

# The Actiotope Model of Giftedness

Albert Ziegler



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Albert Ziegler, University of Ulm, Germany

## 1. Introduction

Every empirical science must first determine its object of investigation. In most cases, this is predetermined by a cultural imprint. In the case of empirical giftedness research, the roots reach back to the beginning of the last century. Many scholars were fascinated by the phenomenon that some persons act much more efficiently in particular fields than others. It seemed to be completely out of the question that a normal person would be able to attain this same level of efficiency, even through extensive learning and with the best means of support. However, terms such as gifts, talents or genius were suggested as causal explanations -- regardless of the fact that they originated from mythological, theological and metaphysical traditions (Ziegler & Heller, 2002).

No science can be content with nonscientific concepts in the long run. Consequently, the theoretical development in the last century was marked by the longing to determine what these terms "really" meant and to supply them with an empirical substance. Obviously, this attempt only makes sense if there are entities within the human psyche which correspond to these terms. Unfortunately, this has only rarely, with a few notable exceptions (e.g., Margolin, 1994; Tannenbaum, 1983), been subjected to serious scrutiny. Fascinating terms such as genius or talent were bandied about, and a spectacular quest for the psychic entities with which these names could be christened was inaugurated.

The first momentous attempt to replace talent with a psychological construct was made by Terman (1925). In his empirical work, gifts were synonymous with high intelligence. His research program, which indisputably led to valuable results for scholars interested in intelligence, turned out to be of less importance for conceptions of giftedness. The first reason was the lack of explanatory power intelligence has for excellence in the academic domain and in the career area (e.g., Simonton, 2000; Trost, 2000). The second reason can be traced to the great demands which were placed on the explanatory power of gifts and talents. For example, DeHaan and Havighurst (1957) defined talents as extraordinary achievements in one of the following areas: intellectual abilities, creative thinking, scientific abilities, social leadership qualities, mechanical abilities and artistic abilities. This wide-ranging abundance of phenomena exceeded the explanatory power of one psychological construct by far.

A logical consequence was to eliminate the limitation of gifts and talents to one psychological construct. One alternative was to sub-classify intelligence into several intelligences (e.g., Gardner, 1983/1994). A further alternative was to assign gifts to an ensemble of several psychological variables as suggested by Sternberg (2003) or Renzulli (1986). However, neither the multiplication of intelligence nor its enhancement through additional psychological variables was able to procure more than a partial clarification of what gifts or talents “really” were and what role they played in the emergence of achievement excellence.

Observations of current developments in this field reveal an improvement in the so far unsatisfactory prognostic ability and explanatory power of the preceding trait models through the integration of various environmental variables. For example, Moenks (1992) expanded the Three-ring Conception of Giftedness developed by Renzulli (1986) by including the influences exerted by peers, parents and teachers. A further attempt is the DMGT developed by Gagné (2000, 2003), in which the environment acts as a catalyst of talents. Gagné’s model is fascinating and a substantial progress, because by including intrapersonal catalysts, he also postulates an environment of talents and gifts within the individual himself. However, models which actively take the environment into consideration are also, as was the case with their predecessors, subject to several fundamental objections:

(1) The individual is still conceptualized as being the “owner” of gifts and the question is one of drawing a connection between the gifts and the appropriate psychological concepts. The possibility that these mystic entities do not exist and there is nothing to map onto the psychological concepts is still largely underestimated. (2) Although the environment is assimilated into these models, it is only of interest with respect to the unidirectional influence it has on gifts. Gifts remain the focus of such models, and gifts (sometimes talents) explain excellence as proximal variables – a perfect example of the powerful attraction of centralized explanations (Kelly, 1994). (3) Unfortunately, there are currently no empirical studies at hand which make a critical comparison of the explanatory power of different conceptions of giftedness. Which conception of giftedness one tends to favor is a question of taste, not a question of the thorough consideration of empirical findings.

