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CHAPTER

7

Want to Optimize Executive Functions and Academic Outcomes?

Simple, Just Nourish the Human Spirit

ADELE DIAMOND

Executive functions (EFs) are critical for success in school, on the job, and in life. EFs suffer if you are lonely, sad, stressed, or not physically fit. Therefore, if we care about academic outcomes, we should care that students feel they are in a supportive community they can count on, that they are happy (even joyful), and that their bodies are strong and healthy. A school curriculum that ignores children's emotional, social, or physical needs is likely to find that those unmet needs will work against achieving the academic goals.

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WHAT ARE EXECUTIVE FUNCTIONS (EFs)?

Executive functions (EFs) are mental functions that enable us to reason and problem solve; understand what we read or hear in a lecture; exercise choice, self-control, and discipline; be creative, and flexibly adjust to change or new information (Burgess & Simons, 2005, Diamond, 2013; Espy et al., 2004; Miller & Cohen, 2001). EFs are needed when we have to concentrate and think, when acting on our initial impulse, relying on instinct or intuition, or going on automatic would be ill-advised, insufficient, or impossible. EFs depend on a neural circuit in which the prefrontal cortex plays a prominent role (Braver, Cohen, & Barch, 2002; Champod & Petrides, 2007; Miller & Cohen, 2001; Petrides, 2005; Zanto, Rubens, Thangavel, & Gazzaley, 2011).

Core EFs are *working memory*, *inhibition* (response inhibition [self-control–resisting temptations and resisting acting impulsively]) and interference control (selective attention and cognitive inhibition), and *cognitive flexibility* (including creatively "thinking outside the box," seeing anything from different perspectives, and quickly and flexibly adapting to changed circumstances; Davidson, Amso, Anderson, & Diamond, 2006; Lehto, Juujärvi, Kooistra, & Pulkkinen, 2003; Miyake et al., 2000). From these, higher-order EFs are built such as reasoning, problem solving, and planning (Collins & Koechlin, 2012; Lunt et al., 2012; see Figure 7.1).

Reasoning involves holding bits of information in mind and seeing how they relate. It would not be possible without *working memory* (holding information in mind and mentally working with it; or said differently, working with information no longer perceptually present; Baddeley & Hitch 1994; Smith & Jonides, 1999), one of the core EFs. Working memory is critical for making sense of anything that unfolds over time, for that always involves relating what came earlier to what came later. Thus it is necessary for making sense of written or spoken language, whether it is a sentence, paragraph, or longer. Doing any math in your head requires working memory, as does mentally reordering items (such as reorganizing a to-do list), translating instructions into action plans, considering alternatives, and mentally playing with ideas. Working memory is critical to our ability to see connections between seemingly unrelated things. Working memory enables us to bring conceptual knowledge and not just

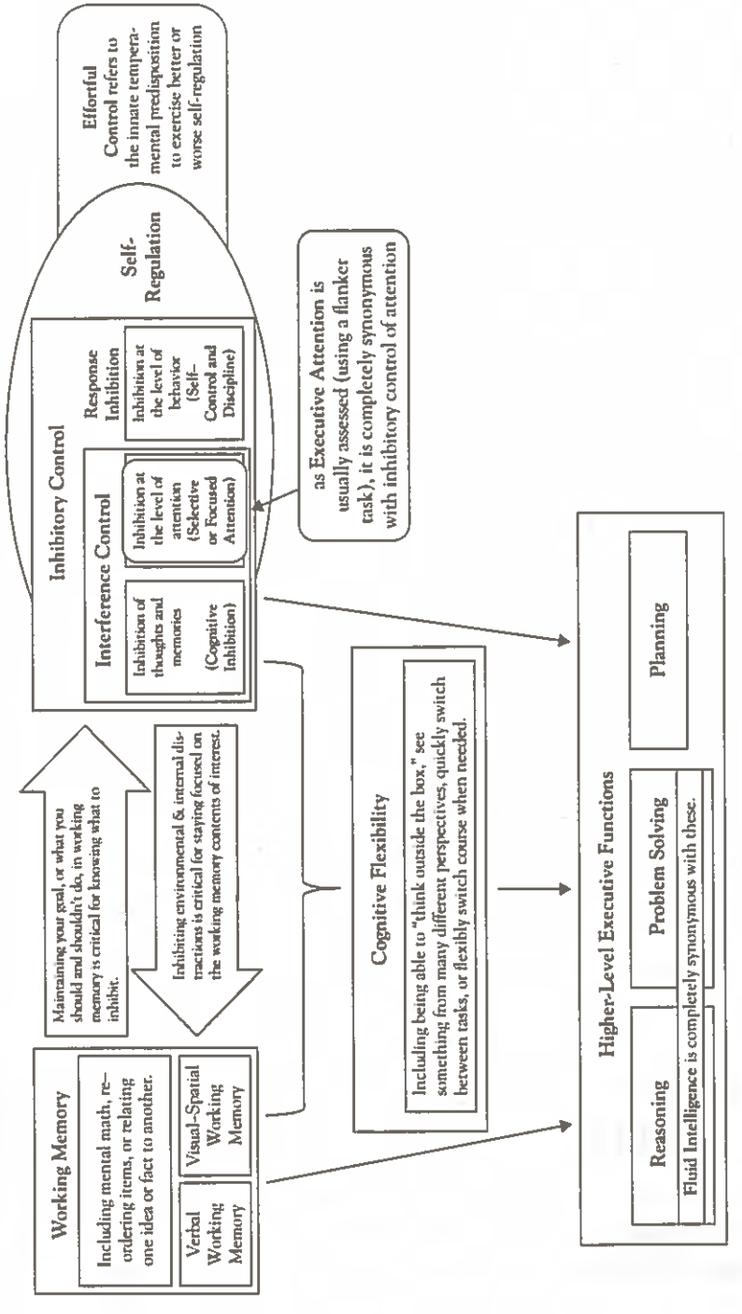

Figure 7.1 Executive functions.

what is perceptually present to bear on our decisions, and to consider the past and our future hopes in making plans and decisions.

Choice would not be possible were we not able to resist, at least partially, the pull of external stimuli, our emotions, or old habits of mind or behavior. Thus it depends on another core EF, *inhibitory control.* Inhibitory control involves being able to control one's attention, behavior, thoughts, and/or emotions to override a strong internal predisposition or external lure. Inhibitory control of attention (selective or focused attention) enables us to focus on what we choose, suppressing attention to other stimuli. Self-control is the aspect of inhibitory control that involves resisting temptations and not acting impulsively. It saves us from putting our foot in our mouth or doing other things we would regret. Discipline is the aspect of inhibitory control that involves making yourself do something, or keep at something, though you would much rather be doing something else.

The third core EF, *cognitive flexibility* (also called *set shifting*, *mental flexibility*, or *mental set shifting*) builds on working memory and inhibitory control, and is closely linked to creativity. Being creative involves "thinking outside the box." For example, coming up with an entirely new way of conceptualizing a problem or a totally different way of attacking it. Being flexible involves being able to take advantage of serendipity though you had other plans, being able to switch between your perspective and another's, and being able to change your mind or course of action based on new information.

