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Overexcitability and the gifted

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A small amount of definitive research and a great deal of naturalistic observation have led to the belief that intensity, sensitivity and overexcitability are primary characteristics of the highly gifted. These observations are supported by parents and teachers who notice distinct behavioral and constitutional differences between highly gifted children and their peers. The work of Kazimierz Dabrowski, (1902-1980), provides an excel-lent framework with which to understand these characteristics. Dabrowski, a Polish psychiatrist and psychologist, developed the Theory of Positive Disintegration as a response to the prevalent psychological theories of his time. He believed that conflict and inner suffering were necessary for advanced development- for movement towards a hierarchy of values based on altruism- for movement from "what is" to "what ought to be." Dabrowski also observed that not all people move towards an advanced level of development but that innate ability/intelligence combined with overexcitability (OE) were predictive of potential for higher-level development. It is important to emphasize that not all gifted or highly gifted individuals have overexcitabilities. However we do find more people with OEs in the gifted population than in the average population.

OVEREXCITABILITIES

Overexcitabilities are inborn intensities indicating a heightened ability to respond to stimuli. Found to a greater degree in creative and gifted individuals, overexcitabilities are expressed in increased sensitivity, awareness, and intensity, and represent a real difference in the fabric of life and quality of experience. Dabrowski identified five areas of intensity-Psychomotor, Sensual, Intellectual, Imaginational, and Emotional. A person may possess one or more of these. "One who manifests several forms of overexcitability, sees reality in a different, stronger and more multisided manner" (Dabrowski, 1972, p. 7). Experiencing the world in this unique way carries with it great joys and sometimes great frustrations. The joys and positives of being overexcitable need to be celebrated. Any frustrations or negatives can be positively dealt with and used to help facilitate the child's growth. The five OEs are described below. Each description is followed by several examples of strategies, which represent a fraction of the possible solutions to issues that may cause concern for overexcitable individuals or those who work and live with them. These should serve as a springboard for brainstorming additional strategies or interventions that will help improve the lives of overexcitable people.

PSYCHOMOTOR OVEREXCITABILITY

Psychomotor OE is a heightened excitability of the neuromuscular system. This Psychomotor intensity includes a "capacity for being active and energetic" (Piechowski, 1991, p. 287), love of movement for its own sake, surplus of energy demonstrated by rapid speech, zealous enthusiasm, intense physical activity, and a need for action (Dabrowski & Piechowski, 1977; Piechowski, 1979, 1991). When feeling emotionally tense, individuals strong in Psychomotor OE may talk compulsively, act impulsively, misbehave and act out, display nervous habits, show intense drive (tending towards "workaholism"), compulsively organize, or become quite competitive. They derive great joy from their boundless physical and verbal enthusiasm and activity, but others may find them overwhelming. At home and at school, these children seem never to be still. They may talk constantly. Adults and peers want to tell them to sit down and be quiet! The Psychomotor OE child has the potential of being misdiagnosed as Attention Deficit Hyperactivity Disorder (ADHD).

PSYCHOMOTOR STRATEGIES

- Allow time for physical or verbal activity, before, during, and after normal daily and school activities-these individuals love to "do" and need to "do." Build activity and movement into their lives.
- Be sure the physical or verbal activities are acceptable and not distracting to those around them. This may take some work, but it can be a fun project and beneficial to all.
- Provide time for spontaneity and open-ended, freewheeling activities. These tend to favor the needs of a person high in Psychomotor OE.

SENSUAL OVEREXCITABILITY

Sensual OE is expressed as a heightened experience of sensual pleasure or displeasure emanating from sight, smell, touch, taste, and hearing (Dabrowski & Piechowski, 1977; Piechowski, 1979, 1991). Those with Sensual OE have a far more expansive experience from their sensual input than the average person. They have an increased and early appreciation of aesthetic

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pleasures such as music, language, and art, and derive endless delight from tastes, smells, textures, sounds, and sights. But because of this increased sensitivity, they may also feel over stimulated or uncomfortable with sensory input. When emotionally tense, some individuals high in Sensual OE may overeat, go on buying sprees, or seek the physical sensation of being the center of attraction (Dabrowski & Piechowski, 1977; Piechowski, 1979, 1991). Others may withdraw from stimulation. Sensually overexcitable children may find clothing tags, classroom noise, or smells from the cafeteria so distracting that schoolwork becomes secondary. These children may also become so absorbed in their love of a particular piece of art or music that the outside world ceases to exist.

SENSUAL STRATEGIES

- Whenever possible, create an environment which limits offensive stimuli and provides comfort.
- Provide appropriate opportunities for being in the limelight by giving unexpected attention, or facilitating creative and dramatic productions that have an audience. These individuals literally feel the recognition that comes from being in the limelight.
- Provide time to dwell in the delight of the sensual and to create a soothing environment.

INTELLECTUAL OVEREXCITABILITTY

Intellectual OE is demonstrated by a marked need to seek understanding and truth, to gain knowledge, and to analyze and synthesize (Dabrowski & Piechowski, 1977; Piechowski, 1979, 1991). Those high in Intellectual OE have incredibly active minds. They are intensely curious, often avid readers, and usually keen observers. They are able to concentrate, engage in prolonged intellectual effort, and are tenacious in problem solving when they choose. Other characteristics may include relishing elaborate planning and having remarkably detailed visual recall. People with Intellectual OE frequently love theory, thinking about thinking, and moral thinking. This focus on moral thinking often translates into strong concerns about moral and ethical issues-fairness on the playground, lack of respect for children, or being concerned about "adult" issues such as the homeless, AIDS, or war. Intellectually overexcitable people are also quite independent of thought and sometimes appear critical of and impatient with others who cannot sustain their intellectual pace. Or they may be become so excited about an idea that they interrupt at inappropriate times.

