# The Upside of Being Atypical: Twice-Exceptional Gifted with Neurologically Based Achievement Difficulties


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**Abstract** In this chapter, we present a review of shared neurological developmental features of neurologically-based achievement difficulties and highlight important aspects of the executive functions, thereby informing complex developmental procedures. Specific learning difficulties, attention deficit disorder, hyperactivity disorder, and autism spectrum all involve some special mode of information processing and can be subsumed under the term atypical development. All of these phenomena have a neurological basis, which is usually identified in the early stages of kindergarten or primary education. Mild variants are not easy to identify and often the diagnosis is false, or the syndromes are mixed up owing to the overlapping symptoms. All these exceptionalities are independent of an individual's intelligence and motivation. However, early intervention and environment can be crucial in the development of these special brains. Particular care is required when neurological exceptionalities are coupled with high abilities and a strong drive for internal development. Many of the great creators show some atypical brain functioning that is usually associated with some form of dysfunction. A special cognitive structure, persistent and obsessive practising, commitment, or lack of social skills are all characteristics that are often mentioned in connection with people with outstanding talent. In most cases, they stem from a significantly different from usual brain functioning. In the provision of gifted children, these multiple exceptionalities should be considered as possible ways along which their talent can evolve. Particular attention should be paid to executive functions, which are key to achieving high performance, but often come into the spotlight as a major problem in neurologically-based achievement difficulties.

**Keywords** Early intervention · Neurological · Atypical brain structure · Neurologically-based achievement · Executive functioning · Profoundly gifted

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A talent's promise will not always manifest itself to us with a shining golden star on their forehead, a smile on their face and outstanding performance. The following are real-life examples that I have observed over the years as a researcher a for what might be considered achievement based on innate talents (all names are pseudonyms).

## Meet Peter, Anna, Andrew and Sarah

***Peter**: At the age of six, he was diagnosed as mentally disabled. He later told his special needs teacher that he didn't like the person doing the assessment, and so he didn't reveal the correct answers to them. At the age of nine, he was already the winner at a county mathematics competition, and he would go on to regularly finish among the top few in country-level secondary-school competitions.*

***Anna**: She is eleven, and she is unable to achieve at school at all because of her hyperactivity and attention disorder. She has officially been diagnosed as mentally disabled. In intelligence tests, she is only able to correctly solve the easiest and the hardest tasks. But she usually doesn't make it to the difficult ones, which would finally engage her attention, because according to the protocol, once a subject gives 3 or 4 incorrect answers, the relevant level is taken as the level of their abilities. She has been writing fantasy novels since the age of ten.*

***Andrew**: Ever since early childhood, he would not even think of doing anything less than perfectly. He was already an excellent musician at six, but he didn't want to perform as long as he himself didn't find his performance appropriate. However, performing in public was obligatory at the music school, so instead he walked away from playing music. The situation was probably similar in public education. He says he would survive day-to-day life in a sort of half dream-like state.*