Alexander Graham Bell gave us an example of *poor* cognitive flexibility: "When one door closes, another door opens; but we often look so long and so regretfully upon the closed door, that we do not see the ones which open for us."

WHAT IS THE EVIDENCE THAT EFs ARE IMPORTANT?

EFs (specifically the subcomponents of self-control and focused attention) are critical for school readiness (Carlson & Moses, 2001; Hughes & Ensor, 2008; Kochanska, Murray, & Coy, 1997; Morrison, Ponitz,

& McClelland, 2010), and children from lower SES and at-risk backgrounds have poorer EFs (Hackman & Farah, 2008). Indeed, EFs are more strongly associated with school readiness than are IQ or entry-level reading or math (e.g., Blair, 2002; Blair & Razza, 2007; Normandeau & Guay, 1998).

EFs are also critical for school success. Working memory (e.g., T. Alloway & Alloway, 2010; Loosli, Buschkuehl, Perrig, & Jaeggi, 2012; St. Clair-Thompson & Gathercole, 2006) and inhibitory control (e.g., Borella, Carretti, & Pelgrina, 2010; Duncan et al., 2007; Fiebach, Ricker, Friederici, & Jacobs, 2007; McClelland et al., 2007; Nicholson, 2007; Savage, Cornish, Manley, & Hollis, 2006) each independently predict math and reading competence throughout the school years from preschool through university. Poor EFs can impede positive teacher-student relations (e.g., Raver & Knitzer, 2002) important for school success (Hamre & Pianta, 2001) because children with poor EFs can be thorns in the teacher's side—not staying in their seat, disrupting the class, and doing things that get other children upset with them. Moreover, evidence suggests that EFs account for more than 2 times more variation in final grades than does IQ, even in college (Duckworth & Seligman, 2005).

Inhibitory control early in life is predictive of adult outcomes. In a study of 1,000 children born in the same city in the same year followed for 32 years with a 96% retention rate, Moffitt et al. (2011) found that children who at ages 3 to 11 had better inhibitory control (e.g., were better at waiting their turn, less easily distracted, more persistent, and less impulsive) grew up to have better physical and mental health (e.g., were less likely to be overweight or to have substance abuse problems), earn more, and be less likely to commit a crime as adults 30 years later than those with worse inhibitory control as children, controlling for IQ, gender, social class, and their home lives and family circumstances growing up. They were also happier as adults (Moffitt, 2012).

EFs are critical for job success. Poor EFs lead to poor productivity and difficulty finding and keeping a job (Bailey, 2007). EFs are also important for marital harmony; a partner with poor EFs can be more difficult to get along with, less dependable, and/or more likely to act on impulse

(Eakin et al., 2004). Poor EFs lead to social problems (including crime, reckless behavior, violence, and emotional outbursts; Broidy et al., 2003; Denson, Pederson, Friese, Hahm, & Roberts, 2011; Moffitt et al., 2011; Saarni, 1999; Winstok, 2009) and to poorer physical health (including obesity, overeating, substance use, and poorer treatment adherence; Crescioni et al., 2011; Cserjési, Luminet, Poncelet, & Schafer, 2009; Hall, Crossley, & D'Arcy, 2010; Miller, Barnes, & Beaver, 2011; Moffitt et al., 2011; Riggs, Spruijt-Metz, Sakuma, Chou, & Pentz, 2010). EFs are impaired in many mental health disorders (including *addictions* [Baler & Volkow, 2006], *attention deficit hyperactivity* [ADHD; Diamond, 2005; Lui & Tannock, 2007], *conduct disorder* [Fairchild et al., 2009], *depression* [Taylor-Tavares et al., 2007], *obsessive compulsive disorder* [OCD; Penadés et al., 2007], and *schizophrenia* [Barch, 2005]). Such disorders are becoming increasingly common (Moffitt et al., 2010; Robinson, Sclar, Skaer, & Galin, 1999) and account for more lost years of life and productivity than any other illness including cancer (Prince et al., 2007). People with better EFs generally enjoy a better quality of life (Brown & Landgraf, 2010; Davis, Marra, Najafzadeh, & Lui-Ambrose, 2010; Tangney, Baumeister, & Boone, 2004) and even tend to live longer (Hall et al., 2010). In short, EFs appear to be critical for mental and physical health, success in school and in life, and cognitive, social, and psychological development.

WHAT'S THE EVIDENCE THAT EFs CAN BE IMPROVED?

There's empirical evidence that diverse activities can improve children's EFs (Diamond, 2012; Diamond & Lee, 2011). The strongest evidence exists for *CogMed computerized training* (Bergman Nutley, 2011; Holmes et al., 2010; Holmes, Gathercole, & Dunning, 2009; Klingberg et al., 2005; Thorell, Lindqvist, Bergman Nutley, Bohlin, & Klingberg, 2009), *a combination of computerized and interactive games* (Mackey, Hill, Stone, & Bunge, 2011), *task-switching computerized training* (Karbach & Kray, 2009), *Tae-Kwon-Do* (Lakes & Hoyt, 2004), and two add-ons to school curricula, *PATHS* (Promoting Alternative Thinking Strategies; Riggs, Greenberg, Kusché, & Pentz, 2006) and *CSRP* (the Chicago School

Readiness Project; Raver et al., 2008, 2011). All these studies used random assignment, included an active control group (it is easier to find an effect compared to no-treatment than compared to subjects who do something else [i.e., are in an "active control group"]) and pre- and post-intervention measures, and found convincing transfer to more than one objective measure of EFs on which the children had not been trained. Weaker evidence, though strong enough to pass peer review, exists for *aerobics* (Davis et al., 2011; Kamijo et al., 2011; Tuckman & Hinkle, 1986), *yoga* (Manjunath & Telles, 2001), *mindfulness* (Flook et al., 2010), and other school curricula (*Tools of the Mind* [Diamond, Barnett, Thomas, & Munro, 2007] and *Montessori* [Lillard & Else-Quest, 2006]).

Five principles hold regardless of the EF program or intervention:

1. The children most behind on EFs (including disadvantaged children) benefit the most from any EF intervention or program (Flook et al., 2010; Karbach & Kray, 2009; Lakes & Hoyt, 2004). Hence, early EF training might level the playing field by reducing social disparities in EFs, thus heading off social disparities in academic achievement and health (O'Shaughnessy, Lane, Gresham, & Beebe-Frankenberger, 2003).
2. EF training appears to transfer, but transfer from computerized working memory or reasoning training has been narrow (e.g., computer training on spatial working memory transfers to other measures of spatial working memory but not to visual working memory or other EF subcomponents; Bergman Nutley et al., 2011). EF gains from training in task switching (Karbach & Kray, 2009), traditional martial arts (Lakes & Hoyt, 2004), and school curricula (Raver et al., 2011, Riggs et al., 2006) have been wider, perhaps because the programs address EFs more globally. For example, training task switching (which arguably requires all three core EFs) transferred not only to an untrained task-switching task, but also to inhibition (Stroop interference), verbal and nonverbal working memory, and reasoning (Karbach & Kray, 2009).
3. The largest differences between intervention groups and controls are consistently found on the most demanding EF tasks and task conditions. It is often only in pushing the limits of children's EF

skills that group differences emerge (Davis et al., 2011, Diamond et al., 2007, Manjunath & Telles, 2001).