INTELLECTUAL STRATEGIES

- Show how to find the answers to questions. This respects and encourages a person's passion to analyze, synthesize, and seek understanding.
- Provide or suggest ways for those interested in moral and ethical issues to act upon their concerns-such as collecting blankets for the homeless or writing to soldiers in Kosovo. This enables them to feel that they can help, in even a small way, to solve community or worldwide problems.
- If individuals seem critical or too outspoken to others, help them to see how their intent may be perceived as cruel or disrespectful. For example saying "that is a stupid idea" may not be well received, even if the idea is truly stupid.

IMAGINATIONAL OVEREXCITABILITY

Imaginational OE reflects a heightened play of the imagination with rich association of images and impressions, frequent use of image and metaphor, facility for invention and fantasy, detailed visualization, and elaborate dreams (Dabrowski & Piechowski, 1977; Piechowski, 1979, 1991). Often children high in Imaginational OE mix truth with fiction, or create their own private worlds with imaginary companions and dramatizations to escape boredom. They find it difficult to stay tuned into a classroom where creativity and imagination are secondary to learning rigid academic curriculum. They may write stories or draw instead of doing seatwork or participating in class discussions, or they may have difficulty completing tasks when some incredible idea sends them off on an imaginative tangent.

IMAGINATIONAL STRATEGIES

- Imaginational people may confuse reality and fiction because their memories and new ideas become blended in their mind. Help individuals to differentiate between their imagination and the real world by having them place a stop sign in their mental videotape, or write down or draw the factual account before they embellish it.
- Help people use their imagination to function in the real world and promote learning and productivity. For example, instead of the conventional school organized notebook, have children create their own organizational system.

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EMOTIONAL OVEREXCITABILITY

Emotional OE is often the first to be noticed by parents. It is reflected in heightened, intense feelings, extremes of complex emotions, identification with others' feelings, and strong affective expression (Piechowski, 1991). Other manifestations include physical responses like stomachaches and blushing or concern with death and depression (Piechowski, 1979). Emotionally overexcitable people have a remarkable capacity for deep relationships; they show strong emotional attachments to people, places, and things (Dabrowski & Piechowski, 1977). They have compassion, empathy, and sensitivity in relation-ships. Those with strong Emotional OE are acutely aware of their own feelings, of how they are growing and changing, and often carry on inner dialogs and practice self-judgment (Piechowski, 1979, 1991). Children high in Emotional OE, are often accused of "overreacting." Their compassion and concern for others, their focus on relationships, and the intensity of their feelings may interfere with everyday tasks like homework or doing the dishes.

EMOTIONAL STRATEGIES

- Accept all feelings, regardless of intensity. For people who are not highly emotional, this seems particularly odd. They feel that those high in Emotional OE are just being melodramatic. But if we accept their emotional intensity and help them work through any problems that might result, we will facilitate healthy growth.
- Teach individuals to anticipate physical and emotional responses and prepare for them. Emotionally intense people often don't know when they are becoming so overwrought that they may lose control or may have physical responses to their emotions. Help them to identify the physical warning signs of their emotional stress such as headache, sweaty palms, and stomachache. By knowing the warning signs and acting on them early, individuals will be better able to cope with emotional situations and not lose control.

GENERAL STRATEGIES

It is often quite difficult and demanding to work and live with overexcitable individuals. Those who are not so, find the behaviors unexplainable, frequently incomprehensible, and often bizarre. Overexcitable people living with other overexcitable people often have more compassion and understanding for each other, but may feel conflicts when their OEs are not to the same degree. Finding strategies for helping children and adults deal with and take advantage of these innate and enduring characteristics may seem difficult. However, resources may be gathered from varied places: Literature regarding counseling, learning styles, special education, and classroom management; parenting books; even popular business texts. Perhaps the best place to begin is with the following general strategies, applicable regardless of which OEs are present.

DISCUSS THE CONCEPT OF OVEREXCITABILITY

Share the descriptions of OEs with the family, class, or counseling group. Ask individuals if they see themselves with some of the characteristics. Point out that this article and many others like it indicates that being overexcitable is OK and it is understood and accepted.

FOCUS ON THE POSITIVES

Jointly discuss the positives of each overexcitability when you first introduce the concept, and continue to point out these merits. Benefits include being energetic, enthusiastic, sensual, aesthetic, curious, loyal, tenacious, moral, metacognitive, integrative, creative, metaphorical, dramatic, poetic, compassion-ate, empathetic, and self-aware.

CHERISH AND CELEBRATE DIVERSITY

One outcome of the pursuit of educational and societal equity has been a diminishing of the celebration of diversity and individual differences. Highly gifted individuals, because of their uniqueness, can fall prey to the public and personal belief that they are not OK. It is vital when discussing OEs that individuals realize that overexcitability is just one more description of who they are, as is being tall, or Asian, or left-handed. Since OEs are inborn traits, they cannot be unlearned! It is therefore exceedingly important that we accept our overexcitable selves, children, and friends. This acceptance provides validation and helps to free people from feelings of "weirdness" and isolation.

