

DEVELOPMENTAL EXECUTIVE SKILLS DISORDER (DESD)

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INTRODUCTION

Helping a child who finds it difficult to succeed academically, socially, or behaviourally can be one of the most trying challenges a parent will ever face.

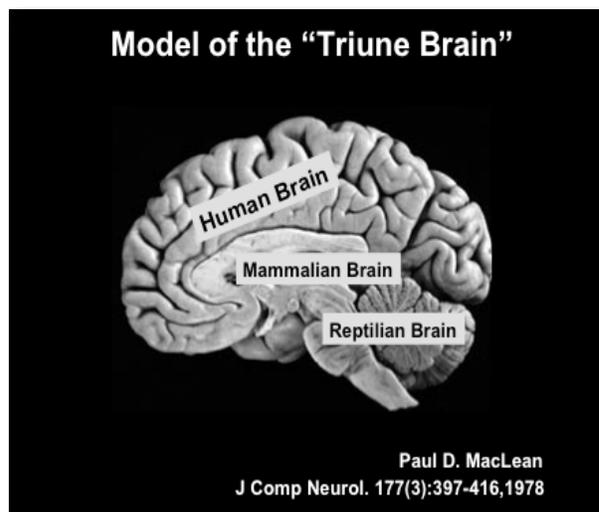
The process requires parents to acknowledge the challenges the child may be facing, search for information and answers, come to new understandings, and implement appropriate interventions to best help the child. This can sometimes be overwhelming and the lack of easy answers frustrating.

When parents first come to my office to discuss behavioural or learning difficulties, it can be overwhelming for them to process all the new information they receive. Addressing academic, social, or behavioural challenges requires a significant learning curve on the part of the parents. Parents should be diligent in taking the time to fully understand the new material, but also patient with themselves as there is a great deal of information to absorb and process.

This paper has been developed to assist parents, teens, educators, referring physicians and other invested parties in understanding the terminology, underlying causes, possible interventions, and treatments of Developmental Executive Skills Disorder.

Introducing: The Triune Brain

During our development as a species, Homo sapiens developed skills for survival and optimal function. Over time this development evolved in response to environmental challenges.



Most recently, our cultural expectations have changed so dramatically and with such unprecedented speed, that it has been difficult for our “nature” to keep pace with our “culture”ⁱ.

The human brain can be described as “tri-une”ⁱⁱ, meaning it consists of three distinct parts acting together as one, each with a different evolutionary history.

The **reptilian** part of the brain, located in the back of the skull, is the oldest part of the brain and developed over a period of 600 million years. It directs many of the automatic processes in the body.

We do not have to direct these processes consciously, and usually are not even aware of them. Functions of the reptilian brain include temperature control, breathing, heart rate, and control of enzymes and hormones.

The **mammalian** part of the brain, positioned midway between the reptilian part in the back and the human part in the front, developed over the past 300-400 million years. It is programmed to direct instinctive processes necessary for survival, like scanning the environment for food and threats, determining what is important/interesting, and avoiding activities or situations that have felt unpleasant or dangerous in the past (i.e. vomiting after eating poisonous mushrooms, threats from wild animals, math homework – the mammalian part of the brain does not distinguish between these and responds with avoidance in a similar manner).

The **human** part of the brain has developed over the past 5-6 million years and is the youngest part of the brain. It is the seat of all our specifically human brain activities such as thinking, understanding, planning, and executing highly complex activities. The prefrontal cortex (PFC) and the orbito-frontal cortex (OFC) are of specific interest for this discussion, as they are involved in the regulatory/executive functions of the human brain.

When we are born, our brain contains 80-100 billion nerve cells that are supported by more than a trillion glia cellsⁱⁱⁱ. As the nervous system matures, the nerve cells branch out and establish thousands of connections with other nerve cells. These get strengthened when used and lost (“culled”) when not employed for their specific function.

In order to be fully operational, nerve cells need to develop a specific insulation over their originally blank cell processes; this insulation allows electrical impulses to travel much faster along the long (neurites) processes of the cell. Only when this maturation occurs does the nerve cells become fully functional.

Consider the following example: the reading centre in the brain of a two year old toddler already contains all the nerve cells necessary for reading, however the average two year old is not yet able to read. This is because the nerve cells in the reading center have not yet matured, connected and become insulated and therefore are not yet able to function.

Metaphorically, it is impossible to learn to fly unless one has grown wings. Similarly, all of one’s neurobiological functioning requires the existence of “wings”: the best flying teacher cannot teach a student how to fly, unless the prerequisite wings have developed – and the best teacher or tutor, using the best methodology, will not be able to teach a child to read until the nervous system is ready. **Teaching and practice can improve our ability to function up to the ceiling determined by the present development of the brain.**

The human brain is a most complex instrument and we are only beginning to understand some of the underlying mechanisms and processes that determine its function. Information contained in the genes of our grandparents, “mixed” in the parents’ genes, is passed down and translated by complex mechanisms into proteins and neurotransmitters that determine a large part of the brain’s function. **The brain is highly adaptable and its final function results from the interconnected development of these neurobiological determinants and the environment in which we live and function.**

THE ROLE OF EXECUTIVE FUNCTIONS IN CHILD DEVELOPMENT

When paediatricians describe a child's development, we historically^{iv} tend to describe four domains:

1. **Gross Motor** (sitting, running, riding a bicycle, catching and throwing a ball)
2. **Fine Motor** (using scissors, crayons, hand-writing, arts and crafts)
3. **Speech** (first words with meaning, two to three word sentences, speech-fluency and clarity)
4. **Social Development** (smiling, reciprocity, pacing and leading, play with peers, understanding social language, theory of mind – understanding others).