4. EF demands need to be continually incrementally increased or few gains are seen (Bergman Nutley et al., 2011; Holmes et al., 2009; Klingberg et al., 2005). There may be two reasons for that: (1) If difficulty does not increase, the activity becomes boring and people lose interest (which raises a general question about the appropriateness of a control group where difficulty does not increase, if that means the groups also differ in their sustained interest). (2) You need to keep pushing yourself to do better, or you stop improving. This is consistent with what Ericsson (e.g., Ericsson, Nandagopal, & Roring, 2009) has found to be key for being truly excellent at anything: hours and hours of practice trying to master what is just beyond your current level of competence and comfort, working in what Vygotsky (1978) would call the "zone of proximal development."
5. Repeated practice is key. Whether EF gains are seen depends on the amount of time spent doggedly working on these skills, pushing oneself to improve (Klingberg et al., 2005). School curricula are shown to improve EFs, train and challenge EFs throughout the day, embedding that in all activities, not only in a module (which may also have the benefit of varying the content and kind of EF practice; Diamond et al., 2007; Lillard & Else-Quest, 2006; Riggs et al., 2006). In 1899, William James wrote:

> [W]e do a thing with difficulty the first time, but soon do it more and more easily, and finally, with sufficient practice, do it semi-mechanically, or with hardly any consciousness at all. Our nervous systems have (in Dr. Carpenter's words) grown to the way in which they have been exercised, just as a sheet of paper or a coat, once creased or folded, tends to fall forever afterward into the same identical folds. . . . [N]o matter how good one's sentiments may be, if one have not taken advantage of every concrete opportunity to act, one's character may remain entirely unaffected for the better. A tendency to act only becomes effectively ingrained in us in proportion to the uninterrupted frequency with which the actions actually occur, and the brain "grows" to their use. . . . Keep the faculty of effort alive in you by a little gratuitous exercise every day. That is, be systematically heroic in little unnecessary points, do every day or two something for no other reason than its difficulty, so that, when the hour of dire need draws nigh, it may find you not unnerved and untrained to stand the test.

Centuries earlier, Aristotle (*Ethica Nicomachea*, 4th century BC) said:

> We are what we repeatedly do. Excellence, then, is not an act, but a habit. i.e., we do not act rightly because we have virtue or excellence, but we rather have these because we have acted rightly; "these virtues are formed in a person by doing the actions"; we are what we repeatedly do.

Certainly, the evidence seems to indicate that this is true for executive functions, especially self-control. Muraven (2010) summarizes several studies showing that self-control can be improved by the regular practice of small acts of self-control (such as cutting back on sweets). Daily EF "exercise" appears to aid EF development and is thus beneficial for mental health, much as physical exercise improves our bodies and is beneficial for our bodily health.

WHAT'S THE EVIDENCE THAT IMPROVING EFs IMPROVES ACADEMIC OUTCOMES?

For example, the Chicago School Readiness Project (CSRP) randomly assigned Head Start preschool teachers to their program or business as usual. Children's EFs (inhibitory control of attention and action) improved significantly more in CSRP classes than in comparison classes (Raver et al., 2011). CSRP children also improved in vocabulary, letter-naming, and math significantly more than controls, but CSRP's improvement of academic skills was *mediated almost entirely via its improvement of* EFs. EFs in the spring of preschool predicted achievement 3 years later in math and reading. Thus disadvantaged children who were lucky enough to have been randomly assigned to a CSRP preschool class tended to continue to perform better in school 3 years later, and that was *primarily mediated through their improved EFs* (Li-Grining, Raver, & Pess, 2011). In many of the intervention studies cited in the previous section, not only did EFs improve, so did academic performance (Diamond & Lee, 2011).

WHAT'S THE EVIDENCE THAT EFs ARE BETTER IF YOU FEEL SOCIALLY SUPPORTED, HAPPY AND RELAXED, AND ARE PHYSICALLY FIT?

Nowhere is the importance of social, emotional, and physical health for cognitive health more evident than with EFs, and nowhere is the importance of social, emotional, and physical health for brain health more evident than with prefrontal cortex. Prefrontal cortex and EFs are the first to suffer, and suffer disproportionately, if you are lonely, sad, stressed, or not physically fit. Lonely people do not reason as well and their prefrontal cortex works less efficiently (Baumeister, Twenge, & Nuss, 2002; Cacioppo & Patrick, 2008; Campbell et al., 2006). When we are sad or depressed, we have worse selective attention (Desseilles et al., 2009; von Hecker & Meiser, 2005); when we're happy we have better selective attention (von Hecker & Meiser, 2005). The most heavily researched predictor of creativity in social psychology is mood. The most robust finding is that a happy mood leads to greater creativity (Ashby, Isen, & Turken, 1999; Hirt, Devers, & McCrea, 2008). It enables people to work more flexibly (Murray, Sujan, Hirt, & Sujan, 1990) and to see potential relatedness among unusual and atypical members of categories (Isen, Daubman, & Nowicki, 1987; Isen, Johnson, Mertz, & Robinson, 1985).

Prefrontal cortex and EFs show the largest benefit from improved fitness and the largest impairments from lack of physical activity (Best, 2010; Chaddock, Pontifex, Hillman, & Kramer, 2011; Hillman, Erickson, & Kramer, 2008). You can see the deleterious effects of stress, sadness, loneliness, and lack of physical health or fitness at the physiological and neuroanatomical level in prefrontal cortex and at the behavioral level in worse EFs (poorer reasoning and problem solving, forgetting things, and impaired ability to exercise discipline and self-control). When we are stressed, our prefrontal cortex gets flooded with too much dopamine (Arnsten, 2000; Cerqueira, Mailliet, Almeida, Jay, & Sousa, 2007; Roth, Tam, Ida, Yang, & Deutch, 1988) and the activity of the neural circuit that includes prefrontal cortex becomes less synchronized (Liston, McEwen, & Casey, 2009).

Almost any activity that requires focused attention, concentration, and working memory, and that also builds community, exercises the body, and brings joy should be able to serve as the means for disciplining the mind and enhancing the skills needed for success in school and in life; see Figure 7.2.

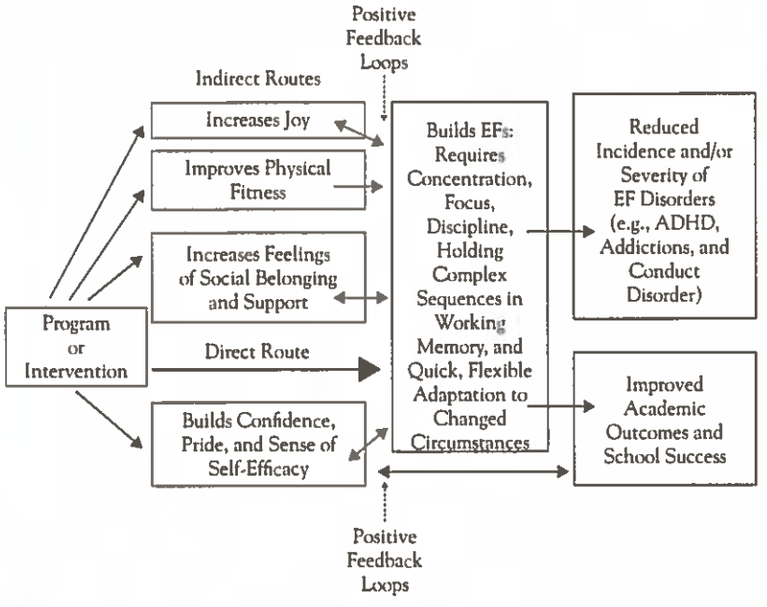

Figure 7.2 I hypothesize that programs that (a) improve EFs (e.g., attention, concentration, discipline, working memory) directly by training them and continually challenging them, and that (b) indirectly improve and support them by reducing stress, increasing children's joy, helping children feel they belong and that others are there for them, and improving their physical fitness will be the most successful at improving their EFs, academic achievement and graduation rates, and also mental and physical health.

