The DMGT: Changes Within, Beneath, and Beyond
Françoys Gagné*

Abstract: This article begins with a brief survey of the recent update of the Differentiating Model of Giftedness and Talent (DMGT). The DMGT defines talent development as the transformation of outstanding natural abilities (called gifts-G) into outstanding knowledge and skills (called talents-T). Two types of catalysts, intrapersonal (I) and environmental (E), actively moderate the talent development process (D). These causal components of talent development have biological underpinnings; I propose here a way to integrate these biological roots to the DMGT in the form of ‘basements’ that exert their influence upwards to moderate the development of natural abilities, as well as many intrapersonal catalysts like temperament, needs, interests, and volition. This new tri-dimensional approach to the structure of talent development leads to two hitherto unpublished proposals. The first one is a Developmental Model for Natural Abilities (DMNA), in which biological building blocks create a diversity of natural abilities, through a developmental process based on maturation and informal learning, and with the necessary contribution of both sets of I and E catalysts. The second one integrates the new DMNA and the DMGT into an Expanded Model of Talent Development (EMTD) that begins with the biological foundations and ends with high level expertise.

Keywords: DMGT, DMNA, EMTD, giftedness, talent, talent development, catalysts, biological foundations, genetics, personality, environment

This article pursues three goals: (a) briefly describe the main elements in the DMGT’s recent major update into the DMGT 2.0; (b) give room to the biological underpinnings of natural abilities and personal characteristics, because of their significant, if indirect, causal impact on the talent development process; (c) propose a developmental model for natural abilities (DMNA) that includes the causal input of biological underpinnings; (d) integrate the DMNA and DMGT into an Expanded Model of Talent Development (EMTD).

Changes Within: Updating the DMGT

The DMGT was created to take advantage of the fact that scholars and practitioners almost unanimously acknowledged that the concept of ‘giftedness’ represented two distinct realities: early emerging forms of giftedness with strong biological roots on the one hand, as opposed to fully developed adult forms of ‘giftedness.’ Scholars expressed that distinction through pairs of terms like potential/realization, aptitude/achievement, or promise/fulfillment. Since two labels, giftedness and talent, were available to describe outstanding abilities, I chose to attach each label to one of these two concepts. Thus were born the two basic definitions that constitute the core of the DMGT framework. Here they are in their current form.

Giftedness designates the possession and use of untrained and spontaneously expressed outstanding natural abilities or aptitudes (called gifts), in at least one ability domain, to a degree that places an individual at least among the top 10% of age peers.

Talent designates the outstanding mastery of systematically developed competencies (knowledge and skills) in at least one field of human activity to a degree that places an individual at least among the top 10% of ‘learning peers’ (those who have accumulated a similar amount of learning time from either current or past training).

* Université du Québec à Montréal, 8340 rue Odile, Brossard, QC, J4Y 2W4, Canada. Email: fysgagne@gmail.com

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The DMGT will stand – or fall – on the validity of that basic distinction, especially on the acceptance of the giftedness part of this crucial duo of constructs.

**Evolution of the DMGT 1.0**

The DMGT has evolved considerably from its first publication in English (Gagné, 1985) to its status just before the major update undertaken in the mid-2000s; figures 1 and 2 illustrate that evolution. Figure 1, borrowed from the original article, shows clearly the core differentiation between gifts and talents, along with a distinction between psychological (the center circle) and environmental (the surrounding doughnut) catalysts.

![Figure 1. Gagné’s Differentiating Model of Giftedness and Talent (DMGT); 1988 version.](image1)

![Figure 2. Gagné’s Differentiating Model of Giftedness and Talent (DMGT); 2005 version.](image2)
There is a developmental arrow linking gifts with talents, but it is ambiguously associated with the concept of motivation. To say the least, the model remains crude. Figure 2, taken from one of the texts that just preceded the update (Gagné, 2004), confirms the major developments brought to the model over the two decades. Here is a brief survey.