We have recently begun to increasingly appreciate the importance of a **fifth domain of human development** that has been described by educators^v, psychologists^{vi,vii,viii} and more recently by medical authors^{ix,x} as: the domain of

5. **EXECUTIVE (OR SELF-REGULATORY) FUNCTIONS**, executive functions are primarily located in the frontal lobe of the brain and depend on intricate connections to many other specific parts of the brain that continue to be ever more clearly defined by ongoing research with functional neuro-imaging studies.

These neuro-anatomical structures mature late, relative to other parts of the brain, and hence executive functions develop later than other functions and continue their growth for a long time, well into the third or fourth decade of life.

Executive functions can be thought of as a highly complex set of automatic pilots that monitor, control, inhibit, prompt, guide, balance, cue, check and correct our perceptions, our emotions, our thinking, our memory and our actions^{xi}.

References to the executive/regulatory functioning parts of the brain being like “the CEO of the brain” or the “conductor of an orchestra” are misleading as they imply a level of awareness and conscious control that is not present. Such comparisons lead us to believe that all that is required in order for a child's executive functioning to improve is ‘trying harder’. This is simply not the case. As a result, the above metaphor (in the highlighted box) is much more appropriate and useful.

Whenever researchers struggle to grasp a new concept - particularly when it is highly complex – it seems inevitable that many different models are proposed, rejected, amalgamated and require fine-tuning.

The idea that difficulties with attention may interfere with learning is not new. **Greek philosophers** and teachers referred to what they called “**aprosexia (απροσεχία)**” when describing distractibility in their students.

Health care professionals have considered difficulties with executive skills within the framework of **Attention Deficit/Hyperactivity Disorder (AD/HD)** since the publication of the DSM III in 1980. Earlier the condition was sometimes considered a “**lack of moral fiber**” (Still 1902), “**Minimal Brain Dysfunction**” (1960), or “**Hyperkinetic Reaction of Childhood**” in the DSM II (1968).

Today the term “AD/HD” is used extensively by many authors and practitioners, both as a label and as a concept. There are considerable differences in the understanding of the relationship between executive skills and AD/HD. Some consider executive skills difficulties to be an integral part of AD/HD^{xii}, while others feel that AD/HD and executive skills difficulties are to a large extent synonymous^{xiii}. This clinician considers the symptoms of “AD/HD” to be merely a part of the overarching presentation of a developmental executive skills disorder.

DEVELOPMENTAL EXECUTIVE SKILLS DISORDER (DESD)

Since 2008 I have used the term **Developmental Executive Skills Disorder (DESD)** to denote a developmental disorder of executive and regulatory skills function. DESD includes difficulties with attention and impulse control as part of a much larger whole. This model goes well beyond a traditional understanding of AD/HD as defined in the Diagnostic and Statistical Manual of the American Psychiatric Association, 4th Edition (1994) (DSM-IV) and various questionnaires originating from that system.

I first introduced the concept of DESD formally to paediatric and psychiatric colleagues in a presentation in Toronto in September 2008. Since then I have worked with patients to refine the concept in my quest to help children with this condition. This view, initially a bit heretic, has been more and more accepted by psychiatrists, educators and paediatricians alike in recent years. I very much like **Russell Barkley’s term “Developmental Disorder of Self-Regulation (DDSR)”** and use it synonymously with **“Developmental Executive Skills Disorder (DESD)”**; both terms refer to the same concept.

Executive skills are very complex and different children will have very different compositions of executive skills strengths and weaknesses. While tests and questionnaires have been developed to capture some of the domains of executive function (e.g. BRIEF, Tower of Saigon, Tower of London), it would be a mistake to think that executive function is one solid entity that can be expressed in a single score. Imagine a puzzle of different functions, with interconnected and interdependent pieces. A weakness in one area does not necessarily mean a weakness in another. Executive function is too complex to be expressed meaningfully by single numbers derived from questionnaires or tests. There is no test or questionnaire – nor is it likely there will ever be one – capable of capturing the full domain comprehensively, although simple tests and questionnaires have been used descriptively to approximate executive function and at least “scratch the surface”.

There are different descriptions of executive skills in the relevant literature. George McCloskey’s pioneering thinking and conceptualizations have very much influenced the field of executive function research and his monograph on the topic is highly recommended if more detailed information is of interest⁶.

IMPORTANT EXECUTIVE SKILLS INCLUDE:

The ability to self-monitor

This refers to our ability to monitor ourselves and our environment in a social and task-oriented context. It is the ability to understand what we should be doing, what others are doing, and what tasks need to be accomplished to optimize the long-term outcome for the group.