HOW ON EARTH ARE SCHOOLS TO ACHIEVE ACADEMIC EXCELLENCE AND ALSO ADDRESS CHILDREN'S EMOTIONAL, SOCIAL, AND PHYSICAL NEEDS WITHOUT MORE HOURS IN THE SCHOOL YEAR?

One Answer Is to Take Advantage of Activities That Simultaneously Address All These Aspects

Music making, singing, dancing, and sports challenge our EFs (thus helping to improve them), make us happy and proud, address our social needs, and help our bodies develop. That is, they address our cognitive, emotional, social, and physical needs—exactly what is needed for the best school outcomes. Perhaps we can learn something from the

traditional practices of people across many cultures and thousands of years, since the presence of music, dance, and play is ubiquitous.

Economist, conductor, and composer José Antonio Abreu founded Venezuela's *National System of Youth and Children's Orchestras* (*El Sistema*) as a social intervention to transform the lives of poor children. Such music training challenges EFs by requiring focused attention over sustained periods, holding complex sequences in mind, and the self-control needed to put in the hours of practice when there are temptations to do other things and when one may be frustrated with one's progress at times. Unlike most music programs, El Sistema is intended to be a social program that has music at its core. Rather than aiming to produce great musicians, it aims to create community. The children know that each is an important part of the whole. They become a community—working together and helping one another. Since 1975 almost a half million children have been enrolled *in* El Sistema in Venezuela. The Inter-American Development (IAD) Bank assessed its efficacy and found that, compared to children not enrolled, children in El Sistema had more improved academic achievement and school attendance, reduced school dropout rates (by 75%!), reduced incidence of juvenile delinquency and youth violence, and improved discipline, responsibility, and punctuality (IAD Bank, 2007).

With such benefits: "The bank calculated that every dollar invested in El Sistema was reaping about $1.68 in social dividends" (Lubow, 2007).

In the words of an El Sistema graduate:

> I see music as a way to rescue children. It is a weapon against poverty. When a child can play an instrument well it builds his self worth. He works hard and succeeds. He can then build on that success. He does well in other areas of his life. To me, poverty creates a feeling of powerlessness. But music creates happiness. The children succeed in making beautiful sounds. This represents hope for families and communities.

Due to the success of El Sistema in Venezuela, the program has since spread to 25 countries in Central and South America, North America, and Europe. El Sistema Scotland was introduced in 2008 in an especially deprived area of Scotland. The Scottish government commissioned an evaluation of the program (which has served more than 338 children).

One hundred percent of parents reported that their children's self-confidence had improved, 90% that their children were happier, and 80% that their children were better able to concentrate and were more disciplined and focused. They also reported that their children were better able to cooperate and work as a member of a team, showed more positive behaviors, were more engaged in learning, and had higher aspirations. The evaluation concluded that El Sistema Scotland "is already having an overwhelmingly positive effect on the children involved . . . [and has the potential to achieve a] social transformation" (GEN, 2011).

High school dropout, ballet dancer extraordinaire, and recipient of a MacArthur Genius Award and the National Medal of Honor, Jacques d'Amboise founded the National Dance Institute (NDI) as a social program with dance at its core—in the belief that the arts have a unique power to engage children and motivate them toward excellence, enabling young people to come to believe in themselves through seeing that they can conquer challenges and achieve what at first looked impossible. D'Amboise had been a poor kid headed for trouble when he happened to walk his sister to dance class one day. He figured if dance was a transformational force in his own life, it could help other troubled youth. Since 1976, NDI has helped over half a million children, holding them to high standards, requiring loads of practice, and building supportive communities where each child is respected as an important part of the whole. NDI's in-school program has been found to improve students' ability to stay focused and think clearly, their confidence and self-esteem, and their social skills in getting along with peers. In their academic subjects, 91% of their teachers report they have increased self-confidence (Horowitz, 2003).

Royston Maldoom is a British choreographer known internationally for his work in the field of community dance. He has worked with children and young people (in, and excluded from, mainstream education), street kids, the displaced, people with disabilities, men and women in prison, and communities in conflict or marginalized or divided by cultural, religious, social, or economic circumstances. His passion is to give all of them the opportunity to transform, through the medium of dance, their views of themselves, their abilities, and their potential—and to change how others view and judge them. Time and again he has seen dance and

performance transform the lives of individuals and communities, supporting and encouraging comprehension, cohesion, sympathy and dialogue. He wrote: "Dance, approached as a balanced social, physical, emotional and spiritual activity touches every part of us." And, "In seeking creative solutions to artistic challenges we acquire understandings and skills that spill over into daily lives."

It is quite likely that being a member of a cohesive group working toward the important shared goal of helping one's community or helping to make the world a better place (a social service activity), or being involved in rowing crew, street soccer, caring for an animal, filmmaking, theater, or any number of other activities could improve children's thinking skills and at the same time bring them joy, increased self-confidence, improved fitness, and a social support group.

It all depends on the way the activity is done and the amount of time spent doing it. For example, many orchestra programs will not yield the same benefits as El Sistema and many dance programs will not yield the same benefits as the NDI—because they are not done the same way. Just going through the motions (e.g., taking orchestra because it is required or because it will look good on your resume, while having little interest in it), will produce little benefit. When some juvenile delinquents were assigned to traditional Tae-Kwon-Do (which emphasizes character development, self-control, and waiting until your opponent attacks or is off balance as much as the physical conditioning aspect) and others were assigned to "modern martial arts" (martial arts as a competitive sport, with only the physical aspect emphasized, and no emphasis on waiting until your opponent moves to attack), those in traditional Tae-Kwon-Do showed less aggression and anxiety and improved social ability and self-esteem. Those in modern martial arts showed *more* juvenile delinquency and aggressiveness, and decreased self-esteem and social ability (Trulson, 1986). Activities named the same thing can be done very differently; it matters *how* an activity is done.

It is important that a child be passionate enough about the activity to be willing to keep practicing and pushing him- or herself to do better, and that the activity energize the child to work harder in general, including on schoolwork. Often a charismatic, enthusiastic adult can galvanize children's ardent interest in something. When we love what we are doing,

we have far more energy and can get far more done (Csikszentmihalyi, Abuhamdeh, & Nakamura, 2005; Wendt, Tuckey, & Prosser, 2011), and we are far more willing to exercise the discipline needed to devote countless hours and intensive effort. It is those long hours spent practicing and pushing oneself to do better that produce the real gain (Diamond & Lee, 2011; Klingberg, 2010; Nandagopal & Ericsson, 2012).