Another way to show acceptance is to provide opportunities for people to pursue their passions. This shows respect for their abilities and intensities and allows time for them to "wallow" in what they love, to be validated for who they are. Removing passions as consequences for inappropriate behavior has a negative effect by giving the message that your passions, the essence of who you are, are not valuable or worthy of respect.

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USE AND TEACH CLEAR VERBAL AND NONVERBAL COMMUNICATION SKILLS

All people deserve respect and need to be listened to and responded to with grace. Overexcitable people need this understanding and patience to a greater degree because they are experiencing the world with greater intensity and need to be able to share their intensity and feelings of differentness to thrive. It is vital to learn good communication skills and to teach them to children. Good communication skills are useful on multiple levels, from improving the chances of getting what you want, to nurturing and facilitating growth in others. Regardless of one's motivation for learning these skills, the outcomes will include less stress, greater self-acceptance, greater understanding from and about others, and less daily friction at home, school, work, or in the grocery store.

When learning communication skills be sure to include both verbal-listening, responding, questioning, telephoning, problem solving (Faber and Mazlish, 1980), and nonverbal-rhythm and use of time, interpersonal distance and touch, gestures and postures, facial expressions, tone of voice, and style of dress (Nowicki, 1992). Verbal and nonverbal strategies improve interpersonal communication and provide the skills individuals need to fit in when they wish to, to change the system if necessary, and to treat others with caring and respect.

TEACH STRESS MANAGEMENT FROM TODDLERHOOD ON

Everyone deals with stress on a daily basis. But overexcitable individuals have increased stress reactions because of their increased reception of and reaction to external input. There are many programs and books about stress reduction. The key components are to (1) learn to identify your stress symptoms: headache, backache, pencil tapping, pacing, etc. (2) develop strategies for coping with stress: talk about your feelings, do relaxation exercises, change your diet, exercise, meditate, ask for help, develop organizational and time management skills and (3) develop strategies to prevent stress: make time for fun; develop a cadre of people to help, advise, humor you; practice tolerance of your own and others' imperfections.

CREATE A COMFORTING ENVIRONMENT WHENEVER POSSIBLE

Intense people need to know how to make their environment more comfortable in order to create places for retreat or safety. For example: find places to work or think which are not distracting, work in a quiet or calm environment, listen to music, look at a lovely picture, carry a comforting item, move while working, or wear clothing which does not scratch or cling. Learning to finesse one's environment to meet one's needs takes experimentation and cooperation from others, but the outcome will be a greater sense of well being and improved productivity.

HELP TO RAISE AWARENESS OF ONE'S BEHAVIORS AND THEIR IMPACT ON OTHERS

Paradoxically, overexcitable people are often insensitive and unaware of how their behaviors affect others. They may assume that everyone will just understand why they interrupt to share an important idea, or tune out when creating a short story in their head during dinner. It is vital to teach children and adults to be responsible for their behaviors, to become more aware of how their behaviors affect others, and to understand that their needs are not more important than those of others. The key is to realize that you can show children and adults how they are perceived, you can teach them strategies to fit in, but they must choose to change.

REMEMBER THE JOY

Often when overexcitability is discussed examples and concerns are mostly negative. Remember that being overexcitable also brings with it great joy, astonishment, beauty, compassion, and creativity. Perhaps the most important thing is to acknowledge and relish the uniqueness of an overexcitable child or adult.

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ADVANCED ACHIEVEMENT IN STEM FIELDS: ESSENTIALS FOR SUCCESS

The Problem

With continuing national security, defense, and economic issues facing the nation, a strong education for Americans in science, technology, engineering, and mathematics (STEM) is more crucial than ever. Students in the STEM fields provide the workforce for vital defense and intelligence community jobs, as well as supplying the great innovators in private industry working on new technologies. However, there is abundant evidence that U.S. students are not being prepared to compete for seats in our most prestigious universities that produce future scientists, mathematicians, and engineers. In a global economy where jobs and business development cross borders, this is increasingly a matter of concern.

On the most recent international PISA[1] exam, 24 countries outperformed U.S. students on the mathematics literacy test, students in 13 countries performed better on the reading test, and 16 countries performed better on the science literacy test. At best, U.S. students are average performers.

Achievement by high-ability students has been languishing for years. When the Thomas Fordham Institute looked at data from the National Assessment of Educational Progress (NAEP) exam, it found that in the last decade since the passage of No Child Left Behind, lowest performing students have made learning improvements while the nation's highest performing students have made almost no learning gains.

For high-potential, low-income students the problem is especially troublesome.

- Between 1996 and 2007, The percentage of students eligible for free school lunches who scored at the advanced level on the NAEP mathematics exam in 4th grade increased by 1.2% to 1.5%, while there was a 5.6% increase to a total of 8.8% by their wealthier age-mates who scored at the advanced level in the same time period[2]
- Of advanced math students starting high school, only 75% of low-income students remain in the top quartile by the end of high school, compared to 84% of their more advantaged peers.[3]

Keys to Developing Talent

Developing talent for the nation's future begins in our K-12 schools. Math and science experts have repeatedly called for federal leadership to build both a STEM-proficient workforce and to cultivate future experts and innovators. To accomplish both of these goals, schools must raise the learning floor for all children **and** raise the ceiling for those students capable of achieving at the highest levels. Although these recommendations focus on the STEM fields, with modification they could be adapted for use across every content area as a true, national talent development strategy.

