

Developing & Supporting “Executive Function”

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The abilities to exercise self-control and stay focused, hold information in mind and work with that information (working memory), problem-solve, and flexibly adjust to change or unexpected problems are important for all aspects of life – social, intellectual and emotional. For instance, self-control is critical for thinking before you act, complying with societal norms and work requirements and not doing things you’d regret. Working memory is critical for reasoning and creatively seeing connections among elements. Cognitive flexibility is critical if one is to flexibly adjust to what life throws your way or creatively ‘think outside the box’ (for example, if there’s a problem we haven’t been able to solve, can you think of a novel way of attacking or conceiving of it?). Collectively, these skills make up what are called “executive functions” (EFs).¹

To improve EFs you need to practice, and the more you practice them and challenge yourself to improve, the better you get.¹ While directly training EFs and pushing yourself to improve is needed for strengthening EFs, that alone is probably not enough. It’s likely that indirectly supporting EFs by lessening things that impair them (like stress or loneliness) and enhancing things that support them (like joy or physical vitality) is also critical.

What activities directly train and challenge EFs and indirectly support them by also addressing our social, emotional, and physical needs? Traditional activities! From the dawn of civilization, across all cultures, storytelling, dance, art, music and play have been part of the human condition. People in all cultures made music, sang, danced, and played sports and games. There are good reasons why those activities arose everywhere and have lasted so long.

I believe it will be shown that El Sistema-inspired programs provide powerful support for executive functions, although no evidence for this exists as yet. Indeed, there are characteristics of El Sistema that make it likely to be especially beneficial, compared with other arts, athletic or cultural programs. Here are some of those characteristics:

- El Sistema’s emphasis on the sheer joy of making music, especially together. EFs depend on the prefrontal cortex (PFC) and the other brain regions with which it is interconnected. PFC is the newest area of the brain and the most vulnerable. If you’re stressed, sad, lonely, or not physically fit, PFC and EFs take the first hit and the biggest. Stress impairs EFs and

¹ Diamond, A., & Ling, D. S., (2016). Conclusions about interventions, programs, and approaches for improving executive functions that appear justified and those that, despite much hype, do not. *Developmental Cognitive Neuroscience*, 18, 34-48.

can cause someone to look as if he or she has an EF impairment (like ADHD) even when that's not the case.² Conversely, we show better EFs when we're happy, healthy, and feel socially supported. In general, people show more creativity and are better able to maintain focused attention when they are happier than when they are more miserable.³

This is why El Sistema's emphasis on joy is so important. Joy is not the opposite of serious. Indeed, research shows we learn more, and get more done, when we're happy. El Sistema concentrates on building positive feelings like pride and self-confidence; children are encouraged not to worry about making mistakes, but to enjoy the process of music-making. In Abreu's words, "Mistakes are simply what happens on the way to getting things right."

- El Sistema's emphasis on community. We are fundamentally social. We need to belong. Being part of something larger than oneself, working with others toward an important shared goal, is one of the greatest joys in life.⁴ We need to feel that there are others who care about us and are there for us. We need to fit in and be liked. PFC works more efficiently, and we have better EFs, when we feel we're not alone.⁵ El Sistema's practices of learning in ensemble and encouraging children to teach one another⁶ help to build feelings of community and solidarity.

- El Sistema's emphasis on the physical activities of playing and practicing. The brain doesn't

² Arnsten, A. F. T., Mazure, C. M., & Sinha, R. (2012). This is your brain on meltdown. *Scientific American*, 306(4).

McEwen, B. S., & Morrison, J. H. (2013). Brain on stress: Vulnerability and plasticity of the prefrontal cortex over the life course. *Neuron*, 79(1), 16–29.

³ 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.

⁴ Urry, H. L., Nitschke, J. B., Dolski, I., Jackson, D. C., Dalton, K. M., Mueller, C. J., . . . Davidson, R. J. (2004). Making a life worth living: Neural correlates of well-being. *Psychological Science*, 15, 367-372.