Why not harness children's passionate interests and use those to improve academic outcomes and reduce crime? If children are passionately involved in an arts, physical exercise, or service activity, that will not detract from their doing well in school. If they are happier, less stressed, and more physically fit, their academic achievement should be substantially better even if they spend less time receiving academic instruction.

Improving EFs, and thus improving school and job success and reducing crime, is serious business, yet there is no reason it needs to be joyless. One can be joyful and still be working hard on important matters. Indeed, research shows that you will be more creative and have more energy for the work if you are passionate about it (Csikszentmihalyi et al., 2005; Hirt et al., 2008). Montessori (1989, p. 11) wrote, "*Our aim is not merely to make the child understand . . . but to so touch his imagination as to enthuse him to his inmost core. We do not want complacent pupils, but eager ones.*"

CONCLUSIONS

If we want schoolchildren, or their teachers, to do their best and be most productive, we cannot ignore stresses in their lives. Stress impairs EFs and can cause someone to look as if he or she has an EF impairment, such as ADHD, when the person has no organic disorder but is simply stressed. Anyone will do better if the causes of his or her stress can be eased and/or if the person is helped to develop a healthier, calmer response to perceived stress.

Each student will do better if you engage that individual's passionate interests, energizing the child. Children who see that time and again what looked impossible becomes possible (even easy) if they just keep trying, develop the confidence that through effort they can succeed despite initial setbacks or failures. People with this confident belief in their own self-efficacy usually do the best (Bandura, 1994; Caprara,

Vecchione, Alessandri, Gerbino, & Barbaranelli, 2011; Dweck, 2006). ("The man who wins is the man who thinks he can," Wintle, 1927). The arts, physical activities, and hands-on learning can engage such passionate interest and they provide repeated, iterative experiences of failure, followed by long hours of disciplined practice, then success. Working together on a shared goal (whether that be an orchestral performance, helping a family after their home was destroyed, or rebuilding a car together) is an excellent way to build community. We cannot ignore the need for healthy, fit bodies if we want students to do their best and make optimal academic progress.

One can see the deleterious effects of stress, lack of physical health or fitness, and loneliness at the physiological and neuroanatomical level in prefrontal cortex and at the behavioral level in worse EFs (poorer reasoning and problem solving, forgetting things, and impaired ability to exercise discipline and self-control). Conversely, when people (be they students, teachers, corporate executives, or octogenarians) are less stressed, happier, more physically fit, and feel socially supported, they can think more clearly and creatively and have more energy for their work. The different parts of the human being are fundamentally interrelated (Diamond, 2007). We are not just intellects; we also have emotions, social needs, and bodies. Even if one's goal is *only* to improve academic outcomes, the best way to achieve that is probably *not* to focus narrowly on academics alone, but to also address children's emotional, social, and physical needs (Diamond, 2010, 2013; Diamond & Lee, 2011). Counterintuitively, the most efficient and effective strategy for improving academic achievement is probably not to focus only on academics but to nurture all aspects of the child. While it may seem logical that if you want to improve academic outcomes you should concentrate on academic outcomes alone, not everything that seems logical is correct.

REFERENCES

Alloway, T. P., & Alloway, R. G. (2010). Investigating the predictive roles of working memory and IQ in academic attainment. *Journal of Experimental Child Psychology, 106*(1), 20–29.

Aristotle. (trans. 1926, version XIX). Nicomachean Ethics: Loeb Classical Library 73.

Arnsten, A. F. T. (2000). Through the looking glass: Differential noradenergic modulation of prefrontal cortical function. *Neural Plasticity, 7*, 133–146.

Ashby, F. G., Isen, A. M., & Turken, A. U. (1999). A neuropsychological theory of positive affect and its influence on cognition. *Psychological Review, 106*(3), 529–550.

Baddeley, A. D., & Hitch, G. J. (1994). Developments in the concept of working memory. *Neuropsychology, 8*, 485–493.

Bailey, C. E. (2007). Cognitive accuracy and intelligent executive function in the brain and in business. *Annals of New York Academy of Sciences, 1118*, 122–141.

Baler, R. D., & Volkow, N. D. (2006). Drug addiction: The neurobiology of disrupted self-control. *Trends in Molecular Medicine, 12*(12), 559–566.

Bandura, A. (1994). *Self-efficacy*. In V. S. Ramachaudran (Ed.), *Encyclopedia of human behavior* (Vol. 4, pp. 71–81). New York, NY: Academic Press. (Reprinted in H. Friedman [Ed.], *Encyclopedia of mental health*. San Diego, CA: Academic Press, 1998).

Barch, D. M. (2005). The cognitive neuroscience of schizophrenia. *Annual Review of Psychology, 1*, 321–353.

Baumeister, R. F., Twenge, J. M., & Nuss, C. K. (2002). Effects of social exclusion on cognitive processes: Anticipated aloneness reduces intelligent thought. *Journal of Personality and Social Psychology*, 83, 817–827.

Bergman Nutley, S. (2011). *Development and training of higher order cognitive functions and their interrelations*. Doctoral Dissertation, Karolinska Institute, Stockholm, Sweden.

Bergman Nutley, S., Söderqvist, S., Bryde, S., Thorell, L. B., Humphreys, K., & Klingberg, T. (2011). Gains in fluid intelligence after training nonverbal reasoning in 4-year-old children: A controlled, randomized study. *Developmental Science, 14*, 591–601.

Best, J. R. (2010). Effects of physical activity on children's executive function: Contributions of experimental research on aerobic exercise. *Developmental Review*, 30, 331–351.

Blair, C. (2002). School readiness: Integrating cognition and emotion in a neurobiological conceptualization of children's functioning at school entry. *American Psychologist, 57*, 111–127.

Blair, C., & Razza, R. P. (2007). Relating effortful control, executive function, and false-belief understanding to emerging math and literacy ability in kindergarten. *Child Development, 78*, 647–663.

Borella, E., Carretti, B., & Pelgrina, S. (2010). The specific role of inhibition in reading comprehension in good and poor comprehenders. *Journal of Learning Disabilities*, *43*(6), 541–552.

Braver, T. S., Cohen, J. D., & Barch, D. M. (2002). The role of the prefrontal cortex in normal and disordered cognitive control: A cognitive neuroscience perspective. In D. T. Stuss & R. T. Knight (Eds.), *Principles of frontal lobe function* (pp. 428–448). Oxford, England: Oxford University Press.

Broidy, L. M., Nagin, D. S., Tremblay, R. E., Brame, B., Dodge, K. A., & Fergusson, D. E. (2003). Developmental trajectories of childhood disruptive behaviors and adolescent delinquency: a six-site cross-national study. *Developmental Psychology*, 30, 222–245.

Brown, T. E., & Landgraf, J. M. (2010). Improvements in executive function correlate with enhanced performance and functioning and health-related quality of life: Evidence from 2 large, double-blind, randomized, placebo-controlled trials in ADHD. *Postgraduate Medicine*, *122*(5), 42–51.

Burgess, P. W., & Simons, J. S. (2005). Theories of frontal lobe executive function: Clinical applications. In P. W. Halligan & D. T. Wade (Eds.), *Effectiveness of rehabilitation for cognitive deficits* (pp. 211–231). New York, NY: Oxford University Press.

