



The following articles first appeared in Dr. Greenstone's "In Focus" column in the *Exceptional Family* magazine.

(3-part series on Executive Function):

Executive Function & Emotional Regulation
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Sustained Attention & Working Memory

- and -

The Amazing Plastic Brain

Executive Function & Emotional Regulation

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As a clinician, I am frequently asked to explain the following paradox to parents seeking consultation around their children's behavior: How could a boy who can recite whole movie scripts by heart and calculate complex mathematical equations in his head, struggle to get dressed in the morning, or find his way home from school when a moving van is blocking his home's visibility? How can a girl give a fifteen-minute presentation on the topic of igloos, yet when asked what an igloo is made out of, be incapable of answering? Why would a child who is capable of intellectualizing information like a little professor engage in continuous tantrums in order to express his discontent? The answers to these questions can be found in understanding the concepts of *executive function and emotional self-regulation*; abilities that have garnered increasing attention from researchers and clinicians in recent years.

It is believed that both executive function and emotional regulation fall under the brain's frontal lobe – an area often described as the brain's "control center." When the brain receives messages via the five senses and vestibular and proprioceptive¹ stimulation, the control center's role is to interpret and react to these signals quickly and appropriately. Memories of prior experiences, consequences and feedback from others – whether positive or negative – are also integral to make good decisions and to develop and implement a timely action plan. This ability is known as executive function. When the brain's control center functions properly, a person is more likely to interpret cues correctly, make good decisions and execute them accordingly.

Emotional self-regulation is defined as the ability to take control of one's emotions. Executive function and emotional self-regulation are intimately related in that a person's ability to emotionally self-regulate largely depends upon a properly-functioning control center. Accordingly, anxiety and anger-management issues are often linked to perceptual difficulties and struggles relating to self-awareness and self-control.

"Houston, we have a problem"

The prospect that your child's control center may have a glitch in its wiring is indeed distressing. The good news is that if the source(s) of the problems can be located and rewired, a smooth landing is ultimately possible.

Even before you begin pinpointing the source of your child's challenges, knowledge of the skills necessary for successful living will give you a leg up on your search. In his book *No Mind Left Behind: Understanding & Fostering Executive Control, The 8 Essential Brain Skills Every Child Needs to Thrive*,¹ Adam Cox hones in on eight "executive control skills" which he deems imperative for proper functioning. They include: initiation, flexibility, attention, organization, planning, a working memory, self-awareness, and managing emotions – and many children with developmental disorders appear to manifest impairments in a number of these skills.

¹ Cox, A.J. *No Mind Left Behind: Understanding & Fostering Executive Control The 8 Essential Brain Skills Every Child Needs to Thrive*. (NY: Penguin Group, 2007)

1. **Initiation** refers to the ability to get started on a particular task or activity. This involves not only being cognizant of the fact that a particular task needs to be accomplished, but also knowing when and how to get it done. Examples of such tasks might include morning and bedtime routines, homework and household chores.

2. **Flexibility** is the ability to see a situation from a different perspective, to be capable of dealing with changes – particularly those that are unexpected – and disappointments, and to be adaptable.

3. A child capable of following a series of instructions, participating in an activity despite the fact that it may not interest him, maintaining eye contact during a conversation (as opposed to zoning-out) and following a task to completion, has mastered the skill of **Sustaining Attention**.

4. **Organization** refers to the ability to perform any task that involves sequencing, ordering, assembling or breaking down steps. It also encompasses the ability to sift out essential from non-essential information. From remembering to bring home your agenda in order to be able to do your homework properly, to getting dressed, tidying your desk or doing a school project without being overwhelmed by clutter and confusion, organization is an essential skill.

5. **Planning** encompasses the ability to think ahead, prioritize, establish a schedule and understand cause and effect. This skill is integral for tasks as basic as sitting down on a chair at the table (which involves motor planning), to developing an exam study-schedule, to setting broader goals for one's life.

6. A child capable of retaining information in his memory and then applying that information in future situations is said to have a **Working Memory**, according to Cox.