## **2. Anchoring the state of giftedness research**

In my opinion, the situation portrayed demands a “conceptual reboot.” First, the central assumptions of giftedness research should be thoroughly scrutinized. Second, a theoretical

regeneration of the actual object of giftedness research should be undertaken, that of excellence in various areas.

## **2.1 The sleep argument: gifts are not personal attributes!**

With a few notable exceptions (e.g., Margolin, 1995), gifts have been conceptualized as the properties of an individual. However, such approaches would be caught in a predicament if it could be shown that talents or gifts emerge and disappear with changes in environmental factors. Such a case would clearly demonstrate that giftedness and talent must be something more than mere personal attributes and that at least the environment in which an individual is acting must be integrated into the construct.

Let us assume that the rules for the game of basketball were altered so that the basket now hangs 20 cm lower than previously dictated. This would seriously reduce the significance of height for success in this game. Let us consider the point in time where this rule comes into effect. All of a sudden, many players who were considered to be gifted in this domain would "lose" their gift, and many, for whom nobody had seriously prophesied a big future in this game, would now experience a "gain" in their talent. This situation is not different from the position many theoretical physicists found themselves in as the computer revolution came into full gear. Suddenly, success in this domain was more or less bound to the ability to be able to generate computer-based simulations of complex physical processes.

I now imagine two young basketball players and two young theoretical physicists. I differentiate the first two on the basis of height, the second two on the basis of computer skills. They are both at home asleep at that moment in time when, respectively, the rule change in basketball becomes valid, and the computer revolution takes place. Even with the most sensitive of measuring instruments, we would not be able to confirm any type of change in the personality characteristics of the basketball players or the theoretical physicists at this point in time!

The only thing that has changed, other than the basketball rules and the start of a new computer generation, has happened in our own heads. We as researchers no longer see plausible opportunities for the tall basketball player and the theoretical physicist with insufficient computer skills to attain excellence in their domains. We as researchers no longer consider them to be talented. We as researchers can now, however, recognize the possibility that the shorter basketball player and the theoretical physicist with good computer skills can attain excellence in their domains. We as researchers now consider them to be talented.

Let us make clear: talents and gifts are not personal attributes, but attributions made by scientists. These are based on our assumptions that a person is in the position to carry out specific actions in the future (great shots in basketball, discoveries in theoretical physics, etc.). In order to keep these assumptions substantiated, we have to renounce a rather convenient approach: norm orientation. The reward here is that we will be better situated to understand two stubborn problems facing gifted researchers: the domain problem and the Aldrin effect.

## **2.2 Norm orientation and its disagreeable consequences**

Giftedness research attempts to explain efficient actions in specific domains which other persons are apparently not able to realize. In our reading of the last sentence, we can put more emphasis on either the phrase "other persons" or "apparently not able to realize." Focusing on the latter phenomenon would have opened a productive path for empirical research; unfortunately, the other path was preferred in giftedness research. Through social norms, the meaning of the phrase "apparently not able to realize" was provided by a statistical trick. Let us assume that, for example, the top 10 % of performers in a specific domain are defined as gifted. Whether this domain is particularly supported or whether those active in this domain work harder than persons active in other domains does not contribute to the psychological meaning of "apparently not able to realize." At any random point in time this 10 % will be guaranteed – regardless of the domain we are talking about.

### **2.2.1 The domain problem**

The rigorous orientation on norms creates the problem that we are no longer able to make comparisons of excellence from different domains with one another. How many people have learned how to play the violin, how many have learned the contrabass? How many people have run the 100 m sprint, how many have experience in synchronized swimming? How many people have had their skills in mathematics placed under analysis, how many in archaeology? Aren't the demands placed on violinists, sprinters and mathematicians much higher, with respect to achievement prerequisites, necessary learning practice and the achievement levels they have actually attained, when they aspire to attain excellence in these areas? Don't contrabass players, synchronized swimmers and archaeologists profit somewhat from the so-called "Big Fish Little Pond-effect" (Marsh, 1987)?

