. Van Eijck and de Graaf (2004) reported a similar pattern of associations in a nationally representative sample of $N = 2,029$ Dutch adults aged 18 to 70. Specifically, when controlling for gender, age, father's education, mother's education, and father's occupational status, years of schooling was most strongly associated with openness to experience ($\beta = .14$). Associations with emotional stability ($\beta = .09$), extraversion ($\beta = -.07$), agreeableness ($\beta = -.07$) and conscientiousness ($\beta = .05$) were more modest.

Unfortunately, neither Goldberg et al. (1998) nor van Eijck and de Graaf (2004) controlled for cognitive ability in their analyses. Because openness to experience is the only Big Five factor with moderate associations with general intelligence ($r = .33$ in a meta-analysis by (Ackerman & Heggestad, 1997), and intelligence is itself robustly associated with years of education ($r = .5$, Neisser, et al., 1996), unadjusted associations between openness and years of education in these studies may have been confounded by associations with cognitive ability. For the current chapter, therefore, we conducted a cross-sectional analysis of data collected in the Health and Retirement Study. Specifically, we used a structural equation model to assess associations between latent Big Five personality factors and years of education. Among $N = 9,646$ American adults from this nationally representative sample, openness ($\beta = .16, p < .001$) was the only personality trait positively correlated with years of education when Big Five

personality factors and cognitive ability, as well as gender, ethnicity, and age, were entered as predictors in the same model.

In sum, traits related to Big Five Openness to Experience seem particularly important in determining how many years individuals spend in school over their lifetimes but, as illustrated in Figure 1, seem to play a diminishing role in how well students meet their course requirements as they progress through school. We suggest that enjoying learning for its own sake may get students to show up to school but not to execute all of the tasks necessary to achieve high grades in those courses. Consistent with this supposition, openness to experience is the best Big Five predictor of school attendance among middle and high school students (Lounsbury, Steel, Loveland, & Gibson, 2004). Moreover, a longitudinal study of high school students showed that when controlling for cognitive ability, intrinsic motivation while studying a particular academic subject predicted the difficulty level of courses in that subject over four years of high school (Wong & Csikszentmihalyi, 1991) but *not* course grades in that subject. In the same study, conscientiousness, measured using a self-report questionnaire, did not consistently predict course difficulty but was the best personality predictor of course grades.

Mediation: Quality-Adjusted Learning Hours (QALHs)

As summarized in this chapter, there is a growing body of empirical evidence establishing the relevance of temperament traits for various academic outcomes. Most notably, effortful control and its facets have emerged as the most robust predictors of the broadest range of academic outcomes, including school readiness, course grades in primary, secondary, and post-secondary school, and graduation from high school. Why? Aristotle's observation of the learning process offers one clue: "the roots of education are bitter, but the fruit is sweet." Indeed, even gifted and talented American high school students dislike homework and studying (Wong

& Csikszentmihalyi, 1991). More generally, the tasks requirements of formal schooling -- including not just homework and independent studying, but also paying attention to the teacher rather than joking with classmates, practicing skills repeatedly to the point of fluency, showing up to school rather than playing hooky -- yield long-term rewards at the expense of short-term comfort and pleasure. Likewise, the social nature of the formal classroom setting suggests that relationships with peers and teachers affect the quality of a student's learning experience, and maintaining positive social relationships requires suppression of impulses (e.g., the impulse to tell off a teacher or classmate in a moment of anger, the impulse to interrupt a fellow classmate in discussion, etc.) whose discharge may provide immediate relief but lead to long-term regret.