7. **Self-Awareness** constitutes the ability to grasp and internalize important social skills, such as turn-taking, the "art" of making and keeping friends and behaving in a socially-acceptable manner. In his description of multiple intelligences, psychologist Howard Gardner refers to such skills as "intrapersonal skills," and lists knowledge of one's strengths and weaknesses, empathy for others and leadership qualities under the same category.²

Whereas both Cox and Gardner classify social and "intrapersonal" skills under the heading of "Self-Awareness," I tend to regard self-awareness and interpersonal relationship skills as two distinct categories. For while many children are proficient in both, some exhibit weakness in both and still others may be stronger in one over the other.

8. A child with good coping abilities, impulse control, the ability to accept disappointments without overreacting and an overall positive outlook on life is said to be capable of **Managing Emotions**. Aside from experiencing social difficulties including relationship challenges, children who are weak in this skill often suffer within themselves; whereas some may tend to confront anger-management issues which are often manifest in aggression toward others, others may turn inwards by becoming withdrawn, increasingly angry, depressed, or anxious.

² Gardner, Howard. *Frames of Mind: The Theory of Multiple Intelligences* (NY: Basic Books, 1993)

While the acquisition of each *individual* skill is crucial to ensuring the healthy and successful development of all children, mastering *all eight* is clearly the ultimate goal. For each skill works in tandem with another – each function in unison: Planning is required for organization, initiation is necessary to get started and sustained attention is required to focus on a plan and see it through. Self-awareness is critical when setting goals and flexibility is a crucial trait to have in the event that our goals are not attained as planned.

Recognizing that each of these skills greatly enhance a child’s ability to perform and live successfully in the world, you are now ready to begin identifying the source(s) of your child’s challenges. This will be –explored in the next issue, .together with suggestions on how to use cognitive restructuring to help your child and to demystify his seemingly inconsistent behavior – which by now you have hopefully come to appreciate, is really beyond his control.

Fine-tuning Executive Function & Emotional Regulation

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In the last issue of *Exceptional Family*, we explored the important roles of executive function and emotional regulation – the “executive control skills” headquartered in the brain’s frontal lobe which enable individuals to interpret signals, integrate information, make good decisions and react appropriately to life experiences, among other abilities.³ More than “book smarts”, these life skills are critical to individuals’ healthy and successful development. Weaknesses in these areas can significantly impair children’s (and adults’) abilities to problem-solve, perceive situations accurately, respond appropriately and deal with their emotions.

The good news is that in many instances, the source(s) of your child’s challenges around executive control skills can not only be identified, they can also be remediated through techniques like cognitive restructuring - a process used in cognitive-behavioral therapy to repair faulty thinking patterns. The following vignettes highlight common scenarios where children typically experience challenges in executive function and emotional regulation and suggest remediation strategies.

Executive Control Skills: Initiation, Organization & Planning

Scenario: *Eleven-year old Eric has to write a two-page essay on a country of his choosing. While the majority of his fellow fifth-graders dove into the task with confidence, Eric has no idea where to begin. He hasn’t a clue where to find any of his research, let alone which country to choose. He conveniently leaves his agenda at school and although he pretends to be working in his room, Eric actually spends the time playing computer games.*

A month later, Eric’s parents are shocked to receive a call from his teacher, who informs them that Eric got a zero on his project; an assignment they never even knew he had.

Challenges: Although Eric’s teacher had provided the class with an outline of her expectations for the project and research tips, Eric was either in a daze during class or too ashamed to admit he hadn’t understood the instructions. On his own, Eric is not able to break down a task. He has poor planning, time management and organizational skills and does not know how to initiate a task. He feels stupid and grows increasingly anxious as the deadline approaches. So he does the only thing he can think of to make the problem go away – he ignores it.

Remediation Strategies:

Eric’s parents and teachers need to collaborate to ensure he receives the additional support he requires both at school and at home around assignments. For example, until Eric has gained the confidence and skills to take responsibility for his work, the teachers could verify that assignments are properly recorded in Eric’s agenda, which his parents would then check each night. Eric’s teachers could also spend a few

³ Adam Cox’s eight “executive control skills” are outlined in his book *No Mind Left Behind: Understanding & Fostering Executive Control: The 8 Essential Brain Skills Every Child Needs to Thrive*.

minutes with Eric privately (either during recess or lunch) to make sure he understands what is expected of him, and provide written instructions for both Eric and his parents to consult.

