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Self-Regulation and School Success

Abstract

Some children fare better academically than others, even when family background and school and teacher quality are controlled for (Rivkin, Hanushek, & Kain, 2005). Variance in performance that persists when situational variables are held constant suggests that individual differences play an important role in determining whether children thrive or fail in school. In this chapter, we review research on individual differences in self-regulation and their relation to school success.

Disciplines

Psychology

Chapter 10

Self-Regulation and School Success

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Some children fare better academically than others, even when family background and school and teacher quality are controlled for (Rivkin, Hanushek, & Kain, 2005). Variance in performance that persists when situational variables are held constant suggests that individual differences play an important role in determining whether children thrive or fail in school. In this chapter, we review research on individual differences in self-regulation and their relation to school success.

Historically, research on individual differences that bear on school success has focused on general intelligence. A century of empirical evidence has now unequivocally established that 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 school success (Gottfredson, 2004; Kuncel, Ones, & Sackett, 2010; Lubinski, 2009). In contrast, the relation between school success and temperamental differences among children has only recently attracted serious attention from researchers. Temperament is typically defined as “constitutionally based individual differences in reactivity and self-regulation, in the domains of affect, activity, and attention” (Rothbart & Bates, 2006, p. 100). While assumed to have a substantial genetic basis, temperament is also influenced by experience and demonstrates both stability and change over time.

This chapter focuses on self-regulation because it is the dimension of temperament most reliably related to school success. We address several related questions: What is the relation between self-regulation and both educational *attainment* (e.g., years of education, high school completion) and

achievement (e.g., teacher-assigned course grades, standardized achievement test scores)? Does self-regulation also predict job performance, health, and other dimensions of success in life? Finally, what progress has been made in deliberately cultivating self-regulatory competence in children?

NAMING, DEFINING, AND MEASURING SELF-REGULATION

We define self-regulation as the voluntary control of attentional, emotional, and behavioral impulses in the service of personally valued goals and standards. By specifying that goals and standards are personally valued, we do not mean that they are necessarily selfish. On the contrary, self-regulation is required to adhere to goals and standards that are altruistic in nature (e.g., sharing a prize rather than keeping it all for oneself) as well as those that are not (e.g., receiving a larger treat for oneself rather than a smaller one). For clarity's sake, we point out that we use the term "self-regulation" interchangeably with the terms self-control, self-discipline, and willpower – and suggest that the terms impulsiveness and impulsivity connote deficits in self-regulatory competence. Of particular relevance to this chapter, we consider self-regulation to be coextensive with effortful control, a well-recognized aspect of temperament in children that has been defined as "the ability to inhibit a dominant response to perform a subdominant response, to detect errors, and to engage in planning" (Rothbart & Rueda, 2005, p. 169). Crucially, in situations that tax self-regulation, at least two mutually exclusive responses are possible, and the weaker (i.e., subdominant) response is preferred to the stronger (i.e., dominant) impulse. While self-regulation is most certainly multi-dimensional in the sense of involving more than one distinct psychological process (Duckworth & Kern, 2011; Whiteside & Lynam, 2001; Zimmerman & Kitsantas, 2005), we suggest it is nevertheless a coherent higher-order construct (de Ridder, Lensvelt-Mulders, Finkenauer, Stok, & Baumeister, 2012; Heatherton & Wagner, 2011) and a profitable target of study alongside its component processes.