Figure 2 summarizes our theoretical model relating effortful control to course grades at all levels of schooling. We suggest that the proximal causal variable linking effortful control to course grades is *quality-adjusted learning hours* (QALHs), a variable that encompasses both the quality and quantity of learning experiences². Our model is similar to that proposed by Eisenberg, Valiente, and Eggum (2010), which highlights the importance of social competence and also Zimmerman and Kitsantas (2005), which places special emphasis on diverse self-regulatory strategies that optimize performance in preparation, execution, and later reflection of learning opportunities. In the interest of simplicity, our model omits grade level, gender, and other demographic variables, in addition to general intelligence, school motivation, and other individual differences which are no doubt important to school achievement. Likewise, we have omitted recursive pathways, though we recognize that virtuous and vicious cycles are almost certainly at play in determining trajectories of course grades for students from kindergarten to college (Tsukayama, 2011; see also Houts, Caspi, Pianta, Arseneault, & Moffitt, 2010). Finally,

² Our conception of QALHs was inspired by the analogous construct in the public health literature, quality-adjusted life years (QALYs).

we have not specified the relative weights of causal pathways, nor have we indicated how the relative importance of causal antecedents might vary with student, teacher, or school characteristics.

No single investigation has tested all of the proposed relationships in Figure 2. Nevertheless, extant empirical evidence is consistent with our suppositions. For instance, Tsukayama et al. (2011) found that trait-level self-control in middle school students is associated with the regulation of both interpersonal-related and work-related impulses. In a separate sample of middle school students, Duckworth, Quinn, & Tsukayama (2011) used a cross-lagged model to establish that a composite measure of control over both interpersonal-related and work-related impulses predicts changes in course grades from fall to spring, and that changes in course grades were mediated by mid-year changes in homework completion and classroom behavior. In a sample of primary school children, Valiente et al. (2008) found that teacher-child relationships, social competence, and classroom participation partially mediated the prospective association between effortful control and change in GPA from the beginning to the end of the school year. Similarly, in a six-year longitudinal study, Valiente et al. (2011) found that social functioning (e.g. social competence and lower levels of externalizing problems) fully mediated the relationship between effortful control at 73 months and report card grades at 12 years. In a sample of Chinese primary school children, Zhou et al. (2010) showed that effortful control predicted GPA in fifth and sixth grade, controlling for baseline GPA, and that social competence mediated this relationship. Veenstra et al. (2010) found that 11-year old children who were lower in self-control were more likely to be persistently truant from school, an association mediated by poor social bonds with teachers, parents, and peers. Rudasill and Rimm-Kaufman (2009) found that effortful control measured at 54 months in the NICHD SECCYD sample predicted teacher-

child relationship quality in first grade. In a sample of 3 to 5-year-olds from low-income backgrounds, Silva et al. (2011) showed that teacher and parent-reported effortful control in the fall predicted school liking in the spring and that this relationship was mediated by teacher-child relationship quality. Finally, Birch and Ladd (1997) have shown in cross-sectional analyses that teacher-child relationship quality in kindergarten is associated with positive school engagement and academic performance. Among college students, there is evidence that effective study habits (e.g., frequency of studying sessions, review of material) and attitudes (e.g., a positive attitude toward education) which are associated with Big Five Conscientiousness, predict college grades over and beyond college admissions tests (Credé & Kuncel, 2008). As well, the salutary, causal role of studying on college GPA has been confirmed in quasi-experimental analyses that minimize the possibility of third-variable confounds (Stinebrickner & Stinebrickner, 2007).

School-Based Interventions

The salutary effects of effortful control, and evidence that rank-order and mean-level change are possible, raise the question, what can schools and teachers do to encourage its development? Several promising advances in this direction are worth highlighting and, collectively, provide convincing evidence for the benefits of supportive, thoughtfully designed educational environments.

Three multi-faceted preschool curricula have demonstrated salutary effects on effortful control and school readiness in random-assignment studies. The oldest of these is the Montessori program, an educational approach developed over a century ago and whose implementation, while somewhat variable across schools, characteristically features multi-age classrooms, student-chosen learning activities carried out with minimal instruction from teachers, and long periods of time designated for uninterrupted pursuit of these activities. Children who attend a