At home, a helpful strategy might be to teach Eric to break the project down into small, manageable parts. In mutually devising a time-line by which each step should be achieved and plotting each step's due date on a calendar, Eric would have a visual reminder of his responsibilities that he could refer to again and again.

Eric might also benefit from a study skills course, where he would learn time-management skills, brainstorming techniques, how to select a topic for an assignment, how to transfer thoughts onto paper, and how to compose a list of questions to be answered.

Above all, Eric needs support, encouragement and reinforcement. Despite the fact that his behaviour may be frustrating to his parents and teachers, they need to remember that Eric is not intentionally acting lazy or difficult; he too is frustrated and anxious, and his dishonesty was his way of compensating for feelings of inadequacy and embarrassment.

Executive Control Skills: Flexibility & Managing Emotions

Scenario: *Eight-year old Suzie has been looking forward to the next ped day, when her parents promised to take her to the petting zoo. When the day arrives, the trip is cancelled at the last minute because of sudden thunderstorms. Although Suzie's parents try to suggest going to a movie instead, Suzie cannot even hear them – she's too busy throwing a tantrum. "It's just not fair! You promised," she wails.*

Challenges: Suzie is unable to make adaptations when she's disappointed or when there is an unexpected change in plans. Neither logic, nor explanation, nor threats of punishment or even promises of rewards will calm her down.

Remediation Strategies: Although Suzie's parents certainly cannot anticipate every time there will be a change in routine, they can minimize the potential for Suzie to be caught off guard by an unexpected scheduling change by leaving their plans somewhat open-ended rather than announcing them as a definite. In the future, they might say, "We'd like to go to the petting zoo on your next ped day. If it rains, we will go to a movie instead."

One of my clients, when faced with a similar dilemma, railroaded a potential meltdown and its devastating consequences by suggesting that instead of the cancelled activity, the family would order out for dinner and her daughter could pick the restaurant. The mother's quick resolve to introduce a compromise (and distraction) before her daughter spiralled out of control didn't just save the situation – it also taught her daughter that disappointments don't signify the "end of the world;" instead, the cancelled activity represented an opportunity to do another activity that was equally pleasurable. The next time Suzie is caught off-guard, she might consider a fun alternative herself and circumvent a meltdown altogether.

Executive Control Skill: Self-Awareness

Scenario: *Thirteen-year old Jared likes to talk. He can talk for 40 minutes without taking a breath and without ever noticing whether his listeners are interested in what he has to say or are bored to tears.*

Challenges: Jared is not aware of his behaviour and its effect on others. He is incapable of putting himself in his listener's shoes and is "socially blind" to nonverbal messages - a critical part of good social skills.

Remediation Strategies: Jared's parents can help by teaching him good conversation skills. They can role-play a game in which one person speaks for five minutes while the listener communicates whether the topic of conversation is of interest through his or her body language; tilting one's head slightly to the side and nodding would be a non-verbal signal conveying interest, for example. Looking up at the ceiling, tapping one's feet and crossing one's arms would send a clear message of disinterest or frustration. At the end of five minutes, Jared would have to identify the message his parents were trying to convey. Once he learns to interpret these cues, he must also be taught the appropriate next step, which would be to change the subject or give the other person a chance to speak.

In all of these scenarios, the central goal is to identify the problem (to yourself and to your child), then explain what the child is expected to do, model appropriate behaviours, and reinforce even the smallest of successes.

The executive skills described above are essential components of children's emotional, behavioural and social development. These need to be improved before tackling other areas of executive dysfunction, such as weaknesses in Focused Attention and Working Memory, which are particularly essential to successful learning and performance in school. They will be the topic of my next article.

Sustained Attention & Working Memory

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In the previous two articles on Executive Function and Emotional Regulation, we explored six out of eight executive skills that are essential to children's emotional, behavioral, and social development. In this final installment of our three-part series, we will examine the remaining skills of Sustained Attention and Working Memory, which are particularly integral to successful learning and performance in school.

Sustained Attention constitutes the ability to block out distractions and concentrate on a given task long enough to glean important information from it, while filtering and discarding that which is irrelevant. Working memory refers to the brain's ability to retain information long enough for it to be used fairly quickly and then either discarded or stored in long-term memory, to be retrieved when needed.