Casting a Wide Net

Currently, a high-ability student's zip code is the determining factor in whether his or her educational needs are being met. Declining resources and competing priorities coupled with the lack of understanding of giftedness widen the chasm of availability, access, and quality of services for our brightest students. Too often, young talent goes unrecognized and undeveloped, which often leads to boredom, underachievement, and increased drop-out rates,[4] which is a loss for both the student and the community. To improve our ability to recognize and develop talent in a systematic way we should:

- Increase access to above grade-level assessments, especially in economically disadvantaged communities[5] to improve student identification for advanced services.
- Include spatial ability, in addition to quantitative and verbal, as a talent area to be identified and cultivated.[5a]

- Encourage pre-service education and professional development for teachers and other personnel in recognizing and developing early signs of talent.[5b]
- Increase the federal government's national role in expanding opportunities for high quality out-of-class opportunities, including extended day and afterschool programs.[6]

Providing Opportunities for Excellence

Developing and supporting advanced knowledge and skills in K-12 requires that students have access to complex, challenging coursework taught by teachers who not only are well-prepared in the content area but also know how to support and inspire students. To improve our ability to meet the specialized needs of high-ability STEM students, we should:

- Increase access to gifted and talented programs and expand access to college coursework and other accelerated learning opportunities for students in high-need schools.[7]
- Create 1,000 new STEM-focused schools to excite and motivate students.[8]
- Recruit 100,000 great teachers who can prepare and inspire students.[9]
- Provide advanced courses that press students to set ambitious goals and achieve at higher levels[10]; pull-out programs in elementary and middle schools can give students who want to go beyond the standard curriculum a way to explore their interests.[11]

Removing Obstacles and Ensuring Supportive Practices

In many states and school districts, there are a host of administrative obstacles that prevent gifted and talented students from moving through school towards graduation at a pace faster than their age peers. Similarly, few districts have developed comprehensive policies that recognize gifted student learning differences and train key personnel and all classroom professionals to recognize, value, and respond to those differences so that gifted students can make learning gains commensurate with their abilities. To create school environments in which academic excellence is respected and can flourish, we should:

- Transform negative attitudes and mindsets of educators and students regarding abilities and intelligence.[12]
- Hold schools accountable for the performance of the top students, rewarding schools and districts that close the achievement gap at the high end of the learning spectrum.[13]
- Encourage state and local policies to adopt consistent and appropriate policies on curriculum acceleration and enrichment.[14]

We are long overdue in developing the systemic supports necessary to ensure a future generation that has the advanced knowledge and skills needed in the 21st century. Our continued inaction threatens the nation's future stability and prosperity.

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[1] Program for International Student Assessment (PISA), an international exam conducted every three years by the Organization for Economic Cooperation and Development for its 34 participating countries.
[2] Plucker, J. A., Burroughs, N., & Song, R. (2010). *Mind the (other) gap: The growing excellence gap in K-12 education*, p. 9. Bloomington: Indiana University, Center for Evaluation & Education Policy.
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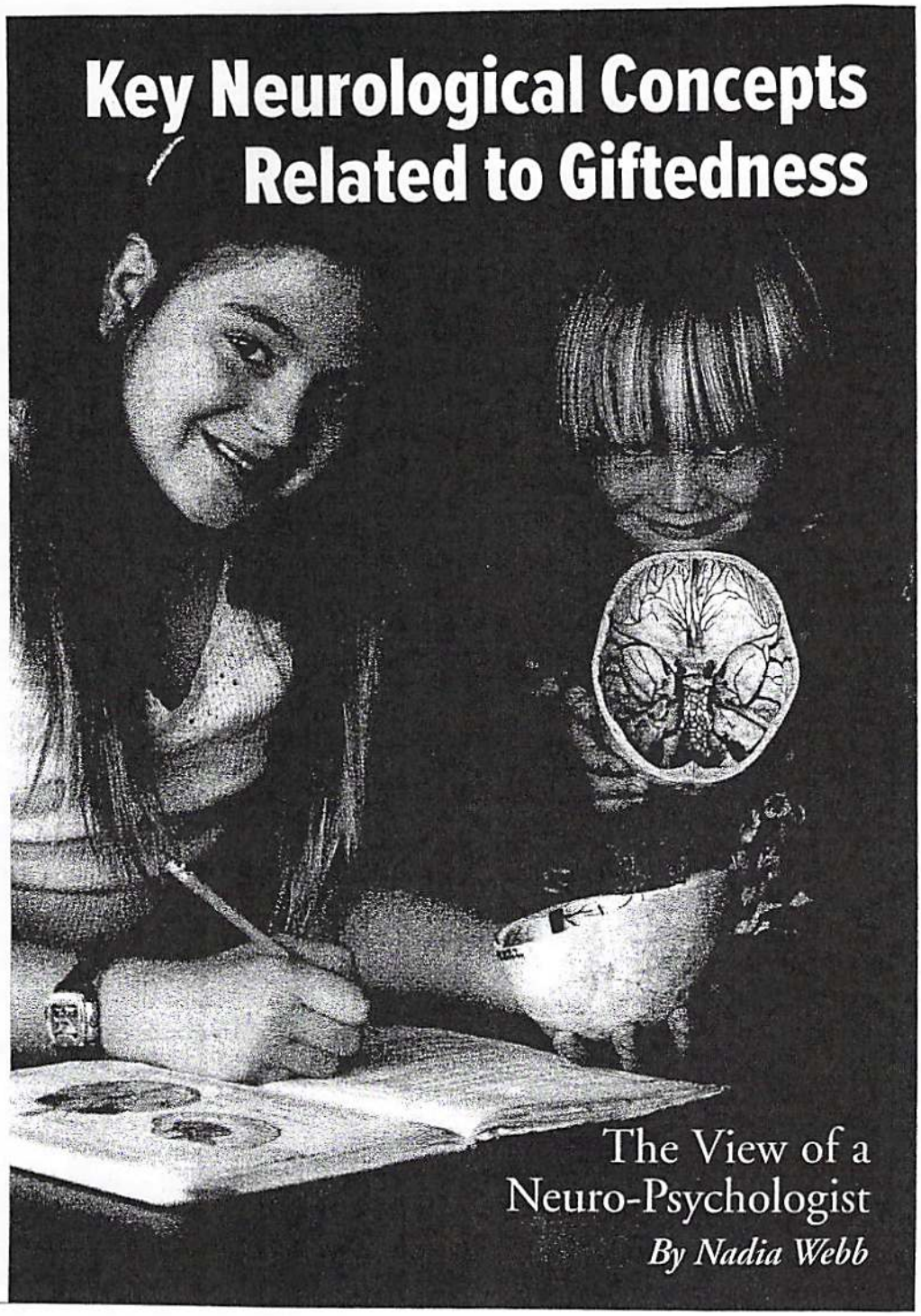
[4] Wyner, et al., p 18.
[5 - 5(b)] NSB report, p. 21.
[6] President's Council of Advisors on Science and Technology (PCAST). (2010). *Prepare and inspire: K-12 education in science, technology, engineering, and math (STEM) for America's future*, p. 92. Washington, DC: Author.
[7] *A blueprint for reform: The reauthorization of the elementary and secondary education act.* (2010), pp. 25, 29. Washington, DC: U.S. Department of Education.
[8] PCAST report, p 101.
[9] PCAST report, p viii.
[10] PCAST report, p 87.
[11] PCAST report, p 94.
[12] NSB report, p 24.
[13] NSB report, p 24.
[14] NSB report, p 17.