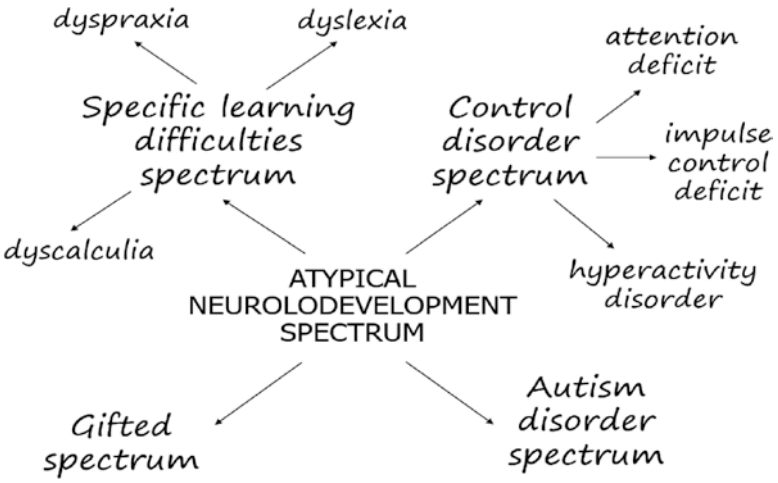


**Fig. 1** Forms of Atypical Neurodevelopment

*He was dyslexic, which made the possibility of being flawlessly perfect at learning even more remote. At ten, he was officially diagnosed as mentally disabled. He continued learning at a private school. In the meantime, he started caving, and finally found a field where only the perfect was acceptable. He has been regularly winning international competitions as a caver.*

***Sarah**: She is thirty, and has a diagnosis of Asperger syndrome, hyperactivity, dyscalculia and mental disability. She is the author of several books, her poems are published regularly, and her paintings can be seen in various exhibitions.*

For the purpose of this chapter, 2e comprise individuals with any kind of physical, medical, psychological, or sociological disadvantage who at the same time also show signs characteristic of giftedness. I further contend that the term "twice-exceptionality" probably stems from a similar concept of medical science, namely, comorbidity, the simultaneous presence of medical conditions. For example, a heart condition might be accompanied by some other, possibly chronic disease, such as hypertension or asthma, which can hinder recovery and exacerbate the situation. The symptoms can also often mask each other.

Pfeiffer (2015) reported that in the vast majority of cases, twice-exceptional giftedness is accompanied by maladaptive symptoms and sometimes two or more separate psychological abnormalities, which probably appear as a result of the dual pressure. Research showed that twice-exceptional children attempt to deal with their difficulties using compensation techniques, but as a result, the problem will remain hidden, and they usually don't get enough support in areas that need development. At the same time, the difficulties and the struggle with their weaknesses mask their giftedness, and, consequently, their areas of giftedness likewise fail to receive reinforcement.

## The Exceptionality of Giftedness: An Historical Depiction within Gifted Education

I posit that giftedness is not a trait, but a special mode of perception, attitude, perspective and reaction. In my research, I have found that gifted individuals are not interested in whether something is attainable, but in how it can be attained. Cognitive processes that differ significantly from the usual, intense and obsessive activity and persistent practice – which are requirements for outstanding achievement – result in a behaviour that is far removed from normality. The literature reveals that a lot of gifted individuals show a special cognitive structure, an unbalanced structure of abilities, hyperactivity, autism, right brain dominance, language difficulties, eating disorders or autoimmune diseases, etc. The exceptionality of the gifted has been looked at in diverse ways in the history of gifted education, as a function of the values of the relevant age and culture:

1. *Giftedness as a mystical force:* At the dawn of civilization, outstanding mental achievements and individuals in possession of special, highly different from normal abilities were regarded as having divine origins, just like other significant natural phenomena. The great figures of ancient times also considered outstanding achievements as supernatural. Many Greek philosophers believed that their wisdom was a gift from muses and demons. Pythagoras is primarily known today as a mathematician, but he was also a prophet and a magician, and his disciples revered him as one guided by divine inspiration. Socrates thought he heard the voice of a daemon, and that his actions were guided by this spirit. Although not considering him a god, Aristotle erected an altar dedicated to Plato. While knowledge was considered a gift from gods in ancient times, the Middle Ages brought diabolical knowledge and witchcraft. Alchemists would practise their science in secret, laced with a fair amount of mysticism. The Faust legend, which has taken deep roots in our culture, has the scientist wanting to know the unknowable consort with the devil (Grinder, 1985)

Mysticism is a part of great creations and creators to this day. Einstein himself remarked that "those individuals to whom we owe the great creative achievements of science were all of them imbued with the truly religious conviction that this universe of ours is something perfect and susceptible to rational striving for knowledge" (*Ideas and Opinions*, 1954, p. 52), and espoused what he came to call "cosmic religion". Newton, who had a difficult birth and later survived a plague, thought of himself as divinely chosen. Bohr believed that he was a chosen one to bring about a Danish scientific renaissance (Briggs, 1990). According to Briggs, a sense of chosenness is in general characteristic of great talents. Geniuses always have a tinge of mysticism in their thinking.