1. Within the G component, the facets were described in much detail, and the four basic domains confirmed.
2. Within the T component, a diversified sample of talent fields and subfields appeared to illustrate the breadth of the talent concept.
3. The intrapersonal (I) and environmental (E) catalysts were clearly distinguished and shown to impact mainly the talent development (D) component.
4. Within the I component, I created a complex substructure of interrelated elements borrowed from existing theories of personality and goal management (Gagné, 2003).
5. Within the E component, I created a substructure of interacting elements.
6. The prevalence of giftedness and talent was operationalized, with a top 10% minimum threshold, and a metric-based (MB) system of five sub-categories within each population (Gagné, 1998).
7. Chance became a significant element, considered almost as a component in itself.
8. I specified a series of complex interactions between the various components, subcomponents, and facets, leading to the discussion of a crucial question: What makes a difference? My personal answer placed the components in the following decreasing order of causal importance: (C), G, I, D, E (Gagné, 2004).

### The Updated DMGT 2.0

If you now compare figure 3 with figure 2, you will see the major transformations brought to the DMGT as part of that detailed update (see Gagné, 2009a). Here is a brief enumeration of the main modifications.

**Figure 3. Gagné's Differentiating Model of Giftedness and Talent (DMGT 2.0; 2008 update).**
1. The DMGT now distinguishes six natural ability domains, four of them belonging to the mental realm (intellectual-GI, creative-GC, social-GS, perceptual-GP), and the other two to the physical realm (muscular-GM, motor control-GR). Each domain constitutes a sub-component with multiple facets.

2. The T component now proposes a comprehensive system of human occupations through nine talent sub-components. Six of them have their origin in John Holland’s work-related classification of personality types: Realistic, Investigative, Artistic, Social, Enterprising, and Conventional (RIASEC) (see Anastasi & Urbina, 1997, chapter 14). The three others ensure an almost complete coverage of existing human occupations, as exemplified in the International Standard Classification of Occupations (ISCO) (see International Labour Organization, 2008), including academic achievements.

3. The D component received the most important ‘facelift.’ Before the update, it contained no internal structuring. The update produced a detailed map with three sub-components – activities (DA), investment (DI), and progress (DP) – each of them with multiple facets. I also proposed a formal definition for the talent development process: the systematic pursuit by talentees, over a significant and continuous period of time, of a structured program of activities leading to a specific excellence goal. The neologism talentee describes anyone participating in a systematic talent development program, whatever the field. Beyond the formal definition, seven essential characteristics (Gagné, 2011) distinguish ‘real’ talent development from inadequate provisions.

4. Having been transformed substantially just a few years before, the I component remained untouched by that recent update (see Gagné, 2010).

5. Figure 2 shows that the E component used to be placed below a central arrow representing the developmental process. In the 2.0 update, the E catalysts have been moved up and behind the I component. This partial overlap signals the crucial filtering role played by most I sub-components with regard to environmental influences; most current views of psychological processes acknowledge that the bulk of environmental stimuli have to pass through the ‘sieve’ of an individual’s needs, interests, or personality traits.

6. Finally, I found a conceptually satisfying way to integrate the role of chance into the DMGT. Chance used to act as a fifth causal factor associated with the environment. But, strictly speaking, chance is not a causal factor. Just like the type of influence (positive vs. negative), chance qualifies the various causal influences (G, I, D, E) in terms of the degree of control a person possesses over any one of them. Because of its redefined role, ‘chance’ should no longer appear in a visual representation of the DMGT. Yet, its popularity among DMGT ‘fans,’ – as well as my personal attachment to it – brought me to create a special room for it in the background of the components it influences.

### Changes Beneath: Biological Underpinnings of the DMGT

The subject of biological underpinnings has its origins in recurring questions from participants to my keynotes, as well as in my own observations and readings. These questions and personal observations targeted the absence in the DMGT of specific references to recognized non-behavioral influences on the growth of natural abilities (e.g., neurophysiological activity, type of muscle fibers) or on the expression of intrapersonal catalysts (e.g., neurotransmitter action, genetic foundations of personality traits). The extraordinary growth of the neurosciences, thanks in large part to neuroimaging techniques, was also showing how brain structures and processes were directly correlated with individual differences in cognitive, social or physical abilities, interests, and other major behavioral functions. As described and illustrated (see figure 3), the DMGT left no specific room to include these distal sources of talent emergence. Science has taken for granted for quite a long time some form of hierarchical organization of explanations,
moving progressively from behavioral phenomena, down to physiology, microbiology, chemistry, then physics. For instance, Plomin, DeFries, Craig, & McGuffin (2003) describe functional genomics as "a bottom-up strategy in which the gene product is identified by its DNA sequence and the function of the gene product is traced through cells and then cell systems and eventually the brain" (p. 14). The expression 'bottom-up' made clear that such biological underpinnings would occupy a basement level under the strictly behavioral DMGT framework. The large number of levels of analysis suggested more than one basement. But how many should there be? Strictly speaking, identifying the proper number of levels was not crucial in the present context. I also imagined that experts in these fields might argue ad infinitum about the 'right' number of such explanatory levels. My examination of the literature brought me to create three underground levels.