The ability to self-regulate

This refers to our ability to regulate and balance the following brain functions:

- **Perceptions**
 - ⇒ Difficulties include an inability to tolerate sensory stimuli such as new clothes, labels, underwear, texture in food - creating picky eating habits. Difficulties regulating perceptions are one of the underlying causes of **Sensory Integration Disorder**.
- **Mood and Anxiety**
 - ⇒ Difficulties may present like an anxiety or mood disturbance but are due to the lack of regulatory function rather than to a primary mood or anxiety disorder.
- **Self-Activation**
 - ⇒ Difficulties may present as problems with sleep or alertness.
- **Thinking**
 - ⇒ Difficulties may lie in organization, planning, sequencing.
- **Acting**
 - ⇒ Difficulties may present with impulsive or disinhibited behavior.

The ability to “connect the dots”

This refers to being able to make meaningful connections between past experiences, present situations and projected outcome and use these to guide decision-making. The child may have the option to watch TV or do homework. If the long-term outcome is not considered, TV will always be the action chosen.

It is worth noting that our ability as a species to “connect the dots” with future outcomes is rather poor; our organizations, politicians, corporations and other decision makers all too often decide in favour of short term gain (such as profits or votes) causing long-term pain (ecological disaster) and putting the long-term survival of both our species and all of the interconnected ecosphere at grave risk.

All of us balance a “two-year old part” and an “adult/grown-up part” in our mind as we go through our days; the two year old wants to get what it wants to get and do what it wants to do at all times and is happy as long as this demand is not challenged. The two-year-old part gives very little consideration to long-term outcome but is caught in the present moment. The difference between the two-year-old and the grown-up part is the development of executive function. This is what parents refer to when they report that their child is so much more mature

than a few years ago, but it is also what they refer to when they report that the teachers consider their child relatively “young” or “immature”.

The ability to pay attention to what others want us to pay attention to

This requires several skills:

- The ability to let go of our internal agenda
- The ability to orient the direction of our focus to what others (teachers, parents, peers) consider important
- The ability to maintain a shared focus of attention
- The ability to initiate and maintain attentive connectedness with the agenda of others.

An ancient Buddhist parable illustrates the challenge some of our children face. A narrow necked vessel filled with treats is tied to a tree. Monkeys are tempted by the treat and reach into the vessel to grasp the meat. When the hunter arrives to catch the monkey, the animal will scream in protest and bare his teeth, but is trapped. The creature simply cannot let go of the treat. **We all have this “Monkey Mind” part of our brain that has trouble letting go.** The ability to let go and calm the “Monkey Mind” is one of the many executive functions we practice to improve throughout our lifetime.

The ability to plan and organize

Being able to think of future requirements and plan to act in the present to meet our obligations in the future is often very difficult for children with executive skills difficulties. Tasks such as keeping our things, our room, our tasks organized can be facilitated with the help of external means (planners, visual organizers, computerized gadgets, assistance from coaches and parents, teachers and peers who are good at organizational skills).

The ability to manage time and be ready

The lack of a “feeling for time” can interfere with the appreciation of how much time will be required for a given task, in order to be ready and finished on time. As well, the lack of such a feeling can lead to resentment when others rush a child who does not understand “what the rush is all about”. Procrastination – based on thinking that one still has time to perform a task, before it is too late – is the result of such time management skills problems.

The ability to determine what is important – saliency determination and prioritizing

The ability to determine the significant elements in social or academic situations allows us to use our energy and focus successfully. By focusing on unimportant details children can become distracted from their purpose and can waste precious time and energy. If we are not able to appreciate what is salient in the textbook we are studying from, it will be impossible to do well on examinations.

Processing Speed

The ability to process information impacts on both the speed of comprehension and thinking as well as on the speed of producing output. This becomes an ever-increasing problem as the demand for speed increases from grade to grade.

Active Working Memory

Active working memory can be compared to the rapid access memory (RAM) that limited older computers that were not able to open a second program once one program was opened (remember the Commodore 64?). Modern computers have RAM that is so large that “one hardly notices that it is there”. Students with limited active working memory will not be able to accommodate all the “mind programs” necessary to perform academic tasks and will have difficulties with sequencing, holding in mind multiple commands or instructions, and thinking of content and language rules at the same time. This often results in difficulties writing papers.

Executive or regulatory functions help us **translate what we know we should be doing into actually doing it**. Children with executive skills difficulties know what they should be doing, but have trouble actually doing it. Metaphorically they could be compared to a computer that is very powerful, has all the required programs (i.e. knowledge of what to do and how to do it), but the system fails because nobody clicks the mouse on the right icon to activate the program at the right moment.

It is fascinating how brittle the connection between “knowing what we should be doing” and “actually doing it” is in humans. Gardner describes the way in which executive functions are needed **‘to use our will (motivation) to apply our skill to reach the hill’**.^{xiv}

Executive Skills

“Click the icon”



ACTIVATE AND USE THE PERTINENT RULES
AT THE RIGHT MOMENT

SHORT ATTENTION SPAN IN PAEDIATRICS: A CLINICAL APPROACH

I begin my clinic each morning with a 90-minute appointment that allows me to devote the necessary time to assess problems within the domain of developmental, behavioral or educational paediatrics.