Key Neurological Concepts Related to Giftedness



The View of a Neuro-Psychologist

By Nadia Webb

Neuro-anatomical terms now sprinkle the gifted literature like so much intellectual pepper. The reader is left trying to sort out whether these terms are being included to add weight to an argument that it otherwise would not have earned, or if here is neurological literature pertinent to giftedness and gifted education. The intent of this article is to help the reader navigate through the key neurological concepts relevant to giftedness and gifted education. Certain key concepts about how and why the brain is organized the way that it is can help a lay reader spot when an article is well grounded in the neuroscience and when it is just neuro-anatomical frippery. A second goal is to include a quick review of what is known about structural and functional differences in the gifted brain.

A QUICK TOUR OF THE BRAIN

The brain is initially intimidating, but the brain is organized logically and the principles underlying its organization are straightforward. Starting with the brain's shape and surface, it looks complicated, like an aggressively indented walnut with the surface folded in on itself. But the folds are simply a way to take a broad surface area and shorten the distance between any points on that surface. If you took a piece of scrap paper and drew three or four small x's scattered across the page and then crumpled the paper, you could see that the folds are an easy way to move all of those surface neurons as close to one another as possible. If you imagine that the x's on the paper are neurons, you've now mastered one of the key organizing principles of the brain—the shorter the distance, the faster the signal transmission from one neuron to another.

There are similar structural principals that organize the internal arrangement of brain nuclei (dedicated processing modules). The closer a nucleus is to the base of the skull and to the spinal cord, the more vital and evolutionarily ancient it is. Over millennia, the brain has flowered from the stalk of the spinal cord. The structures near the base of the brain are nuclei managing survival tasks without your awareness or oversight (e.g., heart rate, respiration, temperature regulation). Damage to this area is incompatible with sustaining life. Again, you may not recognize the name of the nucleus, but if you know where it is located you have a good idea of the kind of function it performs.

Just above these crucial regions, sit the limbic system responsible for emotion, the pituitary gland that controls the entire endocrine system, and a number of nuclei that regulate motor control and the selection and sequencing of physical actions as well as emotional and cognitive patterns. There is little research on these deep structures and giftedness, although it is my clinical hunch that these structures would be implicated in the "overexcitabilities" observed by so many educators, counselors, and parents of gifted children.

FUNCTIONAL ZONES AND THE INTRACRANIAL COCKTAIL PARTY

The neuroscience literature often reads part science and part gossip column. Neuroscientists speak casually about how the "amygdala talks to hippocampus but not to septum" as though they were saying "Bob talks to Lisa but not to Arnold." The nuclei tend to have reciprocal conversations with other nuclei, sometimes directly and sometimes through intermediaries (a sort of neurological note passing).

Some regions process only a single type of information, such as expressive language, receptive language, motion, color, or pure tones of sound. These areas are referred to as *unimodal* because they are processing one mode of information. Other areas of the brain are integrative or *heteromodal.* Their purpose is to integrate information from the various unimodal areas. Heteromodal areas often classify or interpret sensory information.

CORE ORGANIZING PRINCIPLES

Connectivity. The brain is organized along several basic themes. The first is connectivity. Large numbers of neurons need to be able to talk to one another, rapidly and efficiently. So great masses of them are folded to offer maximal proximity and fast signal transmission. Giftedness is associated with enhanced connectivity between neurons. Connectivity can also be enhanced by enriched environments offering play, social opportunities, and exploration. More stimulation is not necessarily better. There is ample research that hours of television exposure by toddlers have a linear relationship with development of Attention Deficit Disorder in childhood. The American Academy of Pediatrics found the data convincing enough to publish a position paper arguing that children under the age of 2 years shouldn't be watching television. Little children need us to serve as a buffer between them and the processing demands of adult life.

