

Executive functions develop throughout the lifespan and are the most essential cognitive functions to navigate adulthood. In particular, self-regulation becomes increasingly important as a child grows into an adult. The ability to resist temptation in favour of long-term goals is essential to a successful future, in terms of both social relationships and vocation.¹

The ability to suppress impulses directed towards immediate gratification in favour of behaviours that allow for attainment of delayed but more substantial long-term reward depends on cognitive control. Neurologically, top-down cognitive control (inhibition) during delay of reward involves the prefrontal cortex, and in particular the inferior frontal gyrus. In contrast, impulsive and more immediate choices are associated with activity in areas of limbic system associated with reward reinforcement and motivation, with exaggerated recruitment in the ventral striatum.^{1,2}

Studies in young preschool children showed that their ability to delay gratification may predict their capacity in adulthood to control impulsive thoughts and actions, and resistance to temptation in childhood may be a relatively stable individual difference that predicts differential activity in these two circuits of the brain.¹ Moreover, these same studies suggest that children with better developed capacities for self-regulation tend to demonstrate better outcomes in relationships, well-being and professional success in adulthood.

Executive dysfunction in adults with ADHD

Deficits in executive function are core features of attention-deficit/hyperactivity disorder (ADHD). Importantly, it is clear that ADHD is not only a disorder of attention, but also a disorder of intention (self-regulation), which must be addressed by treatment. Adults with ADHD report that they know what they need to do in terms of the basic coping strategies required to improve functioning (knowledge), but that they have difficulty consistently turning these intentions into actions (performance).^{3,4} Acknowledgement and validation of this experience by the clinician is paramount. Showing empathy helps to relieve patients' feelings of guilt and shame and concerns of lack of intelligence, and improves commitment to therapy.

The consequences of impaired self-regulation are far from benign. They include emotional dysregulation, pessimistic and self-effacing thoughts, depression and anxiety. In turn these lead to interpersonal problems and adjustment difficulties.⁵ However, the diminished self-control associated with enticing stimuli or social contexts ('hot' stimuli) can be overcome by learning reappraisal or reframing strategies to concentrate on interfering information. These 'cooling' cognitive strategies have been shown to be highly effective in enhancing delayed gratification.

An important intention of cognitive behavioural therapy (CBT) for adult ADHD is to teach patients, who know what to do, how to better effect regulation of the 'hot' system. That is, to translate their knowledge into practical, actionable behaviours. This includes improving the capacity to focus attention (the ability to 'switch off' the default mode network); working memory (the ability to hold information in memory and mentally manipulate this information

during retention); set-shifting (the capacity to switch responses and behaviours between different task demands and sets of instructions); and emotional self-management (coping skills for managing emotional reactions to typical life stressors).² Different CBT approaches may be necessary to address each of these, depending on the needs of the individual.

Diagnosis of executive dysfunction in ADHD

ADHD is predominantly a clinical diagnosis, requiring a careful and detailed clinical interview and relevant collateral information (e.g. from spouse or partner, parents, educators). Assessment of comorbidities is essential (Table 1). In particular, because they exacerbate impaired attention, careful attention must be paid to identifying comorbid mood and anxiety disorders.

Table 1. Psychological comorbidities in adults with ADHD⁶

- Major depressive disorder
- Anxiety disorder
- Bipolar mood disorder
- Panic disorder
- Social phobia, agoraphobia
- Substance use disorders
- Eating disorders
- Post-traumatic stress disorder
- Obsessive-compulsive disorder
- Suicidality

Neuropsychological assessment assists in diagnosis, but, because symptoms are non-specific, there is no single test or profile that is definitive. However, the focus of assessment lies in discerning between impairments in simple attention and those in complex attention. Whereas performance of simple tasks may be impaired in anxiety and depression, ADHD more commonly involves impairment in complex tasks, where there are difficulties with intention, rather than just attention. Assessment measures with the highest diagnostic validity and reliability are the Continuous Performance Test (CPT), Test of Variables of Attention (TOVA) and Conner's CPT-II. In TOVA, in comparison with non-ADHD individuals, those with ADHD consistently score lower across 'intention' scores.