Montessori schools have been shown to perform better on tasks of executive function and on achievement tests than children who lost the lottery to go to the Montessori and therefore were at other schools (Lillard & Else-Quest, 2006). More recently, *Tools of the Mind*, a Vygotskian preschool and early primary school program, has been shown in random-assignment studies to improve performance on executive function tasks and classroom behavior (Barnett et al, 2008; Diamond, Barnett, Thomas, & Munro, 2007). Key principles of the *Tools of the Mind* curriculum include scaffolding student development from regulation-by-others to self-regulation, mental tools (i.e., strategies) to help children gain control of their behavior, reflective and meta-cognitive thinking, practice of self-regulation via developmentally appropriate games and activities, and increasingly complex and extended social, imaginary play (Bodrova & Leong, 2007). Finally, a recent cluster-randomized trial showed that the *Chicago School Readiness Project*, which provides preschool teachers with training in a variety of strategies for managing classrooms effectively and encouraging children to regulate their behavior, improves effortful control in low-income children and that these improvements partially mediate gains in school readiness (Raver et al., 2011).

Econometric analyses suggest that early investment in children should be followed by complementary investment later in development in order to maximize long-term benefits to children and to society (Heckman, 2006). Happily, social and emotional learning (SEL) programs, typically designed for implementation in primary school but sometimes targeting older children, have been shown to improve academic course grades ($d = .33$) and standardized achievement test scores ($d = .27$) in a meta-analysis of controlled studies involving over 270,000 children in kindergarten through college (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011).

An excellent exemplar of the SEL approach, the *Promoting Alternative Thinking Strategies* (PATHS) curriculum, teaches self-control, emotional awareness, and social problem-solving skills (Bierman et al., 2010). The PATHS curriculum is multi-faceted, with an explicit commitment to fostering skills that support each other. For instance, emotional awareness (e.g., recognizing the internal and external cues of affect) is understood as essential to social problem solving (e.g. sustaining friendships, peacefully resolving conflicts with classmates). Teachers trained to deliver the PATHS curriculum guide students through skill-building activities and also reinforce the same lessons throughout the school day. A recent random-assignment, longitudinal study demonstrated that the PATHS curriculum reduces teacher and peer ratings of aggression, improves teacher and peer ratings of prosocial behavior, and improves teacher ratings of academic engagement (Bierman, et al., 2010). There is some evidence that improvements in inhibitory control partially mediate the benefits of PATHS on behavioral outcomes (Riggs, Greenberg, Kusche, & Pentz, 2006). Likewise, a randomized-controlled trial of a preschool version of PATHS showed the intervention improved both performance on an executive function task and experimenter ratings of children's capacity to sustain attention during the testing session, and these gains partially mediated benefits of the intervention on school readiness (Bierman, Nix, Greenberg, Blair, & Domitrovich, 2008).

It is important to note that not all implementations of SEL programming are successful: seven SEL programs, including PATHS, were studied in a multi-site, longitudinal random-assignment study and were not found to improve social and emotional competence, behavior, or academic achievement outcomes among primary school students when considered together or individually by program (Social and Character Development Research Consortium, 2010). Thus, additional research is needed to elucidate moderating factors that influence the efficacy of SEL

programs, including baseline characteristics of students, teachers, and schools, as well as implementation integrity and dosage.

Beyond direct intervention, emotional support in the classroom has been shown to protect children low in effortful control from poor academic outcomes. For instance, children identified as at-risk based on demographic characteristics and prior attention and behavior problems who are placed in warm, relaxed, and well-managed first-grade classrooms develop as positive relationships with their teachers and perform as well on standardized achievement tests as their low-risk peers (Hamre & Pianta, 2005). Likewise, classroom emotional support moderates the association between poor attention regulation just before school entry and achievement test scores in third grade: individual differences in attentional control influence achievement more in classrooms with lower emotional support (Rudasill, Gallagher, & White, 2010). A similar study in which effortful control was measured using an executive function task (tracing a figure as slowly and accurately as possible) showed that positive student-teacher relationships served as a compensatory factor such that children with low task accuracy performed as well as their counterparts if paired with a positive and supportive teacher (Liew, Chen & Hughes, 2010). Therefore, professional development opportunities that help teachers create generally positive classroom environments should yield downstream benefits on their students (Jennings & Greenberg, 2009; Zins, Elias, & Greenberg, 2007).