Investigations of excellence in the areas of music, sports and academics must take such differences into consideration. In athletics, for example, it has long been decided that a thorough specification analysis of the actions required for the individual types of sports

should be undertaken. These supply a starting point upon which one can assess whether a person is in the position to eventually perform these actions after extended learning.

A conception of giftedness cannot effectively operate as a scientific theory as long as it objectifies a random percentage of persons. More appropriate objects of investigation are specific actions. However, one must also be more precise here, since we customarily focus on the product of actions, not on the actions themselves, which in itself leads to problems.

### **2.2.2 The Aldrin effect**

A few moments after Neil A. Armstrong made history as the first human being to set foot on the moon, the action was "copied" by Edwin "Buzz" Aldrin. Armstrong has been celebrated as a hero; Aldrin has been just about forgotten. Similar effects have been reported on actions in giftedness research. A spectacular example can be found in the work of Qin and Simon (1990). They provided college sophomores with the data set used by Kepler. Some of the students were actually capable of recognizing, in less than an hour, the mathematical relationships in this data set which Kepler needed 10 years to verify. Were these university students just as gifted as Kepler, who many consider to be a genius? Is this measurement of excellence comparable?

An orientation on norms is neither capable of providing the motivation nor is it the means to be able to accurately investigate the qualitative similarities or differences between the actions taken by Kepler, who surmounted the physicists of his time, and the randomly chosen and otherwise not particularly conspicuous students. However, the caveat made in the last section, that we should focus on actions in giftedness research, must also be specified at this point. Obviously, it would not suffice to merely consider the product of actions. One would also want to include the means (e.g., pocket calculator) or prior knowledge (e.g., socialization in an anti-empirical era vs. an era marked by an express awareness of technology and the natural sciences) in the analyses, since they obviously exercise an important influence on the actions one is in the position to engage.

Although products of actions are definitely of interest from an analytical perspective, they are not, however, the actual object of the analysis. But if not the products of actions, what is it about actions that we need to focus on if we intend to use them as the manifestation of excellence? Intuitively, we incline to refer to the genesis of these actions in our answer. A brief glance hereon, however, completely disrupts our traditional approaches to the phenomenon of excellence, because it brings up aspects which we cannot analyze within our models.

### **2.3 A look at the entire complexity: the Curie problem**

One can safely assume that Marie Curie would never have been in the position to experience her extraordinary career if she had never made the decision to leave her homeland, Poland. In the year 1891, she sent a gripping letter to her sister Bonia, who was living in Paris at the time. She related that she had decided to pursue an academic career in Paris and asked for support. Bonia agreed to this. One can single out several further crucial stations in Curie's life, such as the matriculation at the Sorbonne or the fact that no one had discovered the existence of Polonium and Radium before she did and that this offered her the opportunity to work in a field ideally suited to her specific talents. If we want to include the genesis of the excellence of Marie Curie in our analyses, then don't we also need to consider the chain of decisions, "random" events and particular circumstances which were necessary for a woman to be able to sustain the most brilliant of scientific careers at that point in time?

Gagné (2003) recognized the necessity of incorporating such occurrences into the explanation of excellence. However, his concept of "Chance" seems at present to be rather unspecific and operates rather as a 'miscellaneous' category. The question is if a better, more systematic possibility can be found to embrace such critical life events into a scientific model of giftedness. However, it is questionable whether such complex processes can be portrayed in linear causal models. In fact, a system theoretic approach is much more suitable in this case. However, before we venture to take the first steps into this new area, we need to first take a step back to the phenomenon itself, i.e. to excellence in different domains and its development.

### **2.4. Back to the phenomenon: a few consequences taken from the biographies of persons demonstrating excellence**

Despite the existence of literally thousands of biographies on eminent persons (e.g., Simonton, 1994) and an immense number of participants in empirical investigations on expertise and talent (e.g. Ericsson, 1996), we are still not yet in possession of a reliable outline of the prototypical course of the development of excellence. From that which we have been able to learn so far, I hold the following points to be instructive with respect to the direction in which a model of giftedness should be developed. In this listing, I will introduce a few new terms which will be explained in greater detail in later passages of this text.