Cacioppo, J., & Patrick, W. (2008). *Loneliness: Human nature and the need for social connection*. New York, NY: Norton.

Campbell, W. K., Krusemark, E. A., Dyckman, K. A., Brunell, A. B., McDowell, J. E., & Twenge, J. M. (2006). A magnetoencephalography investigation of neural correlates for social exclusion and self-control. *Social Neuroscience*, *1*, 124–134.

Caprara, G. V., Vecchione, M., Alessandri, G., Gerbino, M., & Barbaranelli, C. (2011). The contribution of personality traits and self-efficacy beliefs to academic achievement: A longitudinal study. *British Journal of Educational Psychology*, *81*, 78–96.

Carlson, S. M., & Moses, L. J. (2001). Individual differences in inhibitory control and children's theory of mind. *Child Development*, *72*, 1032–1053.

Cerqueira, J. J., Mailliet, F., Almeida, O. F., Jay, T. M., & Sousa, N. (2007). The prefrontal cortex as a key target of the maladaptive response to stress. *Journal of Neuroscience*, *27*, 2781–2787.

Chaddock, L., Pontifex, M. B., Hillman, C. H., & Kramer, A. F. (2011). A review of the relation of fitness and physical activity to brain structure and brain function in children. *Journal of the International Neuropsychological Society*, *17*, 1–11.

Champod, A. S., & Petrides, M. (2007). Dissociable roles of the posterior parietal and the prefrontal cortex in manipulation and monitoring processes. *Proceedings of the National Academy of Sciences*, *104*, 14837–14842.

Collins, A., & Koechlin, E. (2012). Reasoning, learning, and creativity: Frontal lobe function and human decision-making. *PLoS Biology*, *10*(3), e1001293.

Crescioni, A. W., Ehrlinger, J., Alquist, J. L., Conlon, K. E., Baumeister, R. F., Schatschneider, C., & Dutton, G. R. (2011). High trait self-control predicts positive health behaviors and success in weight loss. *Journal of Health Psychology*, *16*(5), 750–759.

Cserjési, R., Luminet, O., Poncelet, A. S., & Schafer, J. (2009). Altered executive function in obesity. Exploration of the role of affective states on cognitive abilities. *Appetite*, *52*(2), 535–539.

Csikszentmihalyi, M., Abuhamdeh, S., & Nakamura, J. (2005). Flow. In A. J. Elliot & C. S. Dweck (Eds.), *Handbook of competence and motivation* (pp. 598–608). New York, NY: Guilford Press.

Davidson, M. C., Amso, D., Anderson, L. C., & Diamond, A. (2006). Development of cognitive control and executive functions from 4–13 years: Evidence from manipulations of memory, inhibition, and task switching. *Neuropsychologia*, *44*, 2037–2078.

Davis, C. L., Tomporowski, P. D., McDowell, J. E., Austin, B. P., Miller, P. H., & Yanasak, N. E. (2011). Exercise improves executive function and achievement and alters brain activation in overweight children: A randomized, controlled trial. *Health Psychology*, 30, 91–98.

Davis, J. C., Marra, C. A., Najafzadeh, M., & Lui-Ambrose, T. (2010). The independent contribution of executive functions to health related quality of life in older women. *BMC Geriatrics*, *10*(1), 16–23.

Denson, T. F., Pederson, W. C., Friese, M., Hahm, A., & Roberts, L. (2011). Understanding impulsive aggression: Angry rumination and reduced self-control capacity are mechanisms underlying the provocation-aggression relationship. *Personality and Social Psychology Bulletin*, *37*(6), 850–862.

Desseilles, M., Balteau, E., Sterpenich, V., Dang-Vu, T. T., Darsaud, a., Vandewalle, G., . . . Schwartz, S. (2009). Abnormal neural filtering of irrelevant visual information in depression. *Journal of Neuroscience*, *29*, 1395–1403.

Diamond, A. (2005). Attention-deficit disorder (attention-deficit/hyperactivity disorder without hyperactivity): A neurobiologically and behaviorally distinct disorder from attention-deficit/hyperactivity disorder (with hyperactivity). *Development and Psychopathology*, *17*, 807–825.

Diamond, A. (2007). Interrelated and interdependent. *Developmental Science*, *10*, 152–158.

Diamond, A. (2010). The evidence base for improving school outcomes by addressing the whole child and by addressing skills and attitudes, not just content. *Early Education and Development*, *21*, 780–793.

Diamond, A. (2012). Activities and programs that improve children's executive functions. *Current Directions in Psychological Science*, *22*.

Diamond, A. (2013). Executive functions. *Annual Review of Psychology*, *64*, 135–168.

Diamond, A., Barnett, W. S., Thomas, J., & Munro, S. (2007). Preschool program improves cognitive control. *Science*, *318*, 1387–1388.

Diamond, A., & Lee, K. (2011). Interventions and programs demonstrated to aid executive function development in children 4–12 years of age. *Science*, 333(6045), 959–964.

Duckworth, A. L., & Seligman, M. E. P. (2005). Self-discipline outdoes IQ in predicting academic performance of adolescents. *Psychological Science*, *16*, 939–944.

Duncan, G. J., Dowsett, C. J., Claessens, A., Magnuson, K., Huston, A. C., Klebanov, P., . . . Japel, C. (2007). School readiness and later achievement. *Developmental Psychology*, *43*, 1428–1446.

Dweck, C. S. (2006). *Mindset: The new psychology of success*. New York, NY: Random House.

Eakin, L., Minde, K., Hechtman, L., Ochs, E., Krane, E., Bouffard, R., . . . Looper, K. (2004). The marital and family functioning of adults with ADHD and their spouses. *Journal of Attention Disorders*, 8, 1–10.

Ericsson, K. A., Nandagopal, K., & Roring, R. W. (2009). Toward a science of exceptional achievement: Attaining superior performance through deliberate practice. *Annals of New York Academy of Sciences*, *1172*, 199–217.

Espy, K. A., McDiarmid, M. D., Cwik, M. F., Stalets, M. M., Hamby, A., & Senn, T. E. (2004). The contributions of executive functions to emergent mathematic skills in preschool children. *Developmental Neuropsychology*, 26, 465–486.

Fairchild, G., van Goozen, S. H., Stollery, S. J., Aitken, M. R., Savage, J., Moore, S. C., & Goodyer, I. M. (2009). Decision making and executive function in male adolescents with early-onset or adolescence-onset conduct disorder and control subjects. *Biological Psychiatry*, 66(2), 162–168.

Fiebach, C. J., Ricker, B., Friederici, A. D., & Jacobs, A. M. (2007). Inhibition and facilitation in visual word recognition: Prefrontal contribution to the orthographic neighborhood size effect. *NeuroImage*, 36, 901–911.

Flook, L., Smalley, S. L., Kitil, J. M., Galla, B. M., Kaiser-Greenland, S., Locke, J., . . . Kasari, C. (2010). Effects of mindful awareness practices on executive functions in elementary school children. *Journal of Applied School Psychology*, 26, 70–95.

GEN. (2011). *Evaluation of big noise, El Sistema Scotland*. New York, NY: Crown. www.scotland.gov.uk/socialresearch.