Plasticity. The brain is "plastic," meaning that it's malleable and always changing in response to the environment and to the skills it is asked to acquire. This isn't just a phenomenon of childhood; the brain continues to change in response to the demands you place on it. The way you spend your time and the tasks you learn reshape the connections between neurons and enhance or undermine the likelihood of an individual neuron surviving. Giftedness can, therefore, be similarly enhanced or undone by the environment and by learning activities. The answer to the nature versus nurture question is a typical one; it is "yes." Life is dynamic and the brain is malleable. There is no blank slate, but abilities and gifts aren't etched in stone either.

Redundancy. The brain discards nothing; it has redundant processes. As we continued to evolve, none of the older more primitive cognitive tools were tossed. This is most evident in childhood because children rely on more primitive structures to help them in problem solving or understanding the world. Gifted children may worry about the closet monster and they still want their allowance in pennies even if they enjoy learning about dark matter.

This redundancy remains true both structurally and cognitively throughout the lifespan. For children, things have feelings and thoughts. A stuffed bear may feel scared of the dark if it is kept in the closet; or it may be lonely or resentful when it hasn't gotten its turn to sleep on the pillow. Children, including gifted children, still live in an animistic world. Animism is considered a developmentally appropriate part of early childhood. As adults, we flatter ourselves by thinking that we have moved beyond such a quaint and charming phase, but under stress primitive thinking remerges. Remember the last time your car wouldn't start and you kept turning the key while making encouraging comments to your car? ("You can do it. Come on!") There is even a body of case law dating through the 16th century addressing the relevant punishment for animals or objects that had wounded a human being.

Animism remains part of adult thinking, albeit with an overlay of rational cognition. We remain vulnerable to mass hysteria, fads, advertising, and other forms of social contagion because we are imperfectly rational beings with multiple, redundant problem-solving systems each making sense of a situation from its own evolutionary level. We do not know how gifted children progress through these conceptual stages, but most of the research so far

suggests that high ability and irrationality are intrinsic aspects of being human.

Gifted children appear to be more sophisticated thinkers at their own developmental level. They may have more complex forms or animism at the appropriate developmental age, such as stuffed animal kingdoms with governments, but they don't appear to vault ahead developmentally. This is why gifted children can show such amazingly immature behavior despite their precocious abilities.

The oddities of neuronal organization have their own intelligence; they are rarely coincidental or purposeless. One of the great advantages of having redundant systems is that it allows people to compensate for neurological injuries or disabilities. One of the challenges in working with "twice-exceptional" individuals is helping them use their strengths to compensate for their deficits; and helping them select environments and careers that play to their strengths and minimize the intrusion of their disabilities.

These redundant systems serve as alternate backup versions of skills that can be pressed into service as needed. For example, we have three balance systems (one in the inner ear, one which detects joint positions, and another which relies on visual cues). All the systems are used to integrate and refine data about your movements through space, but you can still stand upright in the dark if the other systems are intact—albeit with a greater chance of falls and toe stubbing. There are similar redundancies for virtually all cognitive tasks.

The multiple systems often allow gifted children to compensate for deficits effectively when the task demands are simple but as the complexity increases, they may falter. Gifted children who pass through elementary school without incident may struggle as school projects simultaneously become more cognitively demanding and less structured during middle and high school years. The brain is adept at compensating invisibly until the task demands become high enough and novel enough that the person is fatigued or overwhelmed and their neurological ability to compensate begins to fail.

The brain capitalizes on redundant systems even in a neurologically healthy individual. You'll also find that learning that happens at multiple levels enhances the ability of the brain to create a pattern or protocol for responding to a situation once it has experienced it, and hopefully selecting the right pattern when the setting feels familiar. Maturation is primarily creating patterns and learning to recognize and interpret them correctly. Pattern recognition is our most unique quality. Pattern recognition is the skill we possess that cannot yet be duplicated by the fastest computers. We can recognize the alphanumeric sequence from the swirled background easily; computers cannot. We see the pattern in the noise.

Pattern recognition is something we do constantly as part of our social and cognitive lives. Is this a "hug goodbye" or a "handshake" person? Was that "I'm fine" credible, or did the body language suggest something besides contentment? Children are notoriously socially graceless and they gain poise through life experience and the regular embarrassment of their parents. They gain it through the gradual accretion of social information and appreciation of social patterns. "Please" and "thank you" are taught not inferred. The gap remains between cognitive ability and wisdom.

WHAT WE KNOW ABOUT THE GIFTED BRAIN

Hebb (1949) thought that intelligence was organized at the level of the neurons and that it had to do with how quickly the systems of neurons could coordinate and adapt to the environment. He was prescient. The primary structural differences that differentiate giftedness include: the speed with which a neuron can signal another neuron; the volume and density of connections between neurons; the efficiency with which the brain performs tasks; and the structural flexibility or plasticity.

Neural speed. Gifted brains are fast. Cognitive processing speed, or mental speed, tends to be fast during problem-solving puzzles. But the speed of transmission between individual neurons is also faster than normal. When researchers looked at IQ and synaptic reflexes (how quickly you can jerk your hand away from a hot stove), they found that gifted individuals have faster reflexes. One of the unique qualities of a reflex is that it is a small circuit from hand to spinal cord to hand (in the case of our stove.) It is three neurons chained together. These neurons are sending signals faster. Researchers like Jensen (1998) have found that the speed of simple movement, such as pressing a button in response to a tone or a light, is faster in highly gifted 13-year-olds than would be expected for their age. He recruited these students from a pool of young teens who attended U.C. Berkeley and found that their simple reaction times were a better match with their college-age intellectual peers than with their same-age peers.