(1) From a descriptive perspective, it becomes obvious that the development of excellence ensues over a long period of time, which, as a rule of thumb, takes about ten years

(Ericsson, Krampe, & Tesch-Römer, 1993). Although reports abound that some persons are able to attain exceptional achievements before this period of time has elapsed, the fascination here seems to be rather more a result of the seemingly young age of so-called „prodigies“ and less so in the achievements themselves, which seldom reach the level of an adult deemed to have attained excellence (Howe, Davidson, & Sloboda, 1998). These long periods of time necessitate the establishment of a developmental perspective in the explanation of excellence (Moenks & Mason, 2000).

(2) Characteristic of the developmental process of excellence is the execution of an extremely large number of actions in a specific domain. According to various estimations (e.g., Ericsson, 1998), these add up over time to a total of ca. 10,000 hours of intensive learning practice.

(3) Actions in a specific domain are governed by various goals. During the first phase, the pleasure derived from playing the game itself is the principal factor. The next phase is dominated by consequential improvement in performance. When a specific achievement level has been reached, under certain circumstances, the opportunity is then open to speak of the utilization of excellence. The predominant objective is now a faultless execution of skills by the person in question, for example the performance of a violinist during a concert. However, goals can also be identified on further, much more specific levels.

(4) The development of excellence can be described as a successive and continual expansion of action repertoires. A person who is at first only able to solve simple arithmetic problems, will later be able to solve algebra problems or problems which necessitate the mastery of infinitesimal calculus. The intrapersonal factors which are involved in bringing about inter-individual differences in attainment of action repertoires has yet to be clarified. In my opinion, learning theories (e.g., Ericsson et al., 1993), cognitive theories (e.g., Sternberg, 1986), sophisticated syntheses of learning and trait approaches (e.g., Gagné, 2003; Schneider, 2000) and genetic approaches (e.g., Thompson & Plomin, 2000) can all make valuable contributions.

(5) An individual can, at any random point in time, be characterized as a source of effervescent wishes (Gollwitzer, Heckhausen, & Steller, 1990; Heckhausen, 1991). Usually, a wide array of alternative actions which could be taken to realize one of these wishes are continuously at his/her disposal. When acting, an individual has already chosen specific actions out of the universe of those which were subjectively available, which we might term a subjective action space.

The courses of action which are available in the subjective action space are not only a necessary precondition for acting, they define the action limits as well. Writers, for example, report that they suddenly suffer from a lack of confidence, experience periods of self-doubt and may wind up with writer's block. In other words, no potential action course could be represented in their subjective action space which would allow them to continue their artistic accomplishment.

(6) The enormous degree of organization inherent in the learning process, whereby the environment plays an immense role, is impressive. For example, the attainment of academic excellence is utterly impossible without the support of professional instruction. In the school, situations are staged in such a manner that those actions are taken which best enable optimal learning. Trained pedagogic personnel keep track of the learning progress; learning times, learning locations, learning material, and learning content are determined. Similar conditions can be identified for other known areas of excellence including athletics, music and chess. In these fields, excellence would also be far out of reach without competent and meticulous planning. In general, one observes that with the increasing degree of expertise in the learner, the environment becomes increasingly more professional and more tailored to his/her specific learning needs.

(7) The concepts addressed – development, action, goals, action repertoire, subjective action space and environment – are components of a network. Network means that these areas overlap. For example, goals are the objective of every action, which had been represented in the subjective action space and which must also be available in the action repertoire. Network also means that these areas interact in many manners. Alterations in one of the components always implicate alterations for the other components. For example, new goals will result in other actions or a change in the intensity of the present action. Actions also always effect a change in the environment, etc.