Cognitive rehabilitation therapy (CRT)

CRT is a form of CBT specific to the management of executive dysfunction in ADHD that assists the individual to turn intention into action. The treatment focus is a combination of core principles (pillars) focusing on coping strategies to compensate for self-regulation difficulties. These strategies need to be consistently practised and should be applicable to daily life. Complex tasks are broken down into discrete steps so that focus is redirected to short time-limited tasks that are manageable and actionable and which deliver as immediate rewards as possible ('treating the brain as a sprinter, rather than a marathon runner'). In order to increase the likelihood that they will be acted on, these activities should be personalised and involve clear step-by-step directives (behavioural scripts) that

are unambiguous, simple to follow and result in a positive outcome that is meaningful to the individual. Notes, lists and establishment of routines are helpful. Where possible, environmental modifications are made to minimise experiences of internal discomfort (e.g. boredom or impulse to do something inherently enjoyable) and to facilitate completion of the task at hand.²

Basic principles of CRT

Pillar 1: Visual encoding and retrieval

Adults with ADHD have significant impairment in working memory, processing speed and auditory verbal memory relative to their other cognitive abilities.⁷ Therefore they are more likely to sustain focus and recall if supported by visual cues and reminders (e.g., written reminders, notes, charts and to-do lists). These aids reduce cognitive load on working memory by externalising important information.

Consistent with impaired working memory, the behaviour of individuals with ADHD is more controlled by the immediate present, rather than information pertaining to past and future.^{8,9} Because of this 'temporal myopia' or 'time blindness' time reminders (e.g. clocks, calendars) should be easily visible and kept within line of sight.

This leveraging of stronger visual cognitive functioning of individuals with ADHD improves their ability to encode (attend to) and retrieve (remember) information, and it improves their situational awareness, planning and coordination of daily routine.

Pillar 2: Planning

Activities for adults with ADHD need to be structured and time must be taken to formulate a plan. This includes the following:

- Planning time to plan and review. Planning should not take long; 10 minutes should be sufficient
- Daily micro-planning: Listing daily tasks, including time stamps (i.e., expected duration) and contingency time to counteract the planning fallacy (i.e. tasks often take longer or shorter time than has been allocated to them). People with ADHD often overburden themselves and underestimate the time required to complete a task. Intrusions such as fatigue, distraction and unforeseen interruptions exacerbate this inaccuracy. A reasonable contingency time is 0.5 to 1 unit, meaning that for every hour planned for a task an additional 30 minutes to 1 hour should be factored in as a contingency
- Tasks should be broken down into manageable short segments rather than be viewed as intimidating complex wholes which contribute to procrastination (see Pillar 5)
- Daily macro-planning: Visual plans listing major deadlines and events offer long-term perspective
- Breaks must be included to limit cognitive depletion and burnout

This method of planning allows individuals with ADHD to develop a sense of accomplishment by creating reasonable workloads, offers perspective that they have accomplished tasks in their day and also ensures that, for the most part, they will run on time or even early rather than being perpetually late and pressured by deadlines.

Pillar 3: Single function spaces

Environmental (e.g. work space) modification is helpful to reduce distractions and loads on working memory and set-shifting. Examples include making things as simple as possible to limit the time and complexity of set-ups, and utilisation of the space for one function so that it remains prepared for that task.

Pillar 4: Sequencing and creating routines

In instances where there is a variety of choice, planning ahead and assigning sequences reduces executive pressure. Creation of basic flexible routines reduces memory load (e.g. making payments on the same day of the week every week or sequencing meals in the evenings of each day of the week).

Pillar 5: Task-chunking

Breaking tasks down into smaller manageable steps with the option to stop or continue reduces procrastination by limiting complexity (working memory and set-shifting) and the duration required for the activity (sustained attention and self-regulation). A helpful rule is to break for 15 minutes after every 45 minutes of work.

Pillar 6: Focus on completion before reward

Focusing on completion of each step as a goal reduces anxiety-driven task avoidance, guilt and procrastination. For example, individuals should be encouraged to complete a draft before editing or revising and to delay leisure activities until the task at hand is complete.

All adults should be encouraged to exercise and to pay attention to healthy eating and drinking, with avoidance of sugar binges, which can promote cognitive crashes.

Conclusions

Impairment of 'intention' is a specific pathology in adults with ADHD. Effective therapy for ADHD must therefore aim to lighten the load on executive function and improve self-regulation. While medication may be helpful, it is unlikely to be optimally effective without behaviour modification. CRT is an effective modality that teaches individuals with ADHD the skills necessary to manage daily activities while avoiding anxiety, guilt and procrastination. Increasing self-efficiency has potential to improve outcomes at home and at work, self-esteem and relationships and reduce comorbidities associated with frustration and despair.

Acknowledgement

The author gratefully acknowledges the assistance of Dr David Webb in writing this article.

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