More targeted intervention efforts delivered to individual children can also improve aspects of effortful control. For instance, Rueda and colleagues (2005) designed a set of computer exercises to train attention in children between four and six years of age. Children in the intervention group improved in performance on computer tasks of attention relative to children who instead watched interactive videos for a comparable amount of time. Similarly,

Stevens and colleagues (2008) designed a six-week computerized intervention and showed that it can improve selective auditory attention (i.e., the ability to attend to a target auditory signal in the face of an irrelevant, distracting auditory signal). Tominey and McClelland (2011) have developed physical games to improve self-regulation in preschool children and demonstrated that such exercises can improve performance on the HTKS self-regulation task for children who at baseline perform poorly on the HTKS.

Interventions that teach children meta-cognitive strategies, such as goal setting and planning, can also improve self-regulatory competence and, in turn, academic outcomes. The technique of mental contrasting with implementation intentions (MCII), for example, first developed as a self-regulatory strategy for adults, has also been shown to help children and adolescents. For instance, in a random-assignment study of high school students preparing for college entrance examinations, students were instructed to mentally contrast the positive benefits of studying (e.g., “I’ll have a better chance of getting into my top-choice college”) with obstacles that stood in the way of this study goal (e.g., “My little sister bothers me when I try to study”), and then to make a plan to obviate these obstacles (e.g., “If my little sister bothers me, then I will study in my bedroom with the door closed”) (Duckworth, Grant, Loew, Oettingen, & Gollwitzer, 2011). Compared to students in a placebo-control condition who wrote a practice essay for the college entrance exam, students who learned MCII completed more than 60% more questions in study materials provided to students in both conditions. Likewise, in a random-assignment study at an urban middle school, fifth grade students taught MCII improved their report card grades and school attendance relative to students in a placebo-control condition (Duckworth, Gollwitzer, Kirby, & Oettingen, 2011). Children as young as preschool age demonstrate superior self-control when using plans to avoid distraction and temptation (Mischel & Patterson, 1976,

1978; Patterson & Mischel, 1975, 1976), suggesting that the meta-cognitive strategy of planning might be introduced to children in the earliest years of formal education.

Any review of school-based interventions to foster positive dimensions of temperament would be incomplete without mention of exercise and play. Aerobic exercise has been shown to improve attention and performance on standardized achievement tests in preadolescent children (Hillman et al., 2009). The robust findings linking physical activity to attention and other aspects of self-control suggest that eliminating gym class to make room for formal academic instruction may, paradoxically, reduce self-control (Hillman, Erickson, & Kramer, 2008). Play, and in particular pretend (i.e., imaginary) play with others, facilitates the development of a wide array of self-regulation skills (Berk, Mann, & Ogan, 2006; Saltz, Dixon, & Johnson, 1977; Singer & Singer, 1990; Singer & Singer, 2006). Like gym class, recess is often considered of secondary importance to academic objectives, but reducing opportunities for children to make up stories, exercise their imaginations and their bodies, resolve conflicts without help from adults may ultimately impair the normative development of effortful control (Panksepp, 2007).

Directions for Future Research

Early psychologists speculated that differences in temperament can help or hinder performance in – and beyond - the classroom. Extant empirical evidence supports this commonsense conjecture, pointing in particular to aspects of effortful control as supportive of children's educational attainment and achievement. Nevertheless, further investigation is needed to establish which facets of effortful control are most important to academic success. Moreover, longitudinal studies in which likely confounds (e.g., baseline academic performance and socioeconomic status) are precisely measured and statistically controlled are still the exception rather than the rule. Finally, additional multivariate research is needed to confirm that effortful

control, rather than some other correlated dimension of temperament, is indeed causally influencing school performance.

In parallel to increasingly fecund research literature on temperament and academic outcomes, public interest in dimensions of human individuality other than general intelligence is growing. An editorial in the *New York Times* suggested that, as a society, we devote more resources to “the moral and psychological traits that are at the heart of actual success” (Brooks, 2006). The positive effects of direct interventions as well as supportive classrooms and teachers suggest that such investment should indeed pay considerable societal dividends, not only by improving academic outcomes overall, but also by reducing the achievement gap separating disadvantaged children from their wealthier counterparts, who tend to be better at delaying gratification (Evans & Rosenbaum, 2008) and demonstrate superior selective attention (Stevens, Lauinger, & Neville, 2009).