2. *Giftedness as a mental condition:* Renaissance physicians were already of the opinion that thinking was a functioning of the brain and the nervous system and believed that exceptional thinking abilities and behaviour were not inspired by demons or caused by other supernatural forces but were actually a change in neural energies (Alexander & Selesnick, 1966). Any deviation from the usual, either in the direction of insanity and mental illnesses, or in the direction of brilliance and talent, was thought of as a sign of mental instability. Although outstanding mental performance was acknowledged, exceptional mental energies were regarded as a misfortune. Geniuses were considered physically weak, frail and neurotic. Lombroso (1891) used biographical data to prove mental instability in several outstanding creators, including Mozart, Burns and John Stuart Mill, and characterised their genius along these lines. He argued that according to his data, talents are short, pale and slender, a lot of them are left-handed, alcohol- or narcotics abusers, or vagabonds. He strongly believed that the price for talent was melancholy, depression and neurosis.

At around the same time, Sir Francis Galton, while aware of the widespread view that talents are physically frail and neurologically weak etc., raised the point in his book "Hereditary Genius" published in 1869 that while many outstanding

individuals may indeed have poor outward features, this is not a general characteristic of talent. However, in the preface of a later, 1892 edition, in the wake of Lombroso's results, he did acknowledge that "Those who are over eager and extremely active in mind must often possess brains that are more excitable and peculiar than is consistent with soundness."

3. *Psychometric giftedness*. The assessment of and the scientific experimental approach to giftedness began with the work of Sir Francis Galton. Several laboratories were established and started operations, and thanks to Alfred Binet and his colleagues, the first intelligence tests appeared, as well. From then on, talent was thought to be identifiable with the help of intelligence tests. As a follower of Galton, Lewis Terman launched a research with a biologically-based, hereditary viewpoint, whose goal was to squash the earlier negative image of talent. What his longitudinal study showed was that several children with outstanding intelligence failed to live up to expectations in their adulthood, and in fact none of those in the test group ever won a Nobel prize

As a sign of how the way society sees talents changes, in just a few decades, talents went from being physically handicapped, and in terms their neurological and mental state imbalanced geniuses at best, as described by Lombroso, to being outstanding not only in terms of their intelligence but based on the studies of Terman (1925), being strong, healthy, socially mature, and morally above average, as well. However, I highly doubt that the geniuses studied by Lombroso and Terman's group with exceptional intelligence, together with the talents that continue to be identified with tests, belong to the same group of gifted individuals. Thus, tthe psychometric approach is only suitable for the identification of typical giftedness (excluding profound giftedness). The tests identify those exceptional individuals whose talent is revealed already in childhood and who are more or less able to fit into society. However, the individuals who are capable of significantly different-from-average, fundamentally new creations are those who are characterised by a thinking and personality which is significantly, and potentially unacceptably, different from the average. And it is far from certain that these individuals are revealed by their outstanding abilities in childhood.

## *Normality*

Socially speaking, communities tend to equate what is common and lasting with normality. Thus, a bodily or mental characteristic differing from that which is common is often regarded as a deviation from the normal. It is important to note that deviation from normality should not interpreted invariably as a disability. Certain divergence from what is considered normal can actually be interpreted as evidence of creativity or excellence in certain cultures. Examples include a Shaman's ability for trance and hallucination to establish a connection with the spirits, or in the modern age, extreme perception abilities in artists, such as perfect pitch in a musician.

However, even positively perceived exceptionalities can present an obstacle for integration in certain situations, or environments. Having wings could be characterized as a disability if it inhibited an ability to walk on the ground. Such interpretations can be a potential basis for a deviation from the usual, and as such also for a different-from-usual behaviour, and, consequently, for different-from-usual achievements.