In taxonomies of childhood temperament, self-regulation is typically distinguished from two factors that are more reactive and less voluntary in nature: negative emotionality (shyness, fear, sadness, etc.) and surgency (activity level, sensation seeking, positive emotion) (Rothbart & Rueda, 2005). The location of self-regulation in omnibus taxonomies of adult personality is debatable (Revelle, 1997). At present, the most widely accepted organization for adult personality distinguishes five families of traits (the Big Five): Conscientiousness, Agreeableness, Extraversion, Emotional Stability, and Openness to Experience. Many psychologists consider self-regulation

to be identical – or nearly so – with Big Five Conscientiousness (Caspi & Shiner, 2006; Moffitt et al., 2011). Others have proposed that self-regulation relates to other Big Five factors as well. For instance, Whiteside and Lynam (2001) suggest that the tendency to think and plan before acting and the regulation of behavior in the face of frustration are both aspects of Big Five Conscientiousness, whereas the regulation of urgent, negative emotions corresponds to Big Five Emotional Stability, and the tendency to have strong impulses toward risky, exciting activities (which makes self-regulation more difficult) relates to Big Five Extraversion. Additionally, in children, the regulation of impulses in the context of interactions with peers and adults has clear conceptual links to Big Five Agreeableness (Tsukayama, Duckworth, & Kim, 2011).

Executive functioning overlaps conceptually with the temperament trait of effortful control, though the scientific investigation of these two constructs tends to be segregated, with neuroscientists primarily interested in executive functioning and temperament researchers primarily concerned with effortful control (Rothbart & Rueda, 2005). Rueda, Posner, and Rothbart (2005) have argued that executive function (and in particular, the executive attention network, which monitors and resolves conflict between other brain networks) and effortful control are concepts representing different methodological approaches to studying self-regulation of behavior (see also Checa, Rodriguez-Bailon, & Rueda, 2008). Children who do better on direct tasks of executive function tend to be rated significantly higher in effortful control by their parents (Chang & Burns, 2005; Gerardi-Caulton, 2000; Gonzalez, Fuentes, Carranza, & Estevez, 2001; Rothbart, Ellis, Rueda, & Posner, 2003; Simonds, 2007). However, a recent meta-analysis suggests that in general, correlations between individual executive function tasks and questionnaire measures of self-control are small in size (e.g., $r = .14$ with informant-report ratings; Duckworth & Kern, 2011). Even when batteries of executive function tasks are used to improve reliability and validity (Carlson, Faja, & Beck, in press), associates with informant ratings are only moderate in magnitude, suggesting that executive function is not the only contributing factor to self-controlled behavior.

HISTORICAL INTEREST IN SELF-REGULATION AND SCHOOL SUCCESS

The idea that self-regulation plays an important role in the classroom is not new. In a series of lectures addressed to Boston schoolteachers, William James (1899) stated 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.

Improbably, pioneers of intelligence testing were among the first to recognize the importance of self-regulation to academic performance. Binet and Simon (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 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, italics added)

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 which, in conjunction with general intelligence, determine intelligent behavior:

When our scales measure the non-intellective as well as the intellectual factors in intelligence, they will more nearly measure what in actual life corresponds to intelligent behavior. Under these circumstances they might not be so efficient in selecting individuals likely to succeed in Latin and geometry, but they should do a much better job in selecting those destined to succeed in life (p. 103).

Despite these exhortations of intelligence testing pioneers, the study of temperament and its role in academic achievement languished for much of the 20th century. Happily, there has been a renaissance of theoretical and empirical interest in the role of temperament, and particularly in self-regulation, in determining success in and beyond school (Borghans, Duckworth, Heckman, & ter Weel, 2008; Duckworth, 2009; Duckworth & Seligman, 2005; Roberts, Kuncel, Shiner, Caspi, & Goldberg, 2007). Notably, the proportion of scientific publications on self-regulation has accelerated in recent years, with a nearly threefold increase in relevant publications in the child development literature (Carlson, 2011; Duckworth & Kern, 2011).

We now turn to the empirical findings on self-regulation as it relates to three dimensions of success in school: high school completion, report card grades, and standardized achievement tests.

HIGH SCHOOL COMPLETION

About one in four American students drops out of formal schooling before receiving a high school diploma, and in recent decades this dropout rate has increased slightly (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 measured ability is controlled, 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).