In what direction should research on temperament and academic performance proceed? Over a century ago, addressing local schoolteachers, William James (1899) observed that the science of psychology and the art of education are complementary: “the teacher’s attitude toward the child, being concrete and ethical, is positively opposed to the psychological observer’s, which is abstract and analytic” (p. 13). Accordingly, we suggest psychologists collaborate more intimately with educators – sharing insights, debating intuitions, thinking creatively and drawing from respective knowledge bases -- to develop multi-faceted interventions aimed at durably changing behavior and, in turn, objectively measured academic outcomes. In such translational research studies, theoretically-predicted mechanisms of change (e.g., homework completion, school attendance, classroom participation) and moderators (e.g., baseline temperament, school quality, demographic factors) should be precisely assessed over time, so that we can begin to fill

in details of the undoubtedly complex causal story relating temperament to outcomes. In tandem, short-term, controlled field and laboratory experiments should be undertaken, providing a less expensive, more flexible complement to large-scale intervention research and a means of efficiently investigating the “active ingredients” of behavior change. In sum, we see the royal road to progress as one which is inherently interdisciplinary, rife with challenges, and open to as yet unimagined possibilities.

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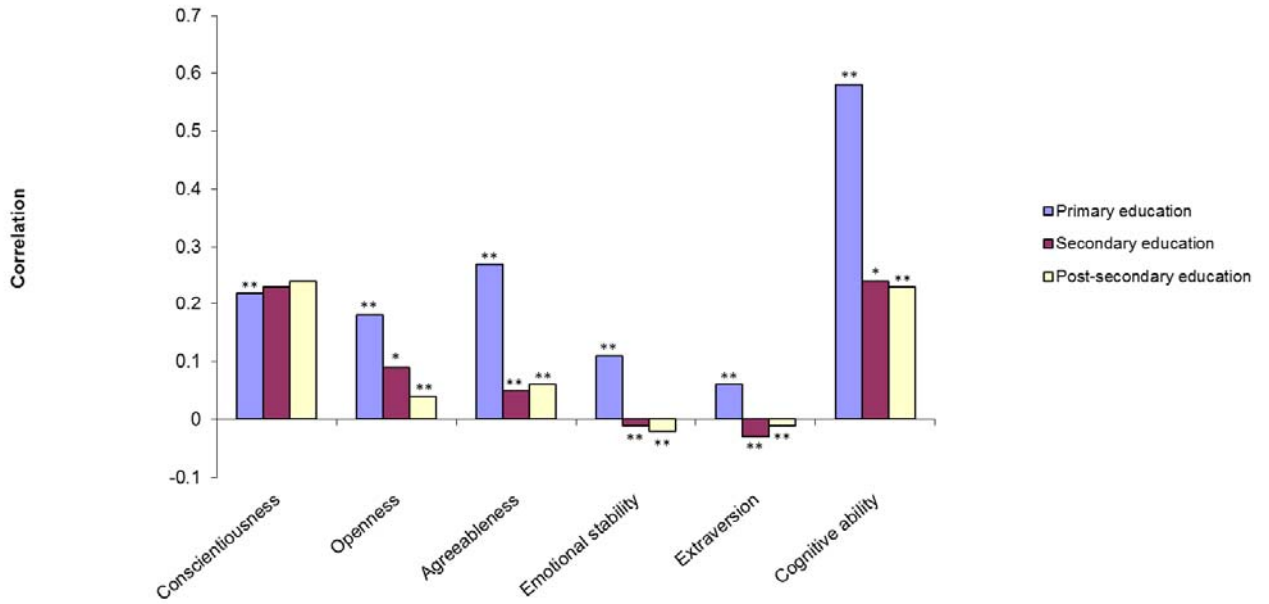


Figure 1. Associations between Big Five Personality Factors and Course Grades by Level of Education.