When I first introduced 90-minute consultation appointments into my practice, I would meet with both the child and parents together in the initial meeting. Over time it became clear that having the child or teenager present sometimes led to misunderstandings that were not in the best interest of the patient: children and teenagers sometimes perceived their parents' story as a complaint about them or misinterpreted their parents' intentions. As a result, I typically meet first with the parents alone, although exceptions can be made with more mature teenagers, particularly if the parents request this based on their knowledge of the child's level of maturity.

During the first meeting a comprehensive history is taken. Questions about the child's development follow; parents are asked for a detailed account of their concerns and questions, as well as their hopes regarding future outcomes. This parent narrative provides the necessary basis for understanding the child's difficulties and developing a course of treatment. The overarching concern must always be **"what is in the child's best interest"** and **"to care for what the child may become"**.^{xv}

If the history suggests that a child has had difficulties with focus for a very long time, it is much less likely to find an underlying medical problem than if the history reveals that a child has only had difficulty focusing for the past few months. In either event, it is common for me to request several medical tests.

These additional investigations may include:

- A formal hearing assessment with an audiologist, (this may include a Central Auditory Processing Assessment for children older than 6 years, if there is a concern that the student might have difficulty processing auditory information, particularly in situations with background noise)
- A formal vision assessment with an optometrist or ophthalmologist
- An electrocardiogram to rule out any electrophysiological cardiac abnormalities
- A formal psycho-educational assessment to rule out any co-morbid academic processing disorders
- Blood-work (only for children whose history is suggestive of a medical concern such as a thyroid disorder, anemia, diabetes, lead poisoning, metabolic disorder, chromosomal disorder).

Questionnaires are a useful tool for me to understand a child's behaviour in different surroundings. Both parents and teachers are asked to fill in questionnaires. Teacher questionnaires and letters describing the student's functioning in the classroom in a narrative fashion complete the picture that the parents provide during their initial consultation.

Several questionnaires are available to formally document distractibility, impulsivity, oppositionality, defiance, social skills difficulties, executive functions, anxiety or mood. The history guides us as to which questionnaires will best further our understanding of the child.

POTENTIAL-PERFORMANCE DISCREPANCY



Many children do not work up to their potential; we call this a potential-performance discrepancy. During the consultation we will explore whether the patient displays such a gap. If a gap is present, we will look for contributing causes, such as executive skills difficulties (including attention), learning processing difficulties, mood or anxiety disorders, or other less common contributors.

We aim to avoid labeling children. Our goal is to understand and describe their functioning rather than to stereotype their presentation. This allows us to prescribe interventions for the children that are systematically based on the description of their strengths and weaknesses.

We appreciate that on a political or administrative level it is sometimes necessary to label children to justify educational funds being allocated to their care.

SHORT ATTENTION SPAN



Short attention span, difficulties with focus, problems with attentive connectedness are symptoms, not diseases; they are what parents and teachers phenotypically observe and describe, but can have many different causes. It is very important to resist the temptation to consider every child who has a hard time concentrating in school to be a child with “AD/HD”.

What looks like attention has several components. They include:

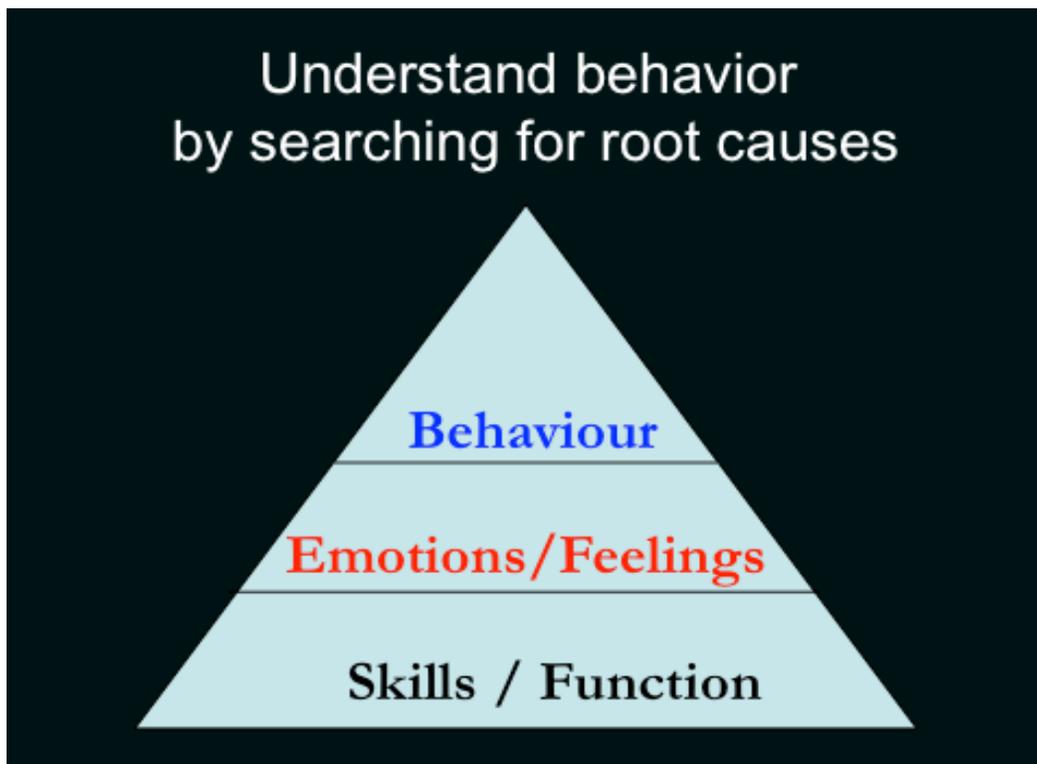
- An attentional component
- An avoidance component (if our mammalian brain wants us to avoid a certain activity, we will not appear like we are concentrating on it)
- A pre-occupation component (a child pre-occupied with sports statistics will not concentrate well on what the teacher is talking about while thinking with great focus about sport statistics)
- A comprehension component (it is not possible to pay attention for any length of time to something one does not understand).

