At the forefront of research on Executive Functions, Professor Adele Diamond describes how we can improve our inhibitory control, working memory and cognitive flexibility to help us think before we act.

A t the University of British Columbia in Vancouver, world leading neuroscientist, Professor Adele Diamond, is collaborating with trainee, Daphne S. Ling, to produce a ground-breaking broad review of current research on interventions and programs to improve executive functions. Diamond describes executive functions as developable skills that consist of working memory, inhibitory control and cognitive flexibility. Executive functions enable us to reason, problem-solve, think before we act, see things from new and different perspectives, and to flexibly adapt to changing demands or priorities. Without these higher cognitive processes we would be at the mercy of our impulses, unable to resist temptations or stay focused on important tasks. Having good executive functions enables individuals to thrive socially, professionally and economically - within the complexity of our modern world.

Researchers in the field are developing various techniques for improving executive functions, such as cognitive training or physical exercise. Diamond and Ling describe their work as the first review to
comprehensively evaluate all the different methodological approaches to executive function training and to look across all age groups. Identifying 8 fundamental principles that appear to apply to all methods of training of executive functions, Diamond and Ling’s review provides a vital appraisal of the evidence gathered so far, with some surprising results.

Navigating the Minefields of Everyday Life

Various researchers have shown that the development of executive functions appears to be critical for an individual’s school readiness, as well as their future academic and career success. We also need these cognitive skills for maintaining positive friendships, marital harmony and good health. While executive functions are positively enhanced by socioeconomic stability, well-being and good health, executive functions are negatively impaired by life or economic stresses, traumas, poor health and loneliness. Diamond underscores the importance of executive functions for navigating the minefields of everyday life, and that executive functions “are sometimes more predictive than IQ or socioeconomic status” for future life success.

The good news is that neuroscientists think that executive function can be improved at any age. We can all reap the benefit of boosting our cognitive functions for observable real world benefits. Diamond and Ling analyse a broad range of studies to evaluate the evidence for the actual cognitive benefits of different types of activities, such as physical exercise and computerised training. They call on future researchers “to follow principles of design that have so often been violated in training studies.” Diamond and Ling’s review aptly outlines correct practice for experimental executive function training.

Charming New Territories: What Works?

Diamond and Ling identify weaknesses within approaches for testing the effectiveness of experimental executive function training. The researchers point out that the placebo effect of taking part in a research study is sometimes not fully captured by researchers, an oversight that may lead to an erroneous conclusion that an intervention was effective. Thus, it is critically important to compare the training to another new program that participants also have high hopes for. Also, researchers need to show that a program both produces more improvement in executive functions than the control condition and results in better executive functions than the control condition. Studies of the benefits of physical activity for executive functions, in particular, have been plagued by differences in executive functions at the outset. Too often the control group starts out better and the training group simply catches up so that the groups do not differ on executive functions after the training. When that happens one cannot know whether normally developmental processes, regression to mean, or the training caused the experimental group to catch up to the controls.

Diamond and Ling conclude that the evidence shows that CogMed®, a computer-based training approach, is the most effective way thus far of improving working memory. Additionally school programs, such as PATHS™, MindUp™, and the Chicago School Readiness Project, provide the ‘best results for improving executive control’ thus far in children in preschool through Grade 4. The researchers also indicate that Taekwondo, integrated Brain and Body Training, yoga and theatre have demonstrated favourable outcomes for improving executive functions, but there is only one intervention study of each so far.

Conversely, Diamond and Ling suggest that the weight of evidence indicates that Mindfulness-Based Stress Reduction (MBSR), a program developed by Jon Kabat-Zinn in the 1970s involving meditative and body awareness, and N-back tasks, or task switching, do not improve executive functions (Note, though, that MBSR’s benefit for EFs with stressed individuals has yet to be studied.) Diamond and Ling conclude that the least effective form of physical activity for improving executive functions is ‘mindless’ aerobic exercise, swimming, which does not engage higher cognitive faculties. However, promising benefits are offered by physical activities that are both physically and cognitively challenging, such as Taekwondo and Yoga.

Success and Social Equality

Diamond’s research suggests that executive function training will be most beneficial for persons: with lower working memory spans, worse attention, ADHD, and adults at the beginnings of cognitive decline. These groups demonstrate larger observable improvement after training than others. A positive equalising effect is particularly clear in socioeconomically disadvantaged children. Children from lower socioeconomic backgrounds are often behind their more advantaged peers in the development of executive functions. These disadvantaged children benefit from the most improvement from targeting executive functions.

Diamond and Ling believe that effective EF training can help to ‘reduce social disparities in academic achievement’, as well as in health, but the implications of their review are even more far-reaching. As a lack of impulse control is associated with criminal activity, boosting low executive functioning could proactively ward someone off from committing criminal acts or reducing recidivism. Similarly, improving an individual’s executive functions can lead to a corresponding improvement in their professional, economic and social success. Considering the societal benefits offered by improving the population’s cognitive performance, Diamond and Ling’s systematic evaluation of various approaches to executive function training paves the way to innovatively combat societal inequity. Early intervention appears to be key.

• Adele Diamond and Daphne S. Ling’s upcoming ‘Review of the evidence on, and Fundamental Questions surrounding, Effective Executive Function Training’ (including working memory) will soon be published in the book, ‘An Integrative Approach to Cognitive and Working Memory Training: Perspectives from Psychology, Neuroscience, and Human Development’ (Oxford University Press)