Several prospective studies have confirmed that self-regulation predicts successful graduation from high school (Kelly & Veldman, 1964). A relatively separate literature has specifically examined the importance of early attention and aggression in determining graduation from high school. Duncan and Magnuson (2010) analyzed a sample of 1,433 individuals in the NLSY-C study, which includes children born to women in the National Longitudinal Study of Youth study initiated in 1979. When child and mother background characteristics, including intelligence and demographic variables, were controlled, anti-social behavior, but not attention measured in childhood, predicted high school completion. Likewise, Fergusson and Horwood (1998) analyzed a sample of 969 individuals in a birth cohort of New Zealand children and found that teacher and parent ratings of conduct problems at age 8 inversely predicted high school completion at age 18. In contrast, Vitaro, Brendgen, Larose, and Tremblay (2005) examined 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. In sum, there is evidence that self-regulation of attention, as well as interpersonal behavior,

positively predicts high school completion, although there is not enough evidence at this point to suggest whether control of attention or of aggressive impulses is more prognostic of school completion.

COURSE GRADES

Binet's (1916) supposition that success in the classroom depends not only on general intelligence, but also on "attention, will, and character; for example a certain docility, a regularity of habits, and especially continuity of effort" augured Poropat's (2009) meta-analysis of Big Five personality traits and course grades in primary, secondary, and post-secondary education. In an aggregate sample of over 70,000 students, Poropat found that the correlation between grades and Conscientiousness ($r = .19$) was almost as large as that between grades and cognitive ability ($r = .23$). Associations with grades were substantially smaller for other Big Five factors, the largest of which was Openness to Experience ($r = .10$). This pattern remained when cognitive ability was controlled and correlations were corrected for scale reliability (see Figure 10.1).

Complementing Poropat's (2009) analyses, several studies examining more narrowly defined traits and course grades support the conclusion that at all levels of schooling, self-regulatory competence robustly predicts the grades students earn from their teachers. Of particular note are prospective, longitudinal studies that have estimated the effect of self-regulation on course grades when baseline levels of grades are controlled. These studies help isolate the effects of temperament by reducing the likelihood that third variable confounds (e.g., socioeconomic status) and halo effects (e.g., inflated ratings of self-regulation based on perceptions of strong academic performance at baseline) account for the observed associations. For instance, self-regulation measured with parent, teacher, and self-report ratings, in addition to performance on delay of gratification tasks, was found to predict report card grades, with both general intelligence and baseline report card grades controlled, in a sample of American middle school students (Duckworth & Seligman, 2005). Likewise, Duckworth, Tsukayama, and May (2010) have used longitudinal hierarchical linear modeling to show that changes in self-regulation, measured with self-report, parent, and teacher ratings, prospectively predict subsequent changes in report card grades, whereas neither changes in report card grades nor in self-reported self-esteem prospectively predict changes in self-regulation. There is some evidence that the importance of self-regulation to school success generalizes to non-U.S. students. For instance, in a sample of Chinese primary

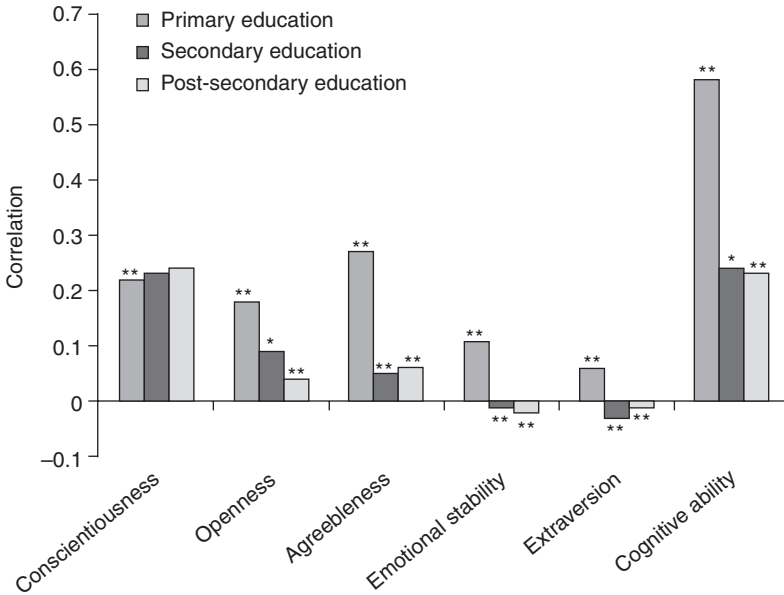


FIGURE 10.1 Associations with course grades by level of education.