David Yeager, Henderson, M., Paunesku, D., Walton, G., Spitzer, B., D'Mello, S., & Angela Duckworth. (2014). Boring but important: A self-transcendent purpose for learning fosters academic self-regulation. *Journal of Personality and Social Psychology*, 107, 559-580.

⁵ Cacioppo, J., & Patrick, W. (2008). *Loneliness: Human nature and the need for social connection*. New York, NY: W. W. Norton & Co., Inc.

Baumeister, R. F., DeWall, C. N., Ciarocco, N. J., & Twenge, J. M. (2005). Social exclusion impairs self-regulation. *Journal of Personality and Social Psychology*, 88, 589-604.

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.

⁶ Hall, T., & Stegila, A. (2003). Peer-mediated instruction and intervention. *NCAC Classroom Practices*, 1-18. (This is online.)

recognize the same sharp division between cognitive and motor function that we impose in our thinking.⁷ The same or substantially overlapping brain regions subserve both cognitive and motor functions. For example, an area of the brain known as the pre-SMA is important for sequential tasks, regardless of whether they are cognitive or motor.⁸

The different parts of a person are fundamentally interrelated.⁹ Each part (cognitive, spiritual, social, emotional, and physical) is affected by, and affects, the others. We have to care about children's emotional, social, and physical well-being, if we want them to be able to problem-solve, exercise self-control, or display any of the other EFs. When children are stressed, sad, lonely or not physically fit, their academic performance suffers.¹⁰

It is worrisome that activities needed for children to thrive (such as music-making and play) are disappearing from school curricula and children's lives. Mainstream education may have it exactly backwards. Focusing exclusively on training cognitive skills is probably less efficient or effective than also addressing youths' emotional, social, and physical needs.¹¹ Addressing those needs may be key to whether children do well in school and in life. No program does a better job of addressing the whole child – mind, heart, and soul – than does El Sistema.

[To watch a TEDx Talk on this subject, watch Adele Diamond at: <http://tedxtalks.ted.com/video/Turning-some-Ideas-on-their-Head>]

⁷ Diamond, A. (2000). Close interrelation of motor development and cognitive development and of the cerebellum and prefrontal cortex. *Child Development*, 71, 44-56.

⁸ Hanakawa, T., Honda, M., Sawamoto, N., Okada, T., Yonekura, Y., Fukuyama, H., & Shibasaki, H. (2002). The role of rostral Brodmann Area 6 in mental-operation tasks: An integrative neuroimaging approach. *Cerebral Cortex*, 12, 1157-1170.

⁹ Diamond, A. (2007). Interrelated and interdependent. *Developmental Science*, 10, 152-158.

¹⁰ Benner, A. D. (2011). Latino adolescents' loneliness, academic performance, and the buffering nature of friendships. *Journal of Youth and Adolescence*, 40(5), 556-567.

Flueckiger, L., Lieb, R., Meyer, A. H., & Mata, J. (2014). How health behaviors relate to academic performance via affect: An intensive longitudinal study. *PLoS ONE*, 9(10), e111080.

<http://doi.org/10.1371/journal.pone.0111080>

Martin, K. (2010). *Brain boost: Sport and physical activity enhance children's learning*. Leederville: Government of Western Australia: Department of Sport and Recreation. (This is online.)

Singh, A., Uijtdewilligen, L., Twisk, J. W. R., van Mechelen, W., & Chinapaw, M. J. M. (2012). Physical activity and performance at school: A systematic review of the literature including a methodological quality assessment. *Archives of Pediatrics & Adolescent Medicine*, 166(1), 49-55.

¹¹ 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. (2014). Want to optimize executive functions and academic outcomes? Simple, just nourish the human spirit. *Minnesota Symposia on Child Psychology*, 37, 203-230.

Diamond, A. (2015). Research that helps us move closer to a world where each child thrives. *Research in Human Development*, 12, 288 – 294. (The "Just One Wish Issue")