Consequently, if we use a 'house' metaphor, we have the DMGT occupying the ground floor (see figure 4), with three distinct basements underneath. I have reserved the third basement for genotypic foundations (e.g. gene identification, mutations, gene expression, epigenetic phenomena, protein production, and so forth). We could roughly summarize that third basement as the chemistry level. The second basement, the biology level, is essentially devoted to microbiological and physiological processes; if one basement could be subdivided, this would probably be the one. This second basement moves us from genotypic to phenotypic phenomena; but their hidden nature, at least to the naked eye, justifies labeling them endophenotypes; they correspond to "physical traits – phenotypes – that are not externally visible but are measurable (. . .) Endophenotypes can reveal the biological bases for a disorder better than behavioral symptoms because they represent a fundamental physical trait that is more closely tied to its source in a gene variant." (Nurnberger & Bierut, 2007, pp. 48–49). Similarly, Gottesman & Todd (2003) explain that in the case of phenomena having multi-gene origins endophenotypes provide "a means for identifying the “downstream” traits or facets of clinical phenotypes,
as well as the “upstream” consequences of genes” (p. 637). Finally, the first basement, the closest to ground level, includes anatomical or morphological characteristics that have been shown to impact abilities or intrapersonal catalysts. Most of these characteristics are observable exophenotypes, either directly (e.g., tallness in basketball, physical template in gymnastics) or indirectly (e.g., brain size through neuroimaging, muscle type through biopsy). Both endophenotypes and morphological traits are part of the complex hierarchical causal chain joining genes to physical abilities, and ultimately to systematically developed skills.

Surveying the Basements

Each basement should include only elements that have been shown to impact one or more of the behavioral phenotypes appearing in the DMGT as causal sources of talent emergence. Consequently, each basement can be subdivided into spaces similar to the components, sub-components, and facets of the ground level disposition of ‘rooms.’ Figure 4 shows that the three basements do not extend underneath the T component. My current belief is that talented behaviors have no direct biological underpinnings. These underpinnings express themselves through the other components and their subdivisions. As support for this statement, Plomin and Price (2003) cite studies showing that the genetic component in academic achievement—a measure of systematically developed abilities—almost totally overlaps the genetic component of IQ scores—a classic measure of cognitive aptitudes. In other words, the genetic roots of academic competence are indirect; they have their origin in the strong relationship between intelligence and academic achievement. This is why the three basements in figure 4 do not extend underneath the T component.²

This is not the place to survey all possible relevant elements that could appear in one ‘room’ or the other at each of the three underground levels; such a survey would probably occupy a book-size publication. Moreover, it is still not clear to what extent and in what ways the different sub-components and facets interact as potential causes of talent emergence. So, the following paragraphs just give an idea of the type of information we would find at each level and for each component or sub-component.