According to the earlier concepts of neurological heterogeneity, that is, neurodiversity, atypical neurological development is a normal biological difference in humans, and as such, is important for humanity in terms of survival (Blume, 1998). The concept used to be applied primarily to autistic individuals at the beginning, but its scope has broadened, and now encompasses individuals with attention disorder/hyperactivity, as well as those with specific learning difficulties, among others.

## *Atypical Development*

Usually, specific learning difficulties, ADD, ADHD and autism are considered as being separate disorders. However, there is more and more evidence to suggest that they should be considered parts of the "atypical neurodevelopment spectrum" that appear in different combinations, levels and forms, like developmental delay or a special way of information processing. Recent research confirms that atypical brain structure is the norm rather than the exception among the most gifted (Duncan et al., 2018). Only autism is referred to in the literature as a spectrum, but learning difficulties, attention and hyperactivity disorders can also be considered as spectra because they all present at different levels and in different forms, while they show much overlapping.

Difficulties in motor planning and sequencing, keeping the beat and timing are relevant to ADHD, dyslexia, and autism spectrum disorders alike. Deficiencies in inhibition and in executive functions, which are involved in control and sequencing, are an important component of ADHD, but also other forms of atypical development. A variety of executive function deficiencies have been found in the case of dyslexia (Reiter et al., 2005), ADHD (e.g., Sergeant, et al., 2002) and autism (e.g., Hill, 2004; Hughes et al., 1994). Pauc (2005) reported that the patterns of comorbidity occurred with such a high frequency that there could be an argument for the downgrading of these conditions from individual disorders to symptoms and that the patterns of comorbidity may fit the criteria for a single developmental delay syndrome. In their study, Mrazik and Dombrowski (2010) described the common neurobiological basis of atypical neurodevelopment and the development of talent. On that basis we can consider the talent spectrum as part of the atypical neurodevelopment spectrum.

All of these exceptionalities are neurologically based and are usually identified early on in kindergarten or primary education. However, because of the overlapping, especially the mild versions are not easy to identify, the diagnosis can often be false, and sometimes the syndromes get mixed up. All of these exceptionalities are

independent of the individual's level of intelligence and motivation. Highly-able children with atypical neurodevelopment can compensate for their weaknesses more or less, but these weaknesses hinder their talent development. Early intervention and a developmental environment can be a crucial factor in their appearance.

An atypical development has several disadvantages and can lead to disorders and subsequently to diagnoses, but children with atypical development can also reach outstanding achievements in a suitable environment. What is more, both studies and experience show that atypical development is highly frequent in the gifted population. Individuals with dyslexia, dyspraxia, dyscalculia, attention-, hyperactivity- and autism spectrum disorder are overrepresented in great creators (Gyarmathy, 2009). The exceptionalities regarded as disorders can often not only appear together, but can also be accompanied by giftedness, which is considered an advantage. This suggests that we are dealing with a sort of "neurological package".

There is no fool-proof identification tool, which is a general problem of diagnosis. Identification of atypical development itself is already incidental to begin with, and the mixing of its different forms makes the diagnosis itself atypical. The "label" a child gets depends often only on the field of expertise of the professional doing the assessment. Of course, the main goal is not about deciding whether a child is struggling with learning-, attention-, hyperactivity- and/or autism spectrum disorder, and/or is gifted. The point of the assessments is to find out what environmental factors help the child develop in the direction of giftedness.

The incidence of atypical development is increasing fast owing to environmental effects, and what is atypical today will soon be typical. Schools and gifted education need effective methods to mitigate the problem that arose in the first place because of a lack of understanding of the changes that in turn brought about changes in children's neurological development.

## *Exceptional Cognitive Structures and Giftedness: ADHD, Autism, and Learning Difficulties*

There are long lists to be found on the internet that enumerate famous people with ADHD. Thomas Edison would watch a spider weave its net instead of paying attention to his teacher. He was deemed unteachable. His restless life is evidence itself for the condition.