Sustained Attention

Picture yourself sitting in an office boardroom, listening to your boss drone on and on about last quarter's sales figures. Although you might doodle a little and even catch yourself thinking about the dinner menu or plans for next weekend, you'd likely still get the gist of the meeting; or at the very least, enough to produce a credible response, should you suddenly be asked a direct question.

Now imagine the same meeting, only this time the fluorescent ceiling lights are flickering like mad. Someone has poured itching powder down your shirt. Suddenly, a crow flies into the room and perches on the projector. It just sits there, staring at you. Then to add to the confusion, the excited shouts of a volleyball team wearing Mickey Mouse hats right outside the window are drowning out your boss' words – which were hard enough to follow in the first place since he keeps slipping into his native Greek! How well do you think you'd answer that sudden question now?

Individuals with attention problems can experience these same levels of distraction in everyday life. Their brains can't filter out extraneous stimuli, like background music, a ringing phone, someone tapping a pencil, or a passing car. And those are only the sounds. Visual stimuli, smells, tactile sensations, even inner thoughts can all be competing for a person's attention at the same time. For people with attention difficulties, an intrusive thought can be just as hard to ignore as that crow on the projector. A tree branch moving in the wind can be just as distracting as the volleyball team with funny hats. When the task at hand - the very task a person is supposed to be addressing with sustained attention – is only one of *many* competing stimuli, chances that it will be accomplished with success are extremely minimal.

A distinction should be made, however, between this type of inattention, which is unintentional, versus *purposeful* inattention, as in the case of a child (or spouse) who *chooses* to zone out. For the individual who actually *wants* to understand the lesson, who actually *wants* to grasp a new skill, constant failure is disheartening and frustrating, especially when compounded by condemnation or punishment. Small wonder that people with the Inattentive Type of ADD also frequently suffer from anxiety, which can be ... you guessed it ... another attention inhibitor.

I frequently see this in my clinical practice – individuals with comorbid attention and anxiety problems. Which came first, which one may actually be causing the other or

at the very least making it worse, doesn't really matter. What's important is that both problems are addressed simultaneously; reducing anxiety will help increase attention; increasing ability to focus will help reduce anxiety.

The following tips may be particularly helpful to parents and teachers of children with attention difficulties:

- When listening attention is required, give the child frequent prompts (“Look at me”) to maintain his or her focus. It’s not the eye contact, per se, that is important; it’s saying or doing something to try to break any distraction the child may be experiencing in order to bring their attention back to the task at hand.
- At an age appropriate level, explain to the child the nature of his or her attention problems (i.e., “You seem to have difficulty sticking to a task and not being distracted.”) Assure the child that you will work together to help surmount these problems. A child who is part of the team is less likely to perceive frequent prompts or any other techniques as criticism.
- Don't ask for too much at one time. Think of the child as a novice juggler. The goal is to be able to toss and catch one ball first, then gradually start adding new ones.
- Use visual prompts and cues whenever possible. Augment verbal instructions with pictures, for instance. People seem to multitask with more efficiency when the brain’s visual cortex– the area responsible for processing visual material - is engaged.
- Be creative. You're more likely to capture and hold a child's attention when the subject matter and the cues, whether auditory or visual, are fun and interesting.
- Where the child sits and works, at home and at school, is critical. Sitting next to a window overlooking the playground or in the back corner of a classroom, with every possible distraction right in front of your eyes, or doing homework at the kitchen table while supper is being prepared and three siblings are fussing for Mom's attention, is just not going to work.

On the other hand, doing homework in a quiet room with soft music playing in the background or a ticking clock on the desk can be good practice, increasing the brain's ability to filter distractions – and for some – a stimulus like quiet music in the background may drown out other sounds and even help the child to focus.

- Be realistic. Recognize that sustaining focus for any length of time can be a Herculean task for children with weaknesses in attention. Try to break up the attention demands into achievable chunks. Allow some time for the brain to relax and recharge before continuing. Over time, the size of the chunks and duration of focused attention can be gradually expanded.

Working Memory

Many researchers believe Working Memory skills are not related to IQ, but they all agree that these skills do form a big part of an individual's “executive thinking skills” - the brain's ability to receive, interpret, process and then react to a constant influx of information efficiently and appropriately. In order to do this, the brain needs to

remember facts and previous experiences, select the ones that would be most helpful in a particular situation, and draw conclusions from them that can be applied to a given circumstance.