BEHAVIOURAL PROBLEMS ARE NEVER *THE* PROBLEM

When children are referred for behavioural problems, our primary objective is to understand the root causes. Often children are referred because teachers have expressed concerns about their behaviour to the parents, and everybody may be under the impression that the child has a primary behavioural problem. In order to treat a symptom successfully, we have to understand the causes.

Otherwise we stay on the surface and treat only the symptoms: a child with appendicitis and fever will not be cured by treating the fever with an antipyretic; the root cause, the inflamed appendix, has to be found and treated appropriately. Similarly, behaviour itself is never *the* problem (although it can certainly be a problem), and the causes have to be understood in order for intervention to be successful.

I have often compared the child's presentation to an iceberg, of which only one eighth can be seen sticking out of the water. We must direct our attention to the part that is hidden – and causes the problems on the surface.



THE SCAN-TRIAGE-BLOCK SEQUENCE

The life-sustaining functions of the mammalian brain optimize the individual's survival in the following sequence:

1. **The Radar or Scanning Function** continuously (even while we sleep) scans the environment to detect threats, find food, and notice other items of importance. In humans, not only the external but also the internal landscape is scanned for items of importance/interest.
2. **The Triage Function** constantly determines which of the items perceived by the radar function require attention.
3. **The Avoidance Function** identifies items that are better avoided.
4. **The Blocking or Focus Function** makes us focus on items deemed interesting or important by blocking everything else – the more interesting/important, the stronger the blocking; the less interesting, the poorer the blocking.



This mammalian behaviour can be observed “in action” watching my favorite animals, Pygmy Marmosets, in the South American Pavilion at the Toronto Zoo, as they spend their entire day scanning their environment with eagerly darting little eyes. This keeps them from being eaten by birds of prey in their natural habitat of the Amazon valley.