This doesn't mean that gifted children with normal or subnormal motor speed aren't gifted, but it appears that many (most?) gifted children have more advanced motor control.

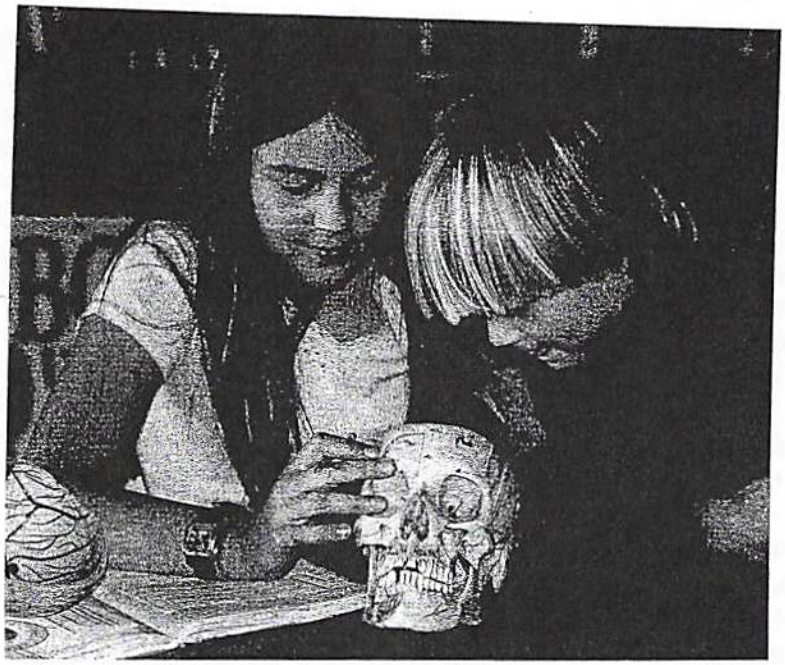
Neural expansiveness. The gifted brain is also neuronally expansive. One of the processes of enhancing the number of connections amongst neurons is called *arborization*, (*arbor* meaning tree). Healthy neurons are lush and bushy looking with ample connections to other neurons. Unhealthy neurons tend to look stunted, like the Charlie Brown Christmas tree. Arborization is fostered by having enriched environments, ample play, challenge, and exploration, as well as protection from neurotoxins. But this process appears to be true across species.

Gifted children appear to have greater arborization, which means greater connectivity and greater potential connectivity between neurons. Enhanced arborization offers one logical explanation for why gifted kids show enhanced cognitive abilities. If neurons are well connected, they are able to recruit the neurons they are connected to assist in performing a task. Given that we have as many neurons in an individual brain as there are people in China, the more neurons that can be recruited appropriately to process information or send a signal, the better our problem-solving ability.

One of the other benefits is enhanced ability to cope with neu-

ronal damage or attrition. Satz (1993), a neuro-psychologist, coined the term *reserve capacity* to describe this phenomenon. Essentially, this is the depth of a person's *neuronal bench* to borrow a sports analogy. If you have a deep bench, you have many players to draw on if your starters are fatigued or injured. If you have a shallow bench, you demand more of your starters and you have few other resources as they begin to falter. Gifted individuals have a deep neuronal bench, which means they are able to hold up well to small strokes, falls, Alzheimer's disease, or other neurological wear and tear. Gifted adults should continue to move apart from their normal age cohort as they age because they are better protected against the neuronal ravages associated with older age and illness. The performance of gifted older adults and adults with a normal IQ can be so distinct on neuropsychological measures that the scores of two groups may not even overlap.

Reserve capacity helps in terms of neuronal recruitment, but it also helps in compensating for neuronal injury. Reserve capacity allows a neuron to reroute the signal around a damaged or dead neuron more readily because there are alternate paths available. The more alternatives, the more likely there will be a reasonably efficient option.



Neural efficiency. Conveniently, the brain relies on one source of fuel—glucose. This makes it easy to track which neurons are working hardest because they will be using the most glucose. We can observe this fuel consumption in real time by using radioactive labeled oxygen or glucose and observing which regions "light up" (e.g., functional MRI, PET and SPECT scans work on this basic principal).

The work of Heier (1992) confirmed two interesting findings about giftedness; first, gifted brains are highly fuel efficient. They are the *Priuses* of the brain world when the tasks are routine or simple. Second, they are able to master novel tasks quickly, and once they have made the task routine they, again, use little fuel.

There was one surprising twist. While their normal metabolic rate of glucose use is quite low, they can show greater surges in glucose use than is typical when a task is novel or challenging. This may be a correlate of the enhanced connectivity; more neurons working means more neurons using fuel. To continue the car analogy, a gifted brain is the *Prius* with the secret heart of a Ferrari. The gifted brain uses little fuel to tootle around to the supermarket but if it has the need, the horsepower is there. It can use massive amounts of fuel and recruit other neurons to perform at an extraordinary level.