Working Memory is not the same as rote memory, which is the ability to remember information like facts, names, the alphabet, or dates, usually through repetition. Working Memory necessitates linking chunks of stored memory together to form new complex ideas and generate solutions. For instance, in solving a math word problem, students have to understand the nature of the problem, figure out what's required, remember the rules of arithmetic, deduce which one(s) would apply in that specific circumstance, recognize and extract the relevant numbers from the irrelevant ones in the problem, and process them mathematically.

The following exercises may help strengthen a child's Working Memory skills:

- Ask the child to draw a red circle and a purple square. If you ask the child to repeat the instructions back to you, he or she may be able to do so quickly and easily, because that requires only rote memory skills. But to actually draw the red circle and purple square requires processing the information, not just remembering it. You can adapt this exercise to make it more age appropriate - "draw a red circle with a yellow triangle in it, and a purple triangle with a green circle in it," for example.
- Ask the child to repeat back a series of numbers (like 5, 30, 17, 52, 89). Simply echoing them back, in order, implies good rote memory skills. But asking them to repeat the numbers back in reverse order requires processing them, and is difficult for someone with weak Working Memory skills. Again, the difficulty level of this exercise can be adapted to the age and ability of the child.
- Ask the child to do a series of physical tasks – like jump up and down, touch his or her nose, then turn in a circle. A child with weak Working Memory skills may be able to repeat the sequence back to you, but not complete the actions. This is probably the child who usually fails to complete tasks asked of him at home or school. When asked "what did I tell you to do?", he might be able to repeat the instructions perfectly. He just wasn't able to execute them, because he couldn't process the steps.
- Sometimes the child just needs help finding the necessary strategies – modeling and/or discussing strategies like visualizing the numbers on the wall when recalling them backwards can greatly improve one's performance.
- Attention and Working Memory problems often go hand in hand. Dealing with a child with problems in either or both areas can be very frustrating for everyone, including the child. But much of that frustration can be alleviated when everyone understands that the child isn't being lazy or "behaving badly." And by providing opportunities for practice and repetition of skill-building exercises, making tasks achievable and interesting, and reducing distractions that get in the way of achievement, weaknesses in Attention and Working Memory can be significantly strengthened. This can, in turn, lead to increased academic success and a higher level of self-esteem.

The Amazing Plastic Brain

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In recent years, scientific studies have increasingly emphasized the role of mental stimulation in maintaining and even improving healthy brain function. While everyone can benefit from brain-stimulation, the latest discoveries are particularly relevant to parents seeking to strengthen weaknesses in their children diagnosed with cognitive impairments. Of course as your child's primary caregiver, it is equally important that you maintain healthy brain function, especially in light of the fact that your mind is constantly active in researching, storing and applying important information related to your exceptional son or daughter. This issue of *In Focus* will highlight a number of easy brain-training exercises you can do, or adapt for your children.

But first, a little history: In our grandparents' era, it was believed that the brain was pretty much genetically hardwired at birth. Only something as significant as a stroke or other brain injury could alter our predestined intelligence and the sole possible change was expected to be both negative and irreversible.

By our parents' time, it was concluded that the brain actually took several *years* to develop fully. Those years were thought to represent a narrow window of opportunity in which children's brains could be stimulated and their intelligence potential drawn out.

Then in our generation, an amazing thing happened. Stories from the neuroscientific world began to emerge of adult brain injury victims who had relearned to speak or walk or write, even though the parts of their brains responsible for those functions had been severely damaged – sometimes even completely destroyed.

As the field of neuroscience came into its own and words like "neuroplasticity" were introduced within our collective vocabulary, we began to understand that the brain is capable of changing and improving itself long into adulthood.

Neuroplasticity, or brain plasticity, refers to this ability of the brain to reorganize itself in order to learn something new or to compensate for a brain function that has been lost. And it appears that we can kick-start this ability by doing brain exercises, at any age, and at almost any level of cognitive functioning.

Certainly the early years of life are when the brain is absorbing information with extraordinary efficiency, and learning at an accelerated pace. Recovery is most rapid in these years, and so for children with special needs, early intervention will always remain key. But we now know that the brain's potential to rewire itself, given the right conditions, has no expiration date. It is never too late to try to improve cognitive function.