Hackman, D. A., & Farah, M. J. (2008). Socioeconomic status and the developing brain. *Trends in Cognitive Sciences*, *13*, 65–73.

Hall, P., Crossley, M., & D'Arcy, C. (2010). Executive function and survival in the context of chronic illness. *Annals of Behavioral Medicine*, 39(2), 119–127.

Hamre, B. K., & Pianta, R. C. (2001). Early teacher-child relationships and the trajectory of children's school outcomes through eighth grade. *Child Development*, *72*, 625–638.

Hillman, C. H., Erickson, K. I., & Kramer, A. F. (2008). Be smart, exercise your heart: Exercise effects on brain and cognition. *Nature Reviews Neuroscience*, 9(1), 58–65.

Hirt, E. R., Devers, E. E., & McCrea, S. M. (2008). I want to be creative: Exploring the role of hedonic contingency theory in the positive mood-cognitive flexibility link. *Journal of Personality and Social Psychology*, 94, 214–230.

Holmes, J., Gathercole, S. E., & Dunning, D. L. (2009). Adaptive training leads to sustained enhancement of poor working memory in children. *Developmental Science*, *12*, F9–F15.

Holmes, J., Gathercole, S. E., Place, M., Dunning, D. L., Hilton, K. A., & Elliott, J. G. (2010). Working memory deficits can be overcome: Impacts of training and medication on working memory in children with ADHD. *Applied Cognitive Psychology*, *24*, 827–836.

Horowitz, R. (2003). *Evaluation of the national dance institute's in-school education programs*. New York, NY: Columbia University Press.

Hughes, C., & Ensor, R. (2008). Does executive function matter for preschoolers' problem behaviors? *Journal of Abnormal Child Psychology*, 36, 1–14.

Inter-American Development Bank. (2007). Venezuela. Propuesta de préstamo para un programa de apoyo al Centro de Acción Social por la Música—Fase II (Vol. IADB). Washington, DC: PR-3161.

Isen, A. M., Daubman, K. A., & Nowicki, G. P. (1987). Positive affect facilitates creative problem solving. *Journal of Personality and Social Psychology*, *52*, 1122–1131.

Isen, A. M., Johnson, M. M., Mertz, E., & Robinson, G. F. (1985). The influence of positive affect on the unusualness of word associations. *Journal of Personality and Social Psychology*, 48, 1413–1426.

James, W. (1899). *Talks to teachers*. London, UK: Green.

Kamijo, K., Pontifex, M. B., O'Leary, K. C., Scudder, M. R., Wu, C.-T., Castelli, D. M., & Hillman, C. H. (2011). The effects of an afterschool physical activity program on working memory in preadolescent children. *Developmental Science, 14*(5), 1046–1058.

Karbach, J., & Kray, J. (2009). How useful is executive control training? Age differences in near and far transfer of task-switching training. *Developmental Science, 12*(6), 978–990.

Klingberg, T. (2010). Training and plasticity of working memory. *Trends in Cognitive Science, 14*, 317–324.

Klingberg, T., Fernell, E., Olesen, P., Johnson, M., Gustafsson, P., Dahlstrom, K., . . . Westerberg, H. (2005). Computerized training of working memory in children with ADHD—A randomized, controlled trial. *Journal of American Academy of Child and Adolescent Psychiatry, 44*, 177–186.

Kochanska, G., Murray, K., & Coy, K. C. (1997). Inhibitory control as a contributor to conscience in childhood: From toddler to early school age. *Child Development*, 68, 263–277.

Lakes, K. D., & Hoyt, W. T. (2004). Promoting self-regulation through school-based martial arts training. *Applied Developmental Psychology, 25*, 283–302.

Lehto, J. E., Juujärvi, P., Kooistra, L., & Pulkkinen, L. (2003). Dimensions of executive functioning: Evidence from children. *British Journal of Developmental Psychology, 21*, 59–80.

Li-Grining, C. P., Raver, C. C., & Pess, R. A. (2011). *Academic impacts of the Chicago school readiness project: Testing for evidence in elementary school.* Paper presented at the Society for Research in Child Development Biennial Meeting, Montreal, QC, Canada.

Lillard, A., & Else-Quest, N. (2006). The early years: Evaluating Montessori education. *Science, 313*, 1893–1894.

Liston, C., McEwen, B. S., & Casey, B. J. (2009). Psychosocial stress reversibly disrupts prefrontal processing and attentional control. *Proceedings of the National Academy of Sciences, 106*, 912–917.

Loosli, S. V., Buschkuehl, M., Perrig, W. J., & Jaeggi, S. M. (2012). Working memory training improves reading processes in typically developing children. *Child Neuropsychology, 18*(1), 62–78.

Lubow, A. (2007, October 28). Conductor of the people. *New York Times Magazine*. http://www.nytimes.com/2007/10/28/magazine/28dudamel-t.html

Lui, M., & Tannock, R. (2007). Working memory and inattentive behaviour in a community sample of children. *Behavioral and Brain Functions*, 3, 12.

Lunt, L., Bramham, J., Morris, R. G., Bullock, P. R., Selway, R. P., Xenitidis, K., & David, A. S. (2012). Prefrontal cortex dysfunction and "jumping to conclusions": Bias or deficit? *Journal of Neuropsychology, 6*(1), 65–78.

Mackey, A. P., Hill, S. S., Stone, S. I., & Bunge, S. A. (2011). Differential effects of reasoning and speed training in children. *Developmental Science, 14*(3), 582–590.

Manjunath, N. K., & Telles, S. (2001). Improved performance in the Tower of London test following yoga. *Indian Journal of Physiological Pharmacology, 45*(3), 351–354.

McClelland, M. M., Cameron, C. E., Connor, C. M., Farris, C. L., Jewkes, A. M., & Morrison, F. J. (2007). Links between behavioral regulation and preschoolers' literacy, vocabulary, and math skills. *Developmental Psychology, 43*, 947–959.

Miller, E. K., & Cohen, J. D. (2001). An integrative theory of prefrontal cortex function. *Annual Review of Neuroscience, 24*, 167–202.

Miller, H. V., Barnes, J. C., & Beaver, K. M. (2011). Self-control and health outcomes in a nationally representative sample. *American Journal of Health Behavior*, 35(1), 15–27.

Miyake, A., Friedman, N. P., Emerson, M. J., Witzki, A. H., Howerter, A., & Wager, T. D. (2000). The unity and diversity of executive functions and their contributions to complex "frontal lobe" tasks: A latent variable analysis. *Cognitive Psychology, 41*, 49–100.

Moffitt, T. E. (2012). Childhood self-control predicts adult health, wealth, and crime. *Multi-Disciplinary Symposium Improving the Well-Being of Children and Youth*. Copenhagen.

Moffitt, T. E., Arseneault, L., Belsky, D., Dickson, N., Hancox, R. J., & Harrington, H., . . . Caspi, A. (2011). A gradient of childhood self-control predicts health, wealth, and public safety. *Proceedings of the National Academy of Sciences, USA, 108*, 2693–2698.

Moffitt, T. E., Caspi, A., Taylor, A., Kokaua, J., Milne, B. J., Polanczyk, G., & Pouton, R. (2010). How common are common mental disorders? Evidence that lifetime rates are doubled by prospective versus retrospective ascertainment. *Psychological Medicine*, 40, 899–909.