Neural flexibility. The plasticity that leads to neural flexibility is a not unique to giftedness, but it is particularly relevant to gifted educators and parents. Much of the debate centers on the nature versus nurture question. Is giftedness something that can be enhanced or undone by lack of exposure to appropriate challenge? Is there a neurological cost to intellectual apathy or the decisions to take on only the assignments that are "easy A's"?

Research on the plasticity of the brain suggests that the brain adapts rapidly to demands that are placed on it and that lengthy, challenging apprenticeships change the brain structurally as well as functionally. Individuals who take up a stringed instrument will show an expansion of the area of the brain devoted to sensory perception of the fingertips on the fingering hand, and the expansion will be measurable within 2 weeks. More neurons have been recruited to make subtle tactile distinctions in those fingers. The brain functions on a "use it or lose it" principle.

CONCLUSION

Intelligence tends to be a trickier concept than it seems. While we will all agree that there is something useful called "smarts," and some of us clearly have more and others, less of it, trying to locate it in a precise brain region or quality of information processing is more challenging. The development of intelligence depends, in part, on the integrity of foundation skills, such as attention, motivation, judgment, sequencing of a task or movement, and neurologically intact perception and expression of knowledge (e.g., no input or output problems). If any of these foundation abilities are disturbed, then the quality of performances by individuals may accurately reflect their development at the time but fail to tell us what they are capable of performing.

What we seem to get, if we are gifted and neurologically intact, is a faster, well-connected, efficient, expansive, malleable brain that is designed to learn and organize information. These structural differences translate into the quality we call intelligence. The general factor of intelligence (Spearman's *g*) can be best thought of as cognitive "stickiness." If you are a snowball that is 15% more sticky, then as you tumble down a snowy hillside you will be picking up 15% more snow along the way. As you tumble and pick up more snow, you will have a larger surface area; that, in turn, will allow you to pick up even more snow, and so forth, and so forth, and so forth. As you come to a halt at the bottom, the cumulative effect of that increased stickiness will be a snowball that dwarfs its peers.

Similarly, as a gifted child rolls along, he or she will accumulate facts, connotations, skills, patterns, associations, conceptual frameworks, and the like until you have a little person with a surprisingly wide array of information. The information and skill sets that you have act as an armature allowing you to gather new information more easily. If you have a conceptual framework, then gathering new information into it allows you to organize and prioritize what you know. If all information is novel and seems of equal weight because of this, it is more difficult to learn. Learning begets learning. Without that exposure, the child cannot gather as much of that idiosyncratic collection of skills and knowledge along the way. Giftedness is capability, and it can be enhanced or undermined by experience at the level of the neuron.

WHAT CAN BE DONE TO SUPPORT GIFTEDNESS?

Certainly enhancing exposure to challenging material is helpful, but this requires helping a child tolerate challenge. This seems straightforward but most gifted children who are shunted out of gifted programs must leave because of social and emotional difficulties, not because they lacked the intellectual wherewithal. Before talking further about practice and mastery, we need to spend time on how to support a person's ability to tolerate and seek out challenge. Without that ability in place, challenge just becomes a source of misery.

Modulation and self-modulation. The cortex or outer *bark* of the brain is, evolutionarily, the most recent. And the most recent section is the frontal cortex that is associated, among other things, with attention, planning, judgment, self-awareness, insight, self-monitoring, and impulse control. If the cortex is immature or injured, the person becomes a bundle of wants and wishes, with little frustration tolerance and little capacity for self-reflection or planning. Three-year-olds throw themselves on the supermarket floor when you won't buy them gum, by 6-years-old this shouldn't be happening unless they are ill, very tired, or very stressed. The frontal cortex is also the last to mature, finishing its development during late adolescence. Despite their eloquence, we don't allow high school students to vote, marry, buy beer, or enter legal contracts for a reason.

Ability to delay gratification turns out to be a better predictor of college performance than SAT scores (2003). Difficulty with frustration tolerance, planning, delaying immediate gratification, and limited self-awareness undermines academic performance, friendships, and relationships with teachers.

Practice, mastery and competence. Winner (1997) coined the phrase, *rage to learn,* to describe the intensity with which gifted children seek their intellectual passions. Often people accuse parents of pushing their child not realizing that it is usually the child who is charging ahead. This rage to learn is worthy of respect, although we often describe it with pejorative language. We don't refer to babies as compulsively practicing walking. It's their developmental task; it's what babies do. They explore broadly and intensely at their own developmental level, and eventually they achieve mastery of walking.

Simonton (1994) devoted most of his research to the question of eminence and mastery in the arts and sciences. His conclusions were that capacity or potential was a distant second to volume. It takes a decade to master a musical instrument. The 10-year-mark appears to be the basic minimum for expertise across disciplines; ten thousand hours of quality practice, beginning at the age that you begin. Rage to learn, in conjunction with practice, makes the tools of a craft transparent. The paintbrush becomes an extension of your own nervous system. Neurologically, this concept is called *automaticity.* A task you have mastered requires little fuel and little effort, allowing you to let your mind wander more freely.

Mastery doesn't develop in a linear fashion; it is marked by plateaus and vertical leaps. For gifted children who are used to things coming easily, having to study or puzzle through a problem is often an unpleasant shock. They often wonder if they were incorrectly identified as gifted, or if they are doing something wrong. Just at the point when they are experiencing challenge, they may stop. Knowing that mastery isn't a linear progression allows them to tolerate being temporarily mediocre. As one artist wrote, "We have to be willing to paint badly in the service of painting well." We build our talents into expertise the same way we build our brains, moment-by-moment and challenge-by-challenge. ■

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