How neuroplasticity works

Information is processed in the brain via neurons. Every action or thought requires countless neurons to fire in different parts of the brain, and communicate with each other along neural pathways. Every time we learn a new skill, existing or new neurons are stimulated, connect to each other, and form new neural pathways. As Donald Hebb, a famous Canadian neuropsychologist said, "Neurons that fire

together, wire together.” And every time we repeat a skill, those neurons and pathways are strengthened.

As with physical exercise, cognitive cross-training is highly recommended. It’s not enough to exercise just one set of muscles in order to achieve total body fitness. Similarly, when it comes to brain training, doing crosswords or Sudoku alone year after year isn’t enough to maintain your brain’s peak performance level. The development of neurons and new neural pathways is most active when the brain is learning something **new** – whether it’s as complex as a new language or ballroom dancing, or as simple as taking a new route to work. Repetition maintains and strengthens the neural pathways that were formed during the learning process, but it’s not nearly as potent a brain workout. And neurons and pathways that aren’t used eventually erode, in much the same way that muscles atrophy when they aren’t exercised. In both cases, it’s a question of “use it or lose it.”

What you can do

Generally, the rule to remember is that if you can do an activity on “automatic pilot,” it’s not giving your brain a workout. So instead of a daily crossword, try doing a jigsaw puzzle occasionally. Have fun learning a new skill like playing a musical instrument, or take a class in something you’ve always been interested in. Do routine things in new ways – like using your non-dominant hand to open your door with a key, or close your eyes as soon as you get in the door and use the “visual map” in your head to find the closet, hang up your coat, and navigate through your home. Shop at a new grocery store. Do mental calculations in your head instead of using a calculator. Watch a TV show with the volume off, and see if you can figure out what’s happening. Give your memory a workout by trying to remember every city you’ve ever visited, or every person you spoke to yesterday. Also, never miss an opportunity to stimulate your senses. Find something in your tool drawer (or better yet, your “junk” drawer!) by using your sense of touch exclusively. Try to identify the contents of spice jars by smell. Combining senses is even more effective. Smell flowers or enjoy a meal while listening to music, for example. There are countless opportunities in an ordinary day to challenge your brain and keep those neurons firing. This is true for everyone of any age, from people who are cognitively-gifted to individuals with impairments.

Nature AND nurture

Neuroplasticity does not detract from the role that genes play in defining individual potential. We are all influenced by our genes as well as our environment. Factors like nutrition, physical exercise and stress management significantly impact brain fitness too. Fortunately, these are all factors we can control, just as we can choose to incorporate brain exercises into our daily routines. Until some future generation comes up with a magic “brain pill” or high-tech neuron regeneration implants, keeping our brains fit should rank just as high on our priority lists as keeping our bodies fit.

Try it at home:

The following simple brain exercises can be adapted to almost any age and/or cognitive level to strengthen specific areas of cognitive weakness.

Memory:

- Play a “matching pairs” or Concentration-type game, using playing cards or cards with pictures, or playing one of the many online versions
- Draw a route map from memory (from your home to work, for example)
- Think of countries that start with a certain letter
- Memorize a new poem or song
- List the contents of your purse or briefcase, without looking

Visual-Spatial and/or Fine Motor Skills:

- Do jigsaw puzzles
- Follow a paper maze
- Construct something out of origami
- Use a mirror to print your name on a paper so that it’s legible in the reflection

Attention:

- Break routines – use your non-dominant hand or close your eyes when perform a routine task, for example
- Play Bingo, or Simon Says
- Instruct someone on the performance of a task while your back is turned. The task may be as simple as making a peanut butter sandwich, or drawing a geometric pattern. Have the other person follow your instructions to the letter, even if you leave out important details.
- Play “find the difference” or “find what’s missing” games – which can be found in books, newspapers, or online.

Executive Function:

- Draw several circles on a page, write the name of a different colour in each one, then colour them in with a different colour. Then say the colour of the circles (not the written word) aloud, as fast as you can
- Recite the alphabet aloud, alternating with numbers (A-1-B-2-C-3 etc.)
- Plan a vacation or theme party in detail, even if it’s just an imaginary one
- Compile a grocery list for the week, listing each item aisle by aisle, from memory.