Note. Associations were 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.

schoolchildren, effortful control measured with parent and teacher ratings predicted report card grades, when baseline grades were controlled for (Zhou, Main, & Wang, 2010).

Why might the capacity to regulate emotion, attention, and behavior in the service of valued goals and standards help students earn higher grades? The adage summarizing Aristotle's view of education holds a clue: "The roots of education are bitter, but the fruit is sweet." Indeed, even high-ability students do not generally enjoy completing homework assignments and studying for tests (Wong & Csikszentmihalyi, 1991). To a large degree, the many tasks required of a student to earn high course grades (e.g., concentrating on difficult new concepts, attending to the teacher rather than joking with classmates, practicing skills repeatedly to the point of fluency, working on homework alone rather than socializing with friends) all yield long-term rewards at the expense of short-term comfort and pleasure. Indeed, there is evidence that the association between self-regulation and course grades is mediated by effective study habits, effort, and prosocial behavior in the classroom (Credé & Kuncel, 2008; Duckworth & Seligman, 2005; Lubbers,

Van Der Werf, Kuyper, & Hendriks, 2010; Nofle & Robins, 2007; Valiente, Lemery-Chalfant, & Castro, 2007; Valiente, Lemery-Chalfant, Swanson, & Reiser, 2008).

There is increasing evidence to suggest that the path of school success is set at a tender age. For example, self-regulation measured during the preschool years predicts school readiness and academic achievement (e.g., Blair & Razza, 2007; Mazocco & Kover, 2007; Morrison, Ponitz, & McClelland, 2010), and teachers often report that the most important determinant of classroom success in kindergarten and early school grades is the extent to which children can sit still, pay attention, and follow rules (e.g., Rimm-Kaufman, Pianta, & Cox, 2000). In fact, self-regulation is often a better predictor of academic outcomes than is IQ or grades. In an especially impressive report, with school achievement levels controlled, children who were rated one standard deviation above the mean on attention span/persistence at age 4 years had 39% greater odds of completing college by age 25 (McClelland, Piccinin, Acock, & Stallings, 2011).

STANDARDIZED ACHIEVEMENT TEST SCORES

Like course grades, standardized achievement test scores reflect a student's acquired skills and knowledge. However, psychological research studies using standardized achievement tests to index academic performance are somewhat less common than those using course grades. There is nevertheless sufficient empirical evidence to suggest that more self-regulated learners surpass their more impulsive peers on these measures of performance as well.

Martin and colleagues 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 (see Martin, 1989, for a summary). Likewise, in a representative sample of 790 Baltimore first graders, teacher ratings of attention span-restlessness in first grade predicted both course grades and standardized achievement test scores four years later (Alexander, Entwisle, & Dauber, 1993).

More recently, in a sample of 143 preschool children from low-income homes, a peg-tapping executive function task (in which children were instructed to tap twice with a wooden dowel when the experimenter tapped once, and once when the experimenter tapped twice) accounted for unique variance in standardized assessments of math knowledge, phonemic awareness, and letter knowledge in kindergarten, even after controlling for general

intelligence (Blair & Razza, 2007). Similarly, in a sample of 291 kindergarteners, teacher and parent ratings of 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, Finn, Pannozzo, and Voelkl (1995) found that teacher ratings of inattention at the beginning of the school year predicted standardized achievement test scores at the end of the school year in a sample of 1,103 fourth graders.