A number of polymaths have been described as digressive in their biographies. Leonardo da Vinci and Benjamin Franklin, for example, are also often found in lists of famous people with ADHD. Winston Churchill is one of the most frequently mentioned hyperactive individuals. Today's famous people with ADHD can even confirm their exceptionalities themselves, as did Frank Coppola or Barbara Streisand, for instance.

The signs of giftedness capable of outstanding achievements and the symptoms of attention disorder/hyperactivity coincide on a number of points. These include

fast reactions, Dabrowski's overexcitability (Dabrowski, Piechowski, 1977), different-from-usual perception, more active than usual behaviour, a creative desire, curiosity, a tendency for questioning authority, tirelessness, disruptive behaviour in absence of a suitable challenge, as well as a low tolerance for monotony (Laznibatova & Juraskova, 2005; Rosengren, 2005). Numerous data indicate that giftedness and attention disorder/hyperactivity are often difficult to separate (Reis & McCoach, 2002). Some common features between ADHD and giftedness in children have even been found that are not expressly behavioural in nature, but physiological. These include low blood sugar levels (hypoglycemia) and allergies. Both of these have a greater than usual prevalence among both hyperactive and gifted children (Webb et al., 2004). There are lengthy debates in the literature on whether the gifted get diagnosed as hyperactive, or whether hyperactivity can be the basis for a type of giftedness (Mika, 2006).

Professionals are establishing for an increasing number of outstanding talents that they meet the criteria for the autistic spectrum syndrome based on their behaviour. Not long ago, Elon Musk, entrepreneur and business magnate came out regarding his autism. Also, Isaac Newton was among those who showed such symptoms. He would talk little; he could get so absorbed in his work that he would even forget to eat; he had few friends, and he would often behave in an indifferent or quarrelsome manner even with them. In his book, James Ioan (2006) identified autism in Béla Bartók, Eric Satie, Alan Turing and Jonathan Swift, among others, based on biographical data. He reports, for example, how excessively Canadian pianist Glenn Gould would stick to what he was accustomed to. Among other things, he would use the exact same chair until it broke completely. In the late stages of his life, he reduced social relations to the telephone and letters. He did not like being physically touched. Michael Fitzgerald (2005) identified autism in the case of 21 famous writers, philosophers, musicians and painters in his book. He was looking for exceptionalities in social behaviour, language and humour, as well as for obsessive interest and habits. He revealed a connection between creativity and the autistic spectrum.

Individuals with autism see the world from a highly unusual perspective. To them, people's behaviour is baffling and frightening. They find it hard to adapt to unusual situations and have difficulties with emotional attachment. Autism is a pervasive, lifelong disorder of the cerebral functioning that results from genetic factors and adverse effects on the brain, similarly to other neurologically-based performance disorders. Exceptionalities that affect social behaviour, communication, and flexible thinking manifest from early childhood on.

Individuals with autism are characterised by an extreme sensitivity. Persistent interest and a good memory can be a firm basis for outstanding performance, but the very same characteristics are also a disadvantage in integration. Professor Temple Grandin, an animal professional, reported that her autism helps her see things the way animals do. Based on her own experience, Grandin emphasised that people with autism can reach outstanding achievements if they receive early educational development and have supportive teachers who are able to channel the compulsiveness of autistic children into constructive directions (Grandin & Scariano, 2004).

Grandin, like most autistic individuals, is hypersensitive to noises and other sensory stimuli. She is a visual thinker, and every thought appears to her in pictures. Her visual memory helps her. She is able to visualize and even recall over and over again what she saw, sort of like a video recording, and observe details that she would miss before.

In the case of people with autism, we are again faced with the same problem we did with hyperactive individuals, namely that characteristics of the syndrome coincide with features of giftedness: intense interest, perfectionism, sensitivity, the ability to see things differently, non-conformity, the ability of visualization. This is why there are lengthy debates on whether a particular outstanding creator was autistic or whether it was their creativity that made them eccentric. A creative personality is very special, and manifests already in childhood (Piske et al., 2016). Several studies point to the result that creative individuals were often solitary children who were not good at integrating, and who often lived in isolation from their peers (McCurdy, 1960; Melrose, 1989). The peculiarities of creative children can be identified as a disorder, but atypical development can also form a basis for creativity.