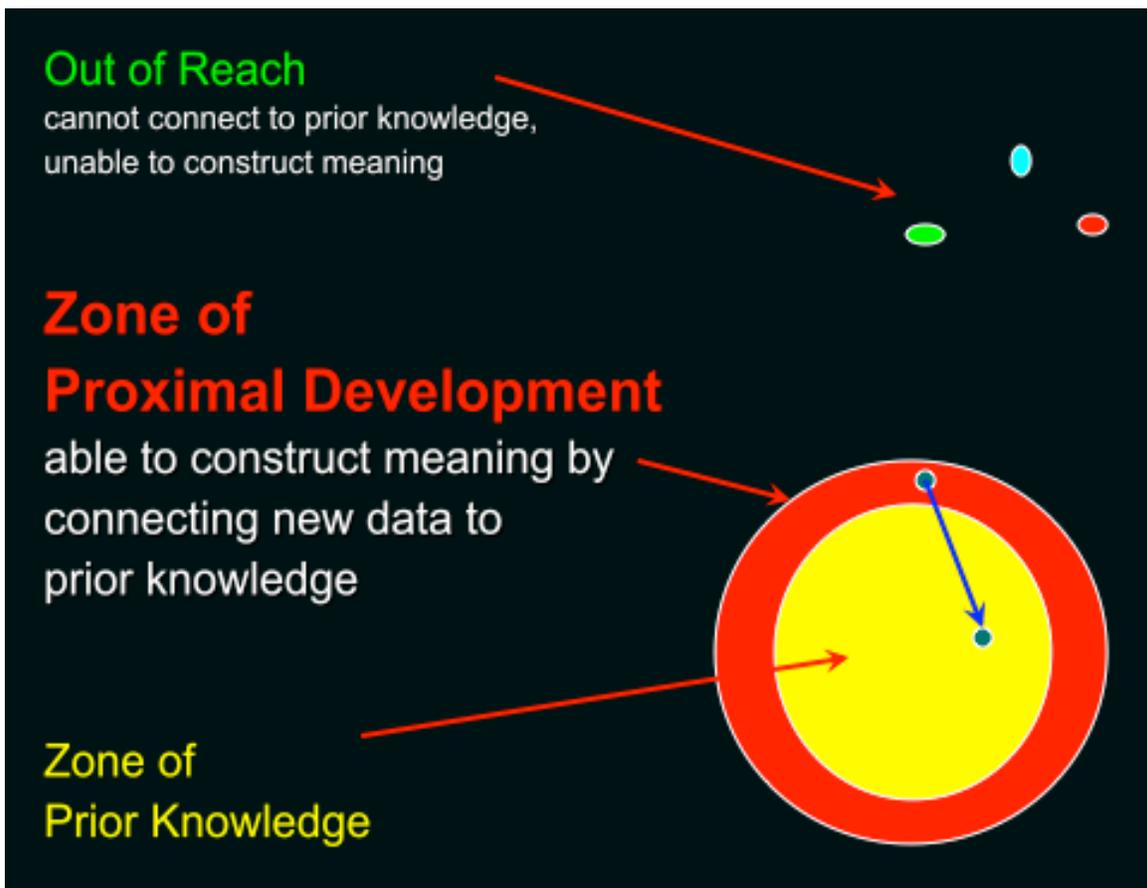


This **Scan-Triage-Block-Sequence** explains why children are often capable of focusing very well on items for which they have an affinity. Their brain considers these items interesting, important, rewarding, or relevant. However, they cannot sustain concentration on activities their triage function considers less important. This can appear as hyper-focus on an area of interest resulting in poor attention to schoolwork or other activities.

VYGOTSKY'S ZONE OF PROXIMAL DEVELOPMENT

Children thrive when teaching is calibrated to their abilities and recognizes their skills and knowledge. Their learning will benefit from instruction that stretches them without challenging them beyond their proficiencies.

This is called teaching in the Zone of Proximal Development (ZPD). The famous and frequently quoted Soviet psychologist Vygotsky^{xvi} (http://en.wikipedia.org/wiki/Lev_Vygotsky) defined the ZPD as the difference between what a learner can do without help and what she can do with the help of a teacher. If a child is taught materials that she already knows, she may feel disinterested or bored. When a student is presented with material so difficult it cannot be connected to knowledge or skills already mastered, she is being taught items outside of reach and will likely disconnect from the learning process.



INTERVENTIONS

After taking the history, considering the scores received on questionnaires, teacher reports, and the results of ancillary tests (hearing, vision, blood-work, ECG, psychoeducational assessments, etc.) we will formulate a preliminary description of the child's symptoms and their causes as we understand them at this time. Our assessment will always allow for the possibility of underlying medical problems.

I will then synthesize the findings and present a comprehensive explanation to the parents. Further understanding is gained from ongoing discussion with parents to fine-tune the working hypothesis that will guide us in translating the description of symptoms and potential causes into a prescription for action. Interventions are virtually always multi-modal – consisting of more than one intervention.

Observing without intervention is a valid choice if the parents feel that the child's learning is not suffering enough to make them want to try medication. Observation alone will not allow us to determine which path is in the child's best interest. Most parents would rather not put their child on medication and only do so with very good reasons, namely that their concern for the child's learning, sense of academic or social competence or safety outweighs their concerns about the child taking medication.

Alternative forms of intervention are available from a variety of sources. Cognitive-Behavioral Therapy has been investigated for Adult-AD/HD^{xvii} but its effectiveness for children is still unclear. Other interventions include nutritional, behavioural, and biofeedback options. Treatments sold with the claim that they will help a child's attention have developed into a multi-billion dollar business. Within the realm of evidence-based medicine, none can be recommended as proven to be effective. With all the many alternative forms of intervention, one so wishes that some of them would really help! These include, but are not limited to acupuncture, acupressure, Chinese herbal remedies, homeopathic medication, Bach Flower remedies, naturopathic intervention, chiropractic intervention, cranio-sacral manipulation, vitamin supplementation, trace mineral supplementation, omega 3, omega 6 or omega 9 fatty acid supplements such as evening primrose oil- thymic oil- fish oil combinations (Effalex Focus®), salmon oil, ginkgo biloba, American ginseng, chamomile, piracetam, pycnogenol, diets (with the exemption of children whose parents are certain that red and orange food dyes and refined sugar increases their child's problems and hence clearly should be avoided), hypnosis and NLP (the effect does not last, unfortunately), computerized bio-feedback, play-attention helmets.

Educational Care Interventions

Educational Care^{xviii} is the primary intervention used to help the child function in school: putting a square peg (the child) into a round hole (the curriculum and rule oriented school system) makes a successful academic career difficult to achieve.

For some thought-provoking ideas, you may want to listen to Sir Ken Robinson's talks on TED Talks:

http://www.ted.com/talks/ken_robinson_says_schools_kill_creativity.html

http://www.ted.com/talks/sir_ken_robinson_bring_on_the_revolution.html

http://www.ted.com/talks/ken_robinson_how_to_escape_education_s_death_valley

http://www.youtube.com/watch?v=zDZFcDGpL4U&feature=player_embedded

“Educational Care Intervention” refers to the process of translating the findings described in the psycho-educational assessment into appropriate interventions that will help the child use his or her strengths to find success. Successes will lead to an improved sense of competence and further improve self-confidence and esteem.

Differentiated instruction in the classroom will be instrumental in meeting our patients needs as are accommodations for examinations and assignments. Some suggested accommodations are:

- Extending time allowed for examinations or assignments
- Permission to write examinations in a quiet room
- Allowing a student to ask for clarification during an examination
- The use of a lap-top computer or a scribe
- Photocopied materials or copies from a peer
- Provision of extra instructional help by the school or a tutor

Providing a learning environment with a maximum of structure and a minimum of distraction with a teacher who “gets the child” and understands strengths, weaknesses and “what makes the child tick” can be most helpful. Parents who “play surrogate frontal lobe” for the child at home can help the child’s function by taking over the function not yet developed in the child’s brain. Having a wonderful teacher can make all the difference in the world because learning has such a strong emotional component.