Task measures of effortful control and related traits in the Conscientiousness family have also been shown to predict performance on standardized achievement tests. For instance, the number of seconds a child waits for a more preferred treat in the preschool delay of gratification paradigm has been shown to predict performance on the SAT college admission test more than a decade later (Mischel, Shoda, & Rodriguez, 1989). The Head-to-Toes and Head-Toes-Knees-Shoulders tasks require young children to inhibit automatic responses, pay attention, and keep instructions in working memory (e.g., to touch their heads when the experimenter says “touch your toes”) (Ponitz et al., 2008; Ponitz, McClelland, Matthews, & Morrison, 2009). Performance on this brief task predicts later performance on standardized achievement tests (McClelland et al., 2007).

Perhaps most conclusively, Duncan and colleagues (2007) analyzed six large, longitudinal datasets whose collective sample size exceeded 34,000 and found that school-entry attention skills, measured variously by task and questionnaire measures, prospectively predict standardized achievement test scores, even with school-entry academic skills controlled. In contrast, internalizing and externalizing behaviors at school entry do not reliably predict standardized achievement test scores.

Where Course Grades and Standardized Achievement Test Scores Diverge

While course grades and standardized achievement tests are highly correlated and are both designed to assess academic skills and knowledge, they are not equally predicted by individual differences in self-regulation. For instance, Duckworth, Quinn, and Tsukayama (2012) found in two samples of middle school students followed longitudinally that self-control predicted changes in report card grades over time better than did IQ, an effect that was mediated by homework completion and classroom conduct. In contrast, IQ predicted changes in standardized achievement test scores over time better than did self-control. These findings are consistent with those of

Willingham, Pollack, and Lewis (2002), who examined data from 8,454 high school seniors in the National Education Longitudinal Study (NELS). Self-regulated behaviors such as attending class regularly and promptly, participating in class activities, completing work on time, and avoiding drug and gang activity were more strongly associated with grade point average (GPA) 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 GPA but not SAT test scores. Similarly, several cross-sectional studies of college students have shown that aspects of self-regulation are more strongly associated with GPA than with SAT scores (Conard, 2005; Nofle & Robins, 2007; Wolfe & Johnson, 1995).

Why does self-regulation predict course grades better than standardized achievement test scores? Course grades and standardized test scores are generally highly correlated (Willingham et al., 2002). Not surprisingly, therefore, standardized achievement tests and grades are often wrongly assumed to be “mutual surrogates; that is, measuring much the same thing, even in the face of obvious differences” (Willingham et al., 2002, p. 2). Table 10.1 compares these two indices of achievement on several dimensions, including content, format, and the relevance of homework and classroom conduct. Many of the design features of standardized achievement tests can be understood as facilitating apples-to-apples comparisons of students from diverse contexts (e.g., different schools). The design features of course grades, on the other hand, reflect a distinct function – the communication of a classroom “teacher’s judgment as to how well a student has fulfilled the implicit local contract between teacher and student” (Willingham et al., 2002, p. 28).

The power of standardized achievement tests to predict later academic and occupational outcomes is well established (Kuncel & Hezlett, 2007; Sackett, Borneman, & Connelly, 2008; Willingham, 1985). Nevertheless, Bowen, Chingos and McPherson (2009) found that cumulative high school GPA predicts graduation from college dramatically better than SAT/ACT scores do, even without adjusting for differences in high school quality. Bowen and colleagues also found high school GPA to more powerfully predict college rank-in-class. In an analysis of about 80,000 University of California students followed over four years, Geiser and Santelices (2007) reached the same conclusion.