Briggs (1990) presented several great creators with learning disorders. Flaubert the writer and Yeats the poet both were dyslexic, while Benoit Mandelbrot, a researcher at IBM and the creator of fractal geometry, did not know his alphabet, and learning even the basic counting operations was a serious problem for him. Recently, Barbara Pavey, Neil Alexander-Passe, and Margaret Meehan edited a book on the relationship between outstanding entrepreneurs and dyslexia.

Some gifted individuals with specific ability disorders may be able to perform well at school, but many of them show severe deficits in certain areas. The identification of gifted individuals with specific learning disorders is hindered by the highly contradictory nature of the picture they present. They are often unable to deal with simple tasks but can solve complex ones. They perform poorly at school but can be exceptionally good at free-time activities. While they often have difficulties with learning at primary school, they can perform well in higher education studies. Tannenbaum and Baldwin (1983) very aptly used the term “paradox learners” for gifted children with learning disorders.

It is a long-established fact that the ratio of dyslexics is higher at the outstanding levels of intelligence (Reis et al., 1995). An important research finding was that of twenty of the world’s leading mathematicians, not one learned to read before going to school, and six of them actually had difficulty learning to read (Bloom 1985). And all the while, according to lists of giftedness characteristics, one of the traits of giftedness is supposed to be an early development of reading skills.

It has also been shown that many inventors had difficulties with reading and writing, even though they possessed excellent technical and spatial abilities (Colangelo et al., 1993). And Sowell (1998) found high-level spatial-visual abilities among children with belated speech development. Many of their family worked in areas requiring such abilities, such as engineering. But we no longer need to build just on assumptions. Carol W. Greider, one of the joint winners of the Nobel Prize for physiology or medicine in 2009, is still struggling with words and spelling today as a diagnosed dyslexic, even though she had plenty of developmental education in

childhood. Her excellent visual memory helped her with learning, and continues to do so. Another laureate with diagnosed dyslexia is Jacques Dubochet, who jointly won the Nobel Prize in chemistry in 2017 with two of his colleagues. Sir John Gurdon was awarded the Nobel Prize for physiology or medicine in 2012. He didn't pay attention at school, and was unable to learn simple facts, he would just do things in his own way. His teacher used the word "disastrous" to describe his work in one of his school reports, and pointed out that he scored only 2 points out of 50 in one of his biology tests. He can be considered the prototype of a gifted person with atypical neurodevelopment.

Talented people often take advantage of their difficulties because they see them as obstacles to be overcome. Demosthenes, one of the great orators of ancient Athens, suffered from a speech impediment. To conquer this, legend has it, he talked with pebbles in his mouth, recited verses while running, and practised speaking on the seashore over the roar of the waves. American jazz musician and poet John Paul Larkin, or Scatman John, who revived "scat" singing and dancing, the most well-known example of which is his hit single "Scatman", suffered from a serious stutter. A deficiency in itself is of course not sufficient for giftedness, since it must be coupled with an internal drive to cope with it. Challenges can strengthen and invigorate them. A weakness of a gifted individual can turn into a strength on the road to coping, but this requires at least some amount of support from the environment.

## The Danger in Deficit Lens: Implications for Researchers and Practitioners

As eluded in Williamson's (1996) *A Return to Love: Reflections on the Principles of "A Course in Miracles",* the source of weakness is not some deficiency, but our avoidance of activities where we face them. From a mere talent development perspective, a lack of practice within a specific will indeed make us "weaker" in that area. The environment has enormous impact in how we regard the perceived deficits of children. And these perceptions and/or labels can become self-fulfilling because children as constantly adopting their and sense of being, individual identity, and attitudes (Varelas et al., 2013; Collins et al., 2022).