Montessori, M. (1989). *To educate the human potential*. Oxford, England: ABC-CLIO.

Morrison, F. J., Ponitz, C. C., & McClelland, M. M. (2010). Self-regulation and academic achievement in the transition to school. In S. D. Calkins & M. Bell (Eds.), *Child development at the intersection of emotion and cognition* (pp. 203–224). Washington, DC: American Psychological Association.

Muraven, M. (2010). Building self-control strength: Practicing self-control leads to improved self-control performance. *Journal of Experimental Social Psychology*, 46(2), 465–468.

Murray, N., Sujan, H., Hirt, E. R., & Sujan, M. (1990). The influence of mood on categorization: A cognitive flexibility interpretation. *Journal of Personality and Social Psychology*, 59, 411–425.

Nandagopal, K., & Ericsson, K. A. (2012). Enhancing students' performance in traditional education: Implications from the expert–performance approach and deliberate practice. In K. R. Harris, S. Graham, T. Urdan, C. B. McCormick, G. M. Sinatra, & J. Sweller (Eds.), *APA educational psychology handbook: Theories, constructs, and critical issues* (Vol. 1, pp. 257–293). Washington, DC: American Psychological Association.

Nicholson, C. (2007, March 26). Beyond IQ: Youngsters who can focus on the task at hand do better in math. *Scientific American*. Retrieved from http://www.sciam.com/article.cfm?chanID=sa003&articleID=90377FAE-E7F2-99DF-3A1204FC5F2BF0F7&ref=nature.

Normandeau, S., & Guay, F. (1998). Preschool behavior and first-grade school achievement: The mediational role of cognitive self-control. *Journal of Educational Psychology*, 90, 111–121.

O'Shaughnessy, T., Lane, K. L., Gresham, F. M., & Beebe-Frankenberger, M. (2003). Children placed at risk for learning and behavioral difficulties: Implementing a school-wide system of early identification and prevention. *Remedial and Special Education*, 24, 27–35.

Penadés, R., Catalán, R., Rubia, K., Andrés, S., Salamero, M., & Gastó, C. (2007). Impaired response inhibition in obsessive compulsive disorder. *European Psychiatry*, 22, 404–410.

Petrides, M. (2005). Lateral prefrontal cortex: Architectonic and functional organization. *Philosophical Transactions of the Royal Society of London. Series B, Biological Sciences*, 360, 781–795.

Prince, M., Patel, V., Saxena, S., Mmaj, M., Maselko, J., Phillips, M., & Rahman, A. (2007). No health without mental health. *Lancet*, 370, 859–877.

Raver, C. C., Jones, S. M., Li-Grining, C. P., Metzger, M., Champion, K. M., & Sardin, L. (2008). Improving preschool classroom processes: Preliminary findings from a randomized trial implemented in Head Start settings. *Early Childhood Research Quarterly*, 23, 10–26.

Raver, C. C., Jones, S. M., Li-Grining, C., Zhai, F., Bub, K., & Pressler, E. (2011). CSRP's impact on low-income preschoolers' preacademic skills: Self-regulation as a mediating mechanism. *Child Development*, 82, 362–378.

Raver, C. C., & Knitzer, J. K. (2002). *Ready to enter: What research tells policy makers about strategies to promote social and emotional school readiness among three- and four-year old children*. New York, NY: National Center for Children in Poverty.

Riggs, N. R., Greenberg, M. T., Kusché, C. A., & Pentz, M. A. (2006). The mediational role of neurocognition in the behavioral outcomes of a social-emotional prevention program in elementary school students: Effects of the PATHS Curriculum. *Prevention Science*, 7, 91–102.

Riggs, N. R., Spruijt-Metz, D., Sakuma, K. K., Chou, C. P., & Pentz, M. A. (2010). Executive cognitive function and food intake in children. *Journal of Nutrition Education and Behavior*, 42(6), 398–403.

Robinson, L. M., Sclar, D. A., Skaer, T. L., & Galin, R. S. (1999). National trends in the prevalence of attention-deficit/hyperactivity disorder and the prescribing of methylphenidate among school-age children: 1990–1995. *Clinical Pediatrics*, 38, 209–217.

Roth, R. H., Tam, S. Y., Ida, Y., Yang, J. X., & Deutch, A. Y. (1988). Stress and the mesocorticolimbic dopamine systems. *Annals of the New York Academy of Sciences*, 537, 138–147.

Saarni, C. (1999). *The development of emotional competence*. New York, NY: Guilford Press.

Savage, R., Cornish, K., Manly, T., & Hollis, C. P. (2006). Cognitive processes in children's reading and attention: The role of working memory, divided attention, and response inhibition. *British Journal of Psychology*, 97, 365–385.

Smith, E. E., & Jonides, J. (1999). Storage and executive processes in the frontal lobes. *Science*, 283, 1657–1661.

St. Clair-Thompson, H. L., & Gathercole, S. E. (2006). Executive functions and achievements in school: Shifting, updating, inhibition, and working memory. *Quarterly Journal of Experimental Psychology*, 59, 745–759.

Tangney, J. P., Baumeister, R. F., & Boone, A. L. (2004). High self-control predicts good adjustment, less pathology, better grades, and interpersonal success. *Journal of Personality*, 72(2), 271–322.

Taylor-Tavares, J. V., Clark, L., Cannon, D. M., Erickson, K., Drevets, W. C., & Sahakian, B. J. (2007). Distinct profiles of neurocognitive function in unmedicated unipolar depression and bipolar II depression. *Biological Psychiatry*, 62, 917–924.

Thorell, L. B., Lindqvist, S., Bergman Nutley, S., Bohlin, G., & Klingberg, T. (2009). Training and transfer effects of executive functions in preschool children. *Developmental Science*, 12, 106–113.

Trulson, M. E. (1986). Martial arts training: A novel "cure" for juvenile delinquency. *Human Relations*, 39, 1131–1140.

Tuckman, B. W., & Hinkle, J. S. (1986). An experimental study of the physical and psychological effects of aerobic exercise on schoolchildren. *Health Psychology, 5*, 197–207.

von Hecker, U., & Meiser, T. (2005). Defocused attention in depressed mood: Evidence from source monitoring. *Emotion, 5*, 456–463.

Vygotsky, L. S. (1978). *Mind in society: The development of higher psychological processes*. Cambridge, MA: Harvard University Press.

Wendt, S., Tuckey, M. R., & Prosser, B. (2011). Thriving, not just surviving, in emotionally demanding fields of practice. *Health & Social Care in the Community, 19*(3), 317–325.

Winstok, Z. (2009). From self-control capabilities and the need to control others to proactive and reactive aggression among adolescents. *Journal of Adolescence, 32*(3), 455–466.

Wintle, W. D. (1927). Thinking. In *The world's best-loved poems* (Compiled by J. G. Lawson). New York, NY: Harper & Row.

Zanto, T. P., Rubens, M. T., Thangavel, A., & Gazzaley, A. (2011). Causal role of the prefrontal cortex in top-down modulation of visual processing and working memory. *Nature Neuroscience, 14*, 656–661.

PART

IV

Reflections