In sum, standardized achievement tests and teacher-assigned course grades both reflect students’ accumulated knowledge and skill, but they differ in important ways. The benefits of dispositional self-regulation, which

TABLE 10.1 *A Comparison of Standardized Achievement Tests and Teacher-Assigned Course Grades*

Dimension	Standardized Achievement Tests	Teacher-Assigned Course Grades
Format	Typically multiple-choice questions, with fewer essay and short-answer questions	Eclectic, including multiple-choice questions, essays and short-answer questions
Authorship	Centralized testing company or government agency	Classroom teacher
Time limitations	Strictly time-limited, with the expectation that at least some students may not finish all questions in the allotted time	Typically less stringent in terms of time limits
Academic content	Skills and knowledge expected to be covered by all students at a given grade level in a particular region (e.g., content that is aligned to school district, state, or national standards).	Specific skills and knowledge taught in the classroom that year to those students
Effort and conduct	Not directly considered	Considered by most teachers, at least to some degree
Homework and long-term projects	Not considered	Considered by most teachers, at least to some degree
Grading standards	Objective and uniform across all test-takers	Subjectively determined by individual teachers
Frequency of assessment	Typically administered once annually during one or two testing sessions	Assessments that contribute to course grades can be daily or weekly

predicts better conduct in the classroom (Duckworth, Quinn, & Tsukayama, 2012), more hours of homework and studying (Duckworth & Seligman, 2005), and fewer hours of television watching (Duckworth & Seligman, 2005), seem more relevant to accomplishing the work teachers have prescribed. In part for this reason, girls, who often are higher than boys in self-regulation, reliably earn higher course grades than boys in every subject from primary school through college (U.S. Department of Education, 2004) and take equally difficult courses (Buchmann, DiPrete, & McDaniel, 2008) – but do not reliably outperform boys on intelligence tests (Duckworth & Seligman, 2006; Fergusson & Horwood, 1997; Matthews, Ponitz, & Morrison, 2009; Stricker, Rock, & Burton, 1993) or standardized achievement tests (Duckworth &

Seligman, 2006). It is worth noting that across all racial groups in the United States, girls now graduate from high school and college at higher rates than boys, a reversal of the historic trend favoring boys (Buchmann et al., 2008).

SCHOOL-BASED INTERVENTIONS

Despite this overwhelming evidence for a positive association between self-regulation and school success, one might be concerned about taking a proactive approach through intervention on the grounds that there can be too much of a good thing. Indeed, it has been argued that the extremes of any trait, even those demonstrated to be salutary in most contexts, have deleterious consequences (Grant & Schwartz, 2011). Despite theoretical concerns that “overcontrol” could manifest itself in pathological behavior (Kohn, 2008), there is scant evidence that very many children suffer from being overly capable of regulating their attention and behavior in the service of their personally valued goals and standards (Baumeister, Schmeichel, & Vohs, 2007; de Ridder et al., 2012; Moffitt et al., 2011).

So then, what can schools do to encourage the development of self-control in children? One perspective is that temperament is entirely immutable; the opposite view is that behavior is entirely determined by context and situation. Empirical evidence supports neither of these extreme positions. On the contrary, generally, the rank-order stability of traits is moderate in childhood (Hampson & Goldberg, 2006; Roberts & DelVecchio, 2000). Thus, while there is enough stability to make it sensible to talk about individual differences in self-regulation, there is enough rank-order shuffling to consider means of intentionally accelerating self-control development. Indeed, several recent studies indicate that executive function is malleable (see Diamond & Lee, 2011). Next we summarize research on school-based interventions, though we should note that there are fewer rigorous empirical studies than one might imagine. Taking a broader view, the U.S. Institute of Education Sciences examined 93 studies of 41 programs aimed at improving aspects of character including self-control, and only 7 of these met their criteria for evidence standards without reservation.

Tools of the Mind, a Vygotskian preschool and early primary school curriculum, has demonstrated in random-assignment studies that it can improve classroom behavior as well as executive functioning (Barnett, Yarosz, Thomas, Hornbeck, Stechuk, & Burns, 2006; Barnett et al., 2008; Bodrova & Leong, 2001; Bodrova & Leong, 2007; Diamond, Barnett, Thomas, & Munro, 2007). *Tools of the Mind* is a multi-faceted curriculum in which teachers receive

detailed curriculum materials and extensive training and support throughout the school year. Key principles of the program's approach 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, 2001). For example, one of the activities in the *Tools* curriculum is "buddy reading" in which one student is the speaker, symbolized by holding up a sign illustrating a mouth, while the peer is the listener, symbolized by a drawing of an ear. In keeping with Vygotsky's (1978) law of development in which regulation shifts from inter- to intra-personal, these cultural tools are gradually shed as children learn to self-regulate during story time.