(8) The interactions and reciprocal influences of the components are not random events; they can rather be described as functioning in the form of feedback loops. For example, a good tennis coach who discovers a weakness in the backhand of his protégé during a training session would not merely try to work out this flaw in the current session. In contrast, he would create a learning situation in which an opponent would pointedly and repeatedly focus play on the weaker backhand of the protégé. Within a short period of time, several dozen learning opportunities could be applied to improve the backhand. In this case a good trainer would offer competent feedback in that comments would be repeatedly given in a feed-forward loop until he was satisfied with the resulting change in behavior.

## 2.5 A first summary

The intent of the previous passages was to make the following points clear:

- Gifts and talents are not personal attributes.
- An orientation on social norms proves to be ill-suited for the concept of excellence. The focus of the analysis should be on actions and their determinants, rather than on persons and their characteristics.
- In answering the question of whether a person will ever attain excellence, social norms are not very helpful. Instead, one should refer to a specification analysis of the actions we expect to find among persons who demonstrate excellence. This examination will provide us with information needed to concretely address the question of whether this person, through learning, will eventually be in the position to acquire the competencies required to act out these actions.
- One must take a large number of variables into consideration in this assessment which not only deal with the current action repertoire and its determinants, but also goals, subjective action space, and in particular environmental aspects.
- In making this analysis, we must also be prepared to incorporate interactions among the components as well as feedback loops into the process.

The results of previous analyses lead me to question whether excellence can adequately be investigated within the framework of causal linear models. Instead, it appears to me as though a theoretical approach must be taken which demonstrates the following properties. It must be:

- action-oriented, instead of trait oriented.
- individualistic, since the constellations of conditions and learning processes which lead to excellence are always unique.
- holistic, in the sense that it permits the analysis of disparate entities and processes within a single theoretical frame.
- systemic, since the entities and processes are related to one another, in that they have the common goal of the optimization of excellence.
- attachable to existing and not yet advanced theories of the conditions and the development of excellence.

## 3. An overview of the Actiotope Model of Giftedness

According to an observation made by Kauffman (1995), science in the 18<sup>th</sup> century, following the Newtonian revolution, was for the most part the science of organized simplicity. The

science of the 19<sup>th</sup> century focused, via statistical mechanics, on disorganized complexity. Only in the 20<sup>th</sup> and 21<sup>st</sup> centuries did one start to come to terms with organized complexity. In the Actiotope Model of Giftedness, excellence is also considered a result of self-organization and the adaptation of a highly complex system. The focus is no longer on personal attributes, but on actions and their development within a complex system. Theoretical access is enabled by system theory, in particular the complexity theory.

System theories constitute a wide-ranging and multi-faceted area; their overviews now fill volumes. Even a brief account of the area would be neither necessary nor meaningful. We are content here to describe the application of the system theory in the Actiotope Model of Giftedness and to point out the fundamental processes involved.

Let us begin with a very basic principle, which most researchers would undoubtedly agree on, to serve as a starting point for further considerations. One characteristic of living systems is that they develop and evolve. In the short run – according to general consensus – the sustainment of a system always has priority; in the long run, it is in jeopardy of extinction if it fails to evolve. Indeed, the concept of the evolution of dynamic systems is not limited to species, but can also be transferred to social groups<sup>1</sup> (e.g., von Cranach & Bangerter, A., 2000) and individuals.

Living systems maintain themselves and evolve both within and alongside the exchange with their environments and the systems contained therein (co-evolution). They are simultaneously interacting with several systems, which are also simultaneously evolving. When, for example, a boy develops a new basketball skill, he not only expands his own action repertoire and can therefore pursue new goals. His newly-won ability is also now available to his basketball team. The integration into various systems contributes thereby to the network as a whole.

The system comprehensive potential of system theory enables an exploratory transfer of this heuristic analogy of evolving living systems to individual development and the phenomenon of excellence. Admittedly, our context is bound to a few important deferrals. In contrast to the development of a species, we are no longer interested in (1a) the maintenance and evolution of a (2a) species in a (3a) habitat, but rather efficient (1b) actions and their evolution for an (2b) individual in a (3b) specific talent domain. In an analogy to the system of environment and species, which is referred to as a biotope, the action system which encompasses the environment and the individual will