Note. Associations reported in a meta-analysis by Poropat (2009). Estimated correlations with Big Five personality factors control for cognitive ability and are corrected for scale reliability.

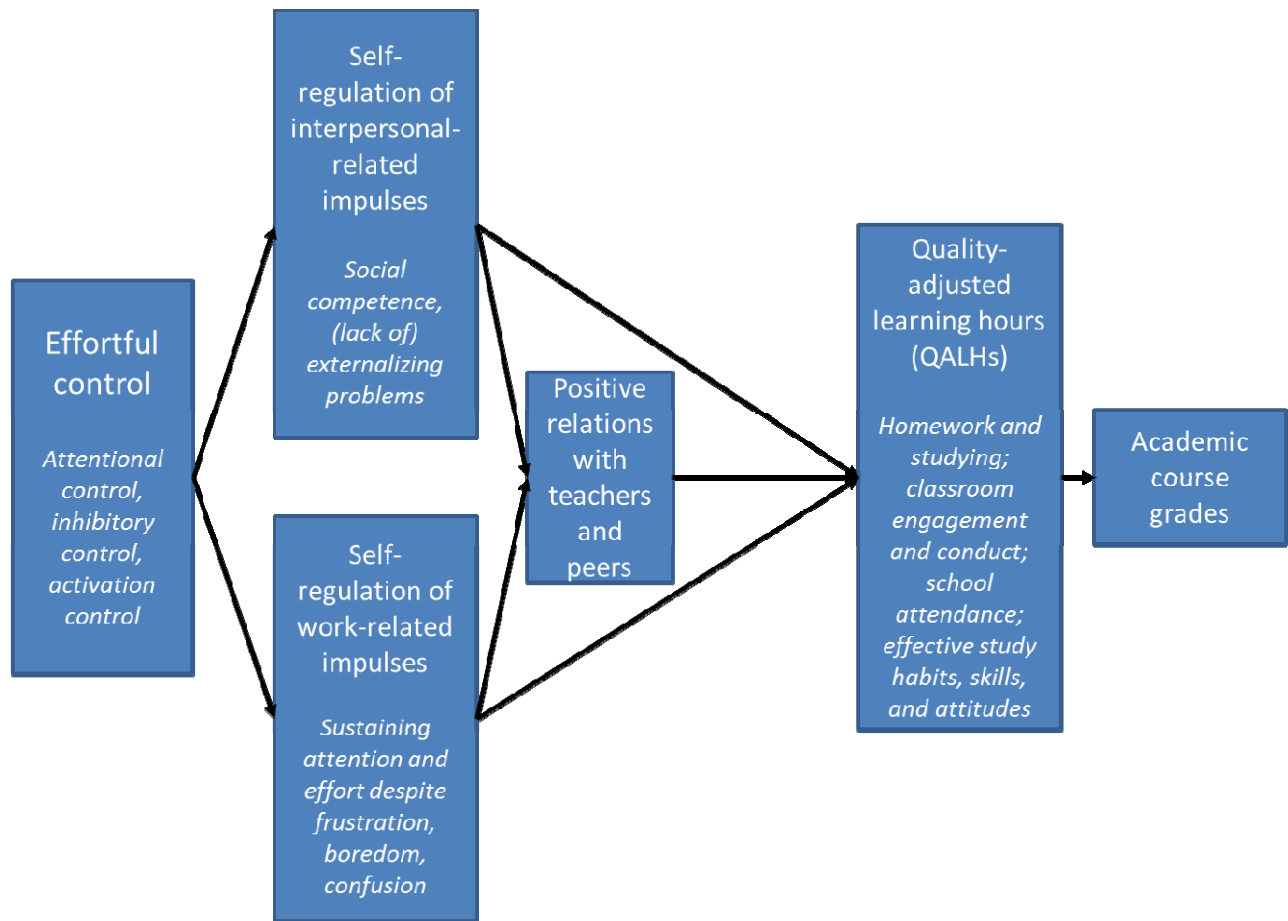


Figure 2. Theoretical Model Relating Effortful Control to Academic Course Grades.