Likewise, children who attended a Montessori school have been shown to perform better on tasks of executive function than children assigned by lottery to non-Montessori schools (Lillard, 2012; Lillard & Else-Quest, 2006). As with *Tools of the Mind*, the Montessori approach is multi-faceted. Characteristics of Montessori schools include 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. Both *Tools of the Mind* and the Montessori approach have been shown in random-assignment studies to improve performance on standardized achievement tests (Barnett et al., 2008; Lillard & Else-Quest, 2006).

In another example, the Promoting Alternative Thinking Strategies (PATHS) curriculum teaches self-control, emotional awareness, and social problem-solving skills and is aimed at elementary school children (Bierman et al., 2010). Like *Tools of the Mind* and the Montessori approach, 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). PATHS is an exemplar of school-based social and emotional learning (SEL) programs, whose impact on both course grades

($d = .33$) and standardized achievement tests scores ($d = .27$) was recently documented in a meta-analysis of controlled studies involving over 270,000 children in kindergarten through college (Durlak, Weissberg, Dymnicki, Taylor, & Schellinger, 2011). Note, however, that not all random-assignment studies of SEL programs have yielded positive results (Social and Character Development Research Consortium, 2010), underscoring the need for research on the active ingredients of multi-faceted SEL interventions.

More generally, classrooms offering strong instructional and emotional support can boost academic performance as measured by standardized achievement test scores. Children identified as at-risk on the basis of prior attention and behavior problems, in particular, benefit from being in classrooms whose general climate is warm, relaxed, and well-managed, with teachers who respond flexibly and appropriately to children's needs while also encouraging children to take responsibility for their own actions (Hamre & Pianta, 2005; Rudasill, Gallagher, & White, 2010). Similar results were reported in the Chicago School Readiness Project, in which teachers who received support and training in classroom management had students who were better self-regulated and, in turn, had higher performance on academic outcomes (Raver et al., 2011). Therefore, interventions and professional development opportunities that help teachers create positive classroom environments should yield downstream benefits for their students (Jennings & Greenberg, 2009; Zins, Elias, & Greenberg, 2007).

Interventions that teach children meta-cognitive strategies, such as goal setting and planning, can also improve self-regulatory competence and 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, 2010). Compared to students in a placebo-control condition who wrote a practice essay for the entrance exam, students who learned MCII completed over 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, 2010). 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 this meta-cognitive strategy 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 executive function and performance on standardized achievement tests in preadolescent children (Best, 2010; 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, 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, and resolve conflicts without help from adults may ultimately impair normative development of attention and other aspects of Conscientiousness (Panksepp, 2007).

CONCLUSION

Early psychologists speculated that differences in temperament can help or hinder performance in – and beyond – the classroom. This conjecture has since been confirmed. Substantial empirical evidence suggests that children's ability to regulate attentional, behavioral, and emotional impulses paves the way for success in school. That is, learning, applying skills and knowledge, staying in school, and graduating from high school and college depend in large part on the capacity to inhibit dominant impulses in order to execute subdominant but superior actions, which overlaps substantially with the temperament/personality trait of Conscientiousness. Growing evidence of the benefits of self-regulation for success in school has motivated several school-based interventions targeting school culture, classroom curriculum and environment, metacognitive strategies, and aerobic exercise. Several of these efforts have now been shown in rigorous random-assignment studies to have measurable effects on behavior and academic

performance, collectively providing proof that a child's temperament, while strongly influenced by genetic factors, is nevertheless amenable to environmental influence. Self-regulation can be cultivated.

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