The steps in this process lead from the psycho-educational assessment (PEA) to the Identification, Placement, and Review Committee (IPRC) Meeting where an Individualized Educational Plan (IEP) is formulated. This document entitles the child to receive the special interventions that are required. Parents and schools must partner in ensuring that the IEP is translated into everyday practice (which is not always easily achieved). It can be helpful to work with an advocate (the Learning Disabilities Association can help find one) to support the parents at the IPRC meeting and optimize the educational care planning. If the educational psychologist who tested the child is able to attend the IPRC meeting, explaining the strengths and weaknesses and the child’s learning style can offer a deeper understanding of the educational needs.

Psycho-pharmacological Intervention and Diagnostic Medication Trials

This is the domain of the physician. After evaluation and analysis of all the data from tests, we return to the dominant issues facing the patient. We consider the following two key questions:

1. Does the child have difficulty focusing on schoolwork?
2. Are the child’s academic performance, learning, or sense of competence suffering because of focusing difficulties?

Only when both questions are answered in the positive, does the patient’s history meet the criteria to proceed with the diagnostic medication trial. Social adjustment and issues of safety may also enter into consideration.

When we consider how to best help a patient, our guiding question must be,
‘What is in the child’s best interest?’

Diagnostic medication trial (DMT)

We begin with the question: ‘Can we find a medication and a dose that significantly improves the child’s ability to concentrate on academic tasks without causing unacceptable side-effects?’ We use the following paradigm to answer this question.

‘LOW, SLOW, GO’

‘**LOW**’ means that we always start the medication on the lowest possible dose, often lower than the officially recommended starting dose. The dose is not determined by age, sex, weight, height, body surface area, body mass index, or severity of symptoms, but only by the individual child’s metabolism for the specific medication.

‘**SLOW**’ means that we increase the dose patiently, usually week by week, to avoid unnecessary side-effects that are sometimes caused by increasing the dose too quickly.

‘**GO**’ means that we increase the dose until we see side-effects that indicate to us that the dose is too high and needs to be decreased. Thus we determine the highest dose of medication that a child can tolerate without disturbing side-effects.

An increase is not necessary if the results are already considered ideal. In general, a higher dose will often improve function better than a lower one – as long as there are no disturbing side-effects.

Critical Considerations about Medication in Children

Psychopharmacological intervention for children with focusing difficulties and other problems can often make a significant difference in outcome for the child. While it is possible that medications improve executive functions other than attention, the primary result of medication intervention is to improve focus. The medication should only be used if it improves the child’s academic or social performance.

Beneficial side-effects of medication may include decreased impulsivity, decreased reactivity, improved *thinking before acting* and *stopping and planning*. Many executive and regulatory functions benefit from improved attentive connectedness.

Medication should only be administered if:

- * The child’s performance is functionally impaired by distractibility
- * The dose does not cause unacceptable side-effects
- * The highest dose tolerated benefits the child’s function significantly

It is imperative that we address here the many media reports about children with ADHD being over-diagnosed and treated with medication. AD/HD is not something a child “is” or “has” and it is not something one can “treat”. It is a *concept* used to describe difficulties with inattention, impulsivity, and high activity. In some children the suffering and functional impairment that stems from their distractibility can be improved – but this should only be done following the guidelines described above.

Psychopharmacological Options

When I started in paediatric practice in the 1980's, the medications available to treat short attention span were Ritalin® and Dexedrine®. Ritalin® came in fast and slow release forms and Dexedrine® was available in Spansules® and immediate release form. (A third medication, Cylert®, is no longer available). We first published our approach to psychopharmacological treatment of short attention span in our office in 1989^{xix}.

Today, we generally use medications with a release mechanism that is technically much improved: these medications are taken at home, in the morning, under the parents' supervision and control, and do not have to be sent to school.

Concerta® (<http://en.wikipedia.org/wiki/Methylphenidate>) is methylphenidate packaged in the Alza® capsule that releases medication over about 12 hours and creates an ascending profile. Twenty-two percent is released in the morning and the remaining 78% over the remainder of the day. The capsules have to be swallowed whole and cannot be opened up. The medication does not build up in the system and only works on the day it is taken. A generic version, **Teva-Methylphenidate ER-C is not fully bio-equivalent to Concerta and should not be substituted** unless specifically prescribed.

Biphentin® (<http://en.wikipedia.org/wiki/Methylphenidate>) is methylphenidate that releases about 40% in the morning and 60% over the course of the day. It usually acts for about 8 hours. The medication does not build up in the system and only works on the day it is taken.

Adderall® is a mixture of three racemic dextroamphetamine salts in combination (<http://en.wikipedia.org/wiki/Adderall>), similar to Dexedrine, but with fewer side-effects; the capsules can be opened up and contain 50% immediate action and 50% delayed action pellets. These can be sprinkled on apple-sauce or a similar semi-solid on a spoon, but it should not be given in fluid or dissolved. It acts for about 10 hours. The medication does not build up in the system and only works on the day it is taken.