As Piske and Collins highlighted in Chap. 2, gifted individuals will not give up so easily. Even when it is not properly nurtured and guided, talents and giftedness of an individual continues to exists, but perhaps not in the direction we would like. A gifted individual for whom the environment creates obstacles can be diverted from social values and develop in an antisocial direction, because their development is different from usual, or because cultural barriers impair their development.

Efficient provision of the gifted is not just important because of the demand for talent, but because it serves society's self-defence. Gifted individuals thwarted in their talent development can become destructive, and twice-exceptional individuals are especially at risk in this respect. When faced with excessively big obstacles, the

tension from the talent force can turn into self-destruction, and in many cases, the individual will turn on not just themselves, but on their environment, as well, and continue down an antisocial path. Persistent obsession can find itself a way, and society may not always be happy about it.

## *Persistent and Obsessive Practice*

In a seminal article on STEM achievement, Roe (1953), apprised that outstanding student achievement in the area of the sciences is attributable more to persistence, concentration ability and commitment, rather than intelligence. Ability is a necessary, but not a sufficient condition. Gifted individuals are characterised by an intense motivation to acquire abilities and knowledge relating to their area of interest at a high level. Almost 40 years later, Gerber and Ginsberg (1990) revealed in a study of successful adults struggling with some form of neurologically-based performance disorder described the kinds of coping strategies they used during their school education in a study: self-control and empowerment, building persistence and grit, an emphasis on accomplishing goals, reframing weaknesses as a personal attribute More recently, Cain et al. (2019) reported that twice-exceptional learners not only show higher level academic performance compared to their non-gifted peers who struggle with disadvantages, but they also show stronger progress with time compared to the general population. In addition, they are able to make much better use of mental hygiene opportunities. As an implication for gifted stakeholders and supporters of gifted individuals, if we succeed in making the environment just a little bit optimal for them, we can expect rapid development. This kind of rapid development and the efficient use of environmental opportunities, can even be a sign of twice-exceptional giftedness.

## *An Imbalanced Ability-Profile*

A generally accepted indicator of giftedness is above-average abilities, which is not necessarily easily observed in earlier developmental years. Gifted individuals gain practice, experience and knowledge through persistent, obsessive activities. However, one of the most widespread tools of gifted identification is still the intelligence test even though there has been a significant amount and wide spread of data for decades showing that an unbalanced intelligence structure is far from rare in special groups of the gifted (e.g., Silverman, 1989; Shaw & Brown, 1991; Gyarmathy, 2000). The imbalance also means that gifted individuals, just like those that underachieve in school, may not perform outstandingly in ability tests either. As a result, identified or perceived deficiencies might stay in place, and hinder later.

success as well.

## *Atypical Development, Giftedness, and the Executive Functions*

Brydges et al. (2012) found a positive correlation between intelligence test results and the executive functions, noting that executive functions play a prominent role as giftedness traits in more recent lists for identifying giftedness. Which cognitive functions exactly belong to executive functions is still under debate, but for sake of shared understanding for this chapter, executive functions are essentially the processes that make it possible for someone to get from A to B without deviating from their goal, and to be able to change, if necessary.

Below,I highlight three main groups of executive functioning:

1. Control functions: inhibition, resisting temptation, keeping up attention, shutting out distracting stimuli.
2. Working memory: keeping information in mind (making it possible to connect one thing to another, or to use information to solve a problem, and, thereby, to sustain the mental process).
3. Cognitive flexibility: switching the perspective of or approach to a problem, a flexible adaptation to novel needs and rules – in other words, mentally picking a direction.

However, the relationship between IQ test results and the executive functions manifests on the performance side, so as the terminology itself shows, these functions do not belong to the direct components of intellectual functioning *per se*. In general, an ability cannot manifest itself in its fullness without execution – that is, without control, working memory or cognitive flexibility. A problem for gifted individuals with atypical development is that some disorder of the executive functions can be identified in all types of atypical development, albeit in different forms. While a deficiency of the working memory seems to be a general characteristic of this group (Beringer & Abbott, 2013; Fugate et al., 2013), a deficiency is primarily found in inhibition functions in the case of the learning-, attention- and hyperactivity disorder spectrums, while the autism spectrum tends to be characterised by cognitive inflexibility.