The G Component. Let’s look first at the cognitive domain. Most researchers use IQ scores as their preferred phenotype for general intelligence; not only do they offer a wide spread of individual differences, from mental deficiency all the way up to exceptional giftedness, but they also constitute excellent measures of the ‘g’ factor. The bulk of past research in behavioral genetics does not have direct relevance for our present survey of the three basements. That research focused on familial comparisons: identical and dizigotic twins, biological and adopted siblings, biological and adopted parents. Their results did confirm emphatically the existence of a ‘nature’ component of general cognitive functioning, but they could not specify how these genetic foundations operated to bring about phenotypic IQ differences. At the same time, other studies were adopting a top-down approach to examine neuroanatomical or neurophysiological correlates of cognitive functioning. With the rapid improvement of neuroimaging techniques, this type of study has grown immensely. There is ample proof that a variety of brain structures (B-1) differ between intellectually gifted and average individuals (e.g, brain size, neuronal density, speed of growth of some brain areas during development), and that a large number of physiological processes (B-2) also correlate with IQ differences (e.g., cerebral glucose metabolism or brain nerve conduction velocity). Luders, Narr, Thompson, & Toga (2009) recently summed up their field as follows: “Newer state-of-the-art approaches have further enhanced our ability to localize the presence of correlations between cerebral characteristics and intelligence with high anatomic precision. These in vivo assessments have confirmed mainly positive correlations, suggesting that optimally increased brain regions are associated with better cognitive performance” (2009, p. 156). Overviews of this type of research can be found in Geake (2009), Haier (2011), Jensen (1998), Kalbfleisch (2009), or Plomin (2003).
What about the lowest basement? Have any ‘giftedness genes’ – as some science writers would say – been discovered? Robert Plomin, one of the most prominent researchers in that area, expressed in the early 1990s (Plomin & Neiderhiser, 1991) very optimistic previsions that clear quantitative trait loci (QTLs) would be identified within a decade. Yet, researchers were unable to replicate studies that had pinpointed promising candidate QTLs. Members of that research team recently explained their yet fruitless search as follows:

“Progress towards identifying quantitative trait loci (QTLs) for complex traits like intelligence and common disorders like mental retardation has been slower than expected. An important factor is that most QTL effects may be much smaller than expected—not just 1% effect sizes but perhaps effects as small as .1%. If so, this would mean that studies have been seriously underpowered to detect and to replicate QTL effects” (Plomin, Kennedy, & Craig, 2006, p. 513).

The domain of social abilities (GS) has also been very rich in terms of neurobiological research, mostly at the level of basements 1 and 2. I found an excellent survey of that research in Goleman’s (2006) most recent bestseller Social Intelligence. Goleman basically identifies two main subdivisions among social abilities, namely social awareness (e.g., sensing non-verbal emotional signals, listening with full receptivity, empathic accuracy, social cognition) and social facility (e.g., interpersonal synchrony at the non-verbal level, proper self-presentation, influence and leadership, and caring altruistically about others’ needs). Goleman devoted a significant proportion of his book to a description of the neurobiological bases of social behavior. His numerous examples and extensive bibliography mostly cover basement B-2.

Finally, research on physical abilities, especially the muscular domain (GM), compares easily in quantity and quality with the domain of cognitive abilities. In fact, researchers in that area have been luckier than their ‘cognitive’ colleagues in identifying significant QTLs. There are so many that a database, updated regularly, keeps track of new identified genes and their phenotypic impacts. From just a few genes identified before 1997, the list grew to 48 by the end of 2003. Then, the number exploded; researchers had identified over 160 candidate genes by the end of 2005. The authors of that specialized map (Rankinen et al., 2006) noted: “the physical performance phenotypes for which genetic data are available include cardio-respiratory endurance, elite endurance athlete status, muscle strength, other muscle performance traits, and exercise intolerance of variable degree” (p. 1863). As for the content of the two upper basements, many sources (e.g., Gagné, 2009b; MacArthur & North, 2005) offer a diversity of examples, but especially Jon Entine’s (2000) magnificent book Taboo.

The I Catalysts. Thanks to kinship comparisons similar to those described above in the case of cognitive abilities, the scientific community has known for many decades that personality characteristics, as well as motivational constructs like needs and interests, have significant genetic roots. These roots were highlighted in a most striking way through the famous Minnesota Study of Twins Raised Apart (or MISTRA: see Segal, 2012). Dozens of other studies used the Five Factor Model (FFM), also known as the Big Five Personality Factors, to explore the heritability of personality traits (Rowe, 1997). The FFM also served as phenotypic criterion for numerous neuroanatomical and neurophysiological analyses (Canli, 2009; Goleman, 2006; Munafo, 2009). Just think of our accumulated knowledge base on the specific role of dozens of brain structures (e.g., amygdala, caudate nucleus, hippocampus, mirror neurones) or neurotransmitters (e.g., dopamine, serotonin, oxytocin). Among the Big Five dimensions – Extraversion (E), Agreeableness (A), Conscientiousness (C), Neuroticism (N), and Intellect/Openness (O) – Conscientiousness or will power stands out as a more significant causal agent of talent emergence. Most scholars place it in second rank as a predictor of academic achievement or job performance (von Stumm, Hell, & Chamorro-Premuzic, 2011). No doubt that its biological underpinnings would occupy a central position in the ‘I’ area of each of the three basements. Recently, von Stumm et al. (2011) proposed a third-rank causal source: intellectual curiosity (or ‘the hungry mind’). Using meta-analytic evidence and theoretical considerations, they demonstrated “the importance of a curious mind for scholarly
success in addition and in relation to ability and effort” (p. 574).

**The E Catalysts.** It seems strange at first glance to discuss the biological underpinnings of environmental influences. Yet, the subject is relevant in two distinct ways. First, significant individuals, the EI sub-component, behave in ways that have been progressively sculpted by both genetic and environmental influences. Natural abilities (G), as well as intrapersonal characteristics (I), will influence the way parents, siblings, teachers, coaches, or mentors will interact with talentees. In other words, acting indirectly through phenotypic behaviors, their own biological underpinnings will have a possibility to impact the talent development process. The second form of influence of genetics on environmental phenomena has been considered one of the major discoveries of behavioral genetics; researchers refer to it as “the nature of nurture.” Basically, it means that measures of environmental effects are themselves influenced by genetic influences (see a review in Plomin, 1994). For instance, this influence was demonstrated with the Home Observation for Measurement of the Environment (HOME), the most widely used measure of the home environment relevant to cognitive development. Plomin (2003) described how an adoption study helped discover that nature-nurture interaction. He added: “Dozens of studies using diverse measures of the environment in addition to family environment such as life events and social support – and even television-viewing, accidents, and divorce – find consistent evidence for genetic influence” (pp. 189–190).

**Changes Beyond: Two New Models Called DMNA and EMTD**

The concept of giftedness, as a set of biologically anchored natural abilities or aptitudes, has been the target for some decades of strong attacks by a small group of researchers who defend a strict environmental ideology of talent development. This ideology has a long history; it represented the main scientific paradigm – and politically correct view – for most of the last century. Some scholars (see Tooby & Cosmides, 1992) even referred to it as the Standard Social Science Model (SSSM), and Pinker (2002) devoted one of his bestsellers, humoristically called The Blank Slate, to a comprehensive rebuttal of their main arguments. In spite of the overwhelming size of available evidence, major representatives of that ideology (e.g., Ericsson, Roring, & Nandagopal, 2007; Howe, Sloboda, & Davidson, 1998) have keep their frontal assault at that construct, which they call ‘innate talent’ in order to better attack its purported ‘sudden appearance’ and ‘immutability.’ I chose the term ‘Antinat’ – as opposed to ‘Pronat’ – to identify that minority, and react to their arguments in a recent detailed defense of the giftedness concept (Gagné, 2009b); I also devoted a significant part of that chapter to expose their questionable scientific behavior.

In another context, that same ‘innate’ label made me literally gnash my teeth. It came from its frequent use by well-intentioned fans of the DMGT and other presenters of the theory to describe the DMGT's gifts. They were comparing gifts and talents in terms of innate as opposed to acquired, in my view a clear misunderstanding of the DMGT's giftedness construct. Yet, in every presentation of the theory I insist that gifts are not innate, that they develop during the course of childhood, and sometimes continue to do so during adulthood. I specify what I mean by ‘innate’, but frequently to no avail. Of course, this developmental view of ‘natural’ abilities has to fight its way through a host of common language expressions that maintain the ambiguity, like “she is a born musician,” or “it's God's gift,” or “that is something you don’t learn; either you have it or you don’t!” So, if all these uses of the label ‘innate’ are incorrect, what does ‘innateness’ really mean?

**About Innateness**

When we say that little Mary is a 'born' pianist, we are certainly not implying that she began playing the piano in the nursery, nor that she was able to play a concerto within weeks of beginning her piano lessons. Describing her talent as innate only makes sense metaphorically. It will convey the idea that Mary progressed rapidly and seemingly
effortlessly through her talent development program, at a much more rapid pace than that of her learning peers. The same applies to any natural ability. Intellectually precocious children do not suddenly manifest an exceptional vocabulary or logical reasoning processes; they develop these cognitive abilities by going through the same developmental stages as any other child. The difference resides in the ease and speed with which they advance through these successive stages. The term ‘precocious’ says it all: they reach a given level of knowledge and reasoning before the vast majority of learning peers. And the higher their intellectual giftedness will be, the faster – thus earlier – these successive stages will be mastered.

Researchers in behavioral genetics have given the term ‘innate’ a very specific definition. At the behavioral level, it implies “hard-wired, fixed action patterns of a species that are impervious to experience. Genetic influence on abilities and other complex traits does not denote the hard-wired deterministic effect of a single gene but rather probabilistic propensities of many genes in multiple-gene systems” (Plomin, 1998, p. 421). When we use that term to qualify the DMGT's natural abilities, we convey two false images about them: (a) that the observed individual differences are immutable, and (b) that they are present at birth or, if not, that they appear suddenly with very little training. Because of its restricted meaning, very few scientists use the term ‘innate’ to describe any type of natural ability or temperamental characteristic.

If natural abilities by themselves cannot be considered ‘innate’ as defined above, what exactly is innate? Where does the ‘gift’ in giftedness reside? Certainly not in the first basement (B-1). Most of these anatomical structures result from extensive development; most do not achieve their maturity until adolescence or adulthood. So, they are clearly not innate in the way we defined that term. If we go one basement down to the level of biological or neurophysiological processes, we might be in a gray zone where it becomes difficult to separate innate processes from those that result from development. For example, most stages of the whole process of embryogenesis are governed by genetic rules. If the development is strictly maturational, then we could probably speak of innateness. At this point, my limited expertise in these matters stops me from proposing a definitive answer. What seems to be clear is that the lowest basement, the basement devoted to gene activity, is almost – but not totally, according to the new field of epigenetics – completely under inborn control.

In conclusion, the present section should have made it clear that most natural abilities are not innate; nor do they appear suddenly at some point during a person's early – or later – development. Just like any other type of ability, natural abilities need to develop progressively, in large part during a person's younger years; but they will do so spontaneously, without the structured learning and training activities typical of the talent development process.

**Presenting the DMNA**

Now that I have shown that except for a few exceptional cases natural abilities do develop, how does the development of these natural abilities proceed? Figure 5 shows my proposal for a Developmental Model for Natural Abilities (DMNA). At first glance, it looks strangely similar to the DMGT illustrated in figure 3. But, a closer look shows major differences between the two, both at the component and the sub-component levels. The main difference is of course a transfer of the G component from the left side to the right side; aptitudes – and their outstanding expression in gifts – are now the outcome of this particular developmental process. Here, the three levels of biological underpinnings, structural elements as well as processes, become the building blocks for the phenotypic behavioral abilities. Genotypic foundations (B-3) are isolated with an arrow showing their action on both endo- (B-2) and exo- (B-1) phenotypes. I chose to link the two upper basements because of their parallel influences on the growth and manifestation of outstanding aptitudes.
The developmental process specific to the DMNA appears here in summary form, with just two macro processes identified. Maturation of course covers a diversity of biological processes at each of the three basement levels, from embryogenesis upward, that govern the growth of mental and physical abilities. These maturational processes have nothing to do, directly of course, with the talent development process; they mold the natural abilities that will become, in turn, the building blocks of talents. As for the learning sub-component, it is called 'informal' because it lacks the structured organization (e.g., curriculum, access rules, systematic schedule, formal assessment) typical of talent development activities. It takes the form of spontaneous learning acquired mostly subconsciously, that is with little attention to its growth from day to day, or week to week. We could subdivide that informal process into the three sub-components – activities, investment, progress – adopted in the case of talent development, but the lack of systematization would make these elements difficult to assess in any systematic way. Of course, parents will be able to identify their children's physical activities, the approximate amount of weekly investment, as well as their approximate standing among same sex age peers. Beyond that, we would be moving into talent development territory.

One cannot imagine a developmental process without catalytic influences, both intrapersonal and environmental. These two sets of catalysts appear here structurally unchanged, that is with the same sub-components and facets. Of course, as we will see below, the exact contents within each element will differ, as well as their relative causal significance. For example, we cannot expect young children to show the same level of awareness (IW) toward their strengths and weaknesses as older individuals would. But, no doubt that intense interests and passions can manifest themselves very early. Similarly, within the realm of mental traits (IP), very large individual differences appear as soon as we start assessing any of them, either through self, parent, or teacher ratings. For example, in a famous research program, Jerome Kagan was able to distinguish inhibited toddlers from uninhibited ones (Kagan, 1989), then follow their development for a number of years. Children express very early their desire – or lack of – to engage in all kinds of daily activities: physical exercise, reading, video games, playing with friends, and so forth. Their level of interest will influence of course to some extent the amount of their short-term or long-term investment, just as it does, again to some extent, influence their decision to participate in a talent development program and to maintain their involvement in it.

Finally, environmental catalysts also play a significant role in fostering or hindering the development of human aptitudes; and all three sub-components – Milieu, Individuals, and
Provisions – are involved. Here are just a few examples. With regard to the Milieu (EM), recent research has identified a hitherto unsuspected causal influence of individual differences in cognitive abilities: the burden imposed at a national level by parasitic and infectious diseases (called the DALY index). It explains to a significant degree cross-national differences in IQ (Hassall & Sherratt, 2011), as well as cross-state IQ differences in the USA (Eppig, Fincher, & Thornhill, 2011). It remains to be seen if a similar impact will appear at the level of individual differences. At this same EM level, recent studies have clearly shown that the degree of heritability of cognitive abilities varies with the socio-economic level of the families: the H component’s importance decreases significantly in low-income families (Harden, Turkheimer, & Loehlin, 2007; Tucker-Drob & Harden, 2012).

In fact, the whole area of gene by environment interactions belongs to the E component. It is worth noting also that the strict environmentalist ideology gives preeminence to this source of causal influences on the development of cognitive aptitudes.

With regard to the Individuals (EI) sub-component, any interventions by the parents to create a specific family environment, either propitious to general knowledge learning, to musical activities, or to athletic ones, could impact the development of related natural abilities. The same applies to their active efforts to involve their children in such activities, like visits to museums or concerts, winter or summer family sports activities, or any other activities that could foster a child’s mental or physical natural gifts. In the case of the Provisions (EP) sub-component, government programs developed to improve the school preparedness (a.k.a. cognitive abilities) of at-risk children represent an interesting example of efforts to build up these natural abilities. But, since most of them target children with average or below average abilities, their relevance for the emergence of cognitive giftedness remains disputable.

In sum, natural abilities proceed through a developmental process somewhat similar to the talent development process. The same basic ‘ingredients’ are involved in fostering or hindering their growth. Of course, as Angoff (1988) aptly pointed out, the most significant distinction between gifts and talents remains the amount of direct genetic contribution. The DMNA makes that point very clear in its choice of building blocks.

Figure 6. Gagné’s Expanded Model of Talent Development (EMTD).
**Introducing the EMTD**

As a conclusion to this exploration within, beneath, and beyond the DMGT theory of talent development, is there a better way to bring closure to the process than by joining the two developmental models into an *Expanded Model of Talent Development* (EMTD). Figure 6 illustrates the result, with the G component's central position ensuring the linkage between the buildup of outstanding natural abilities on the left side and the talent development process itself on the right side. The EMTD shows that talent development has its distal origins in the progressive buildup of natural abilities, as early as through the chance meeting of a sperm cell with an ovum. This produces a unique genotype in the fertilized egg. Through the complex process of embryogenesis, that single egg will multiply, its descendants will diversify into hundreds of different cell types, each with billions of exemplars, in a coordinated developmental process closely supervised by the genotype that will lead to the birth of a new baby. The maturation process will continue after birth as the various natural abilities, mental and physical, progressively take form at a particular level, thanks to the contribution of the two sets of catalysts, as well as innumerable occasions for informal learning. At some point, usually during late childhood or early adolescence depending on the type of talent chosen, some gifted individuals, or those not too far from the DMGT's cutoff threshold of top 10 percent, will choose a talent field that fits their perceived profile of natural abilities and interests, and embark on the long and complex journey leading to eventual top performance, as described through the DMGT framework. Some will go far, others will not, and the reasons behind the level of expertise achieved by these talentees will be as numerous as the facets that comprise the DMGT. As I have kept saying for the last two decades:

Talent development results from a complex series of interactions between the four groups of causal components; it becomes a choreography unique to each individual.

**Reference Notes**

1 Interested readers can download from the author’s website (www.gagnefrancoys.wix.com/dmgt-mddt) a 6-page overview of the updated version. That overview is also available from the same source in five other languages: French, German, Polish, Portuguese, and Spanish.

2 As I was writing this text, I began thinking more closely about the biological underpinnings of the D component. I had difficulty finding clear examples that were not just extensions of their influence on abilities or intrapersonal catalysts. Consequently, I decided, until further examination, to put aside that component in my survey of biological underpinnings.

3 There are at least two possible exceptions to the position defended in that section, namely that natural abilities are not innate, but must go through a developmental process. The first one concerns recent research with very young children and even infants, to explore the presence of innate abilities, abilities that are either present at birth or close to it, or that appear later without any perceptible practice period. For example, Dehaene (1997) has shown that young babies are able to distinguish quantitatively different sets of objects, what he calls a 'number sense.' According to him, "elementary arithmetic appears to be a basic, biologically determined ability inherent in our species (...) Furthermore, it has a specific cerebral substrate, a set of neuronal networks that are similarly localized in all of us and that hold knowledge of numbers and their relations" (Dehaene, 2011, pp. 169–170). Still, we must keep in mind that these abilities are extremely primitive and limited in scope; they will require extensive developmental activities to attain levels expected from students entering school. In other words, after their initial appearance, they rejoin the developmental path I propose. The second exception refers to the exceptional prowess of ‘savants.’ I have never given much thought to this phenomenon in the past, certainly fascinated by regular TV
presentations of some of them, notably the incredible Kim Peek who died recently, but considering them essentially as very marginal phenomena. As I was working recently on a chapter for an edited book on talent development and expertise, the editor called to my attention another chapter whose interpretation of savants’ exceptional ‘talents’ challenged my view on the non-innate, developmental nature of aptitudes. The chapter, by Darold A. Treffert (in press), was based on his recent book Islands of genius (2012). In essence, Treffert describes a few examples of exceptional achievements manifested by autistic individuals, young and adults, which he labels ‘innate talents’ or ‘islands of genius.’ He considers these talents as innate because they appear suddenly, often in early youth, and express themselves at a high level of quality, a few of them rapidly reaching prodigious levels of excellence with a minimum of systematic learning. He proposes a novel interpretation, namely the existence of a ‘genetic memory’ that ensures “the inherited transfer of specific talents and actual knowledge in addition to all the other physical characteristics, instincts, traits, proclivities, inclinations and dispositions that our inherited genes carry forward in each of us from conception” (p. 13 in manuscript). He further proposes “that there exists in each person already at birth an enormous amount of inherited, ‘factory-installed, hard wired’ circuitry for certain abilities, coupled with considerable likewise genetically transferred knowledge itself regarding the “rules” of those talents, unconsciously remembered” (p. 13).

Since I have not yet obtained the book on which Treffert’s chapter is based, I do not feel informed enough to express a definitive opinion on this ‘genetic memory’ interpretation. The rarity of the savant syndrome in the population incites me to caution with regard to his second hypothesis about each one of us having such inherited, dormant, hard-wired circuitry for certain complex skills. On the other hand, I found myself comfortable with his label ‘innate talents’ instead of ‘gifts’; the complex abilities described look much more like high level competencies and skills than aptitudes because of their close similarity with achievements in specific fields (e.g., mental computing, playing a musical instrument, photographic memory, graphic skills). In other words, these exceptional achievements coincide well with my own view of talented behavior, at least in terms of content if not in terms of origin. If we agree that these ‘islands of genius’ are truly ‘innate talents,’ where are the underlying aptitudes – the DMGT’s gifts – that should manifest themselves prior to the progressive growth of these exceptional achievements? That will remain an open question until I have time to examine these examples more closely, keeping that question in mind as I explore Treffert’s book. It might be that the DMGT cannot, in its present form, explain every expression of talent. Yet, for the time being, it represents a theoretical framework that fits well with the vast majority of talent development situations, whatever the field.

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The Author

After earning his Ph. D. in Psychology from l’Université de Montréal (1966), professor Gagné spent most of his professional career in the Department of Psychology at l’Université du Québec à Montréal (UQAM). He devoted most of his research and teaching activities to the field of giftedness. He has gained international renown through his theory of talent development: the Differentiating Model of Giftedness and Talent (DMGT). Professor Gagné has received many professional prizes, including the prestigious Distinguished Scholar Award (1996) from the National Association of Gifted Children (NAGC – USA). Officially retired since 2001, Dr. Gagné maintains regular publishing projects and numerous international keynoting activities.