Vyvanse® (<http://en.wikipedia.org/wiki/Lisdexamfetamine>) is lisdexamfetamine mesolate and the capsules can be opened, allowing the powder to be sprinkled on a semi-solid or dissolved in liquid and taken in solution. It acts for about 13-14 hours. The medication does not build up in the system and only works on the day it is taken.

Strattera® (<http://en.wikipedia.org/wiki/Atomoxetine>) is atomoxetine and is different from the above medications. It acts on noradrenergic transmission rather than on dopaminergic neurons as the above medications. It is prescribed by weight, builds up in the body and provides coverage for 24 hours.

Intuniv® (www.intuniv.com) became available in Canada in November 2013; this medication is originally a blood pressure medication and can be used either alone as monotherapy or together with other medication to enhance their effect. Side effects include tiredness, and the medication is therefore often prescribed to be taken in the evening. We usually start with 1 mg and increase up to 4 mg, using body weight as orientation (increasing the dose to about 1 mg/10 kg body weight).

Historical Notes

The above medications are sometimes referred to as **stimulants or psychostimulants**. This is a term that derives from the days of animal experiments with rats in the early part of the 20th century when Bazedrine was shown to stimulate the rats' food searching behavior in a maze. This terminology is not particularly appropriate for today's purposes – the medication “stimulates” inhibitory frontal lobe function and inhibits behavior.

In the 1930's children presented to their physicians (after viral illnesses that caused damage to the frontal lobe) with symptoms of irritability and impulsivity, polykinesis (“hyperactivity”), and poor attention. To understand what was going on, they were investigated with pneumo-encephalography - a procedure during which air was injected into the space around the brain to allow a radiograph image to be taken that showed the outlines of the brain (a long time before CT scans or MRIs became available). The technique caused terrible headaches for the patients and in an attempt to treat these headaches Bradley treated them with Bazedrine and reported in 1937 that he had found significant improvement in their behavior^{xx} - while the medication did not help the headaches.

Precautions and Side-Effects

I always recommend an ECG (electrocardiogram) when starting medication to document normal cardiac electrophysiology, although it is not required (according to the American Academy of Pediatrics and the Canadian Pediatric Society).

If there is a family history of sudden cardiac death in a closely related young person (the kind of tragic death of a fit, very healthy person during sports), a cardiac consultation should be arranged before starting medications.

Side-effects of the medications that help us find the highest tolerated dose during the diagnostic medication trial include:

- Decreased appetite and loss of weight – growth and weight must be monitored. Medication will not cause a decrease in adult height unless the weight has been affected severely over an extended period of time.
- Being too quiet, losing one's sparkle or creativity, inappropriate social inhibition, acting “like a zombie”.
- Difficulties falling asleep – sleep is very important and needs to be protected.
- Increased blood pressure – this is extremely rare in children, but blood pressure needs to be monitored.
- Increased anxiety or phobias, increased obsessive-compulsive behavior.
- Changes in mood (very rare).
- Tics: particularly if tics are present before medication is started or if there is a family history of tics, this needs to be carefully watched.
- Headache or stomach aches (medication should best be taken after food and followed by a whole glass of fluid to ascertain that the capsule has made it all the way into the stomach and will not cause problems.
- Tiredness, feeling less energetic (particularly with Intuniv®)

Addiction and drug dependence – either physical or psychological – are **not** side-effects of the above medications, as the serum levels do not increase fast enough to cause a “high” and do not decrease fast enough to cause a craving to re-administer the medication^{xxi}. When medications are referred to as “amphetamine”, this refers to their chemical composition and does not imply drug dependence as in street drug abuse of amphetamines.

When a child starts the diagnostic medication trial, we ask that parents call us right away should there be any side-effects, concerns or questions before their return appointment. We usually see children three weeks into the trial unless there are concerns before then. During the diagnostic medication trial, medication is taken every day, including weekends, to afford the parents the opportunity to observe the child on medication directly.

The Diagnostic Medication Trial is the only way parents can obtain the information they need to make an informed decision about whether or not medication is in their child’s best interest.

Children will often go through several different medication trials to find out what medication gives the best results without causing side-effects.

Once a decision has been made to continue the medication, patients are seen at regular intervals. These appointments are necessary to ensure that we can review the following concerns:

- Review effects and side-effects
- Fine-tune dosage
- Monitor progress in school and at home
- Discuss associated concerns and interventions
- Consider if medication should be taken during weekends or holidays (this varies from child to child).

Most children who find medication helpful for their focus during their school-years will continue taking it all the way to college or university; many will continue as needed when they have to meet high executive function requirements and need to concentrate during long lectures, reading assignments or projects during their university years. While some patients stay on medication as adults, many find a professional niche that allows them to use their strengths and end up with activities that are interesting enough for them to no longer suffer from focusing difficulties when performing these tasks.

Many highly successful adults went through years of school suffering from functional impairment because of distractibility and turned into highly successful CEOs, inventors, artists, or had creative careers^{xxii} ... and we want to do everything we can to help our patients to get there.

Acknowledgements:

The editorial assistance of Jennifer Gotlieb, Veronika Davy, Irene Davy, Ph.D., is most gratefully acknowledged.

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