When it comes to giftedness, however, weaker executive functions can have advantages, too. In their study, Fugate et al. (2013) found not just a weaker working memory, but also significantly greater creativity in gifted learners with traits of ADHD than in those without ADHD characteristics. The greater than average creativity identified in the case of dyslexics (Cockcroft, & Hartgill, 2004) could also be attributable to the upside of the relevant deficiencies.

The more rigid mental control in autistic individuals which makes them more disinclined to deviate from the original goal can also be an advantage, as it will not allow thinking to skirt obstacles, but will make it go on tenaciously, and may find solutions. It is possible that if something unusual happens in brain development - for example, certain functions operate at a higher, than average level - then control and guidance systems such as executive functions may be diverted to ensure a relatively balanced developmental pace. When the two forms of exceptionality occur together,

their combination offers greater opportunities for exceptional creative performance. In other words, the propulsion of a rocket differs from that of a very fast car not just in one area, but in a significant part of the whole system.

## The Complex Development of Atypically Developing Gifted Individuals

The objective of complex development is to strengthen the executive functions in a way that doesn't affect the exceptional neurological functioning of a gifted individual. The task doesn't seem simple, but I attest that we can follow two courses in parallel. One course leads through solving projects and problems offered in the gifted individual's areas of interest, in which case systematic and persistent activity is supported by their interest. Another possibility is offered by natural cultural tools like exercise, arts and strategic games. These are the cultural activities that have served to strengthen executive functions since the beginning of humanity's history.

A major cognitive leap happened in the evolution of Homo sapiens sometime around 100,000 and 40,000 years ago with a neurological mutation which led to a restructuring of the brain, and which laid the foundation for the emergence of executive functions (Coolidge & Wynn, 2009). The transition to farming required an ability for systematic work and thinking, which was sharply different from what used to be needed for the earlier hunter-gatherer lifestyle (Gyarmathy, 2020). Sports, exercise, arts and strategic games used to play an important role in all ancient cultures, but they have mostly turned into areas of special achievements that have faded from everyday life by today. However, they offer an excellent opportunity for the atypically developing gifted to combine creativity with the development of executive functions. A gifted individual is simultaneously both an adventuring hunter-gatherer and a systematically working farmer. In the case of the typically identified gifted, the latter aspect is stronger than the former, while the situation is exactly the opposite in the case of atypical development. Both kinds of gifted individuals, and indeed everyone, need both kinds of neurological functioning, though. For this purpose, complex development could be made widespread.

## Conclusion

Atypical brain development is in itself no guarantee for outstanding achievements but can have the potential to lead to not simply outstanding, but ingenious creations. Giftedness does not arise exclusively from an irregular, atypical brain development, of course, but genius (profoundly gifted) does seem much more to be some special neurological type, rather than simply a higher level of giftedness. The difference is therefore probably qualitative, and not just quantitative. However, individuals

manifesting an atypical brain development are often identified as struggling with a disorder, a problem, or an illness, rather than as gifted, and, as a result, often fail to get the appropriate provision.

The atypically developing gifted differ from both the gifted and the atypically developing populations. Their development is far more dependent on environmental effects than that of the other gifted, but given the appropriate environment, they will develop at a far greater rate than any others. That provision of gifted is the most efficient method in the identification of gifted is particularly true in their case. Complex development, which builds on the gifted side while strengthening neurological maturation and harmony through executive functions, mitigates the disadvantages of a special brain organization while maintaining its advantages.

One of the great challenges of the third millennium is the increasing number of children with outstanding abilities who are incapable of meeting common expectations. Their provision and the channeling of the powers within them necessitates not only a rethinking of education, but a revision of our concept of giftedness and a transformation of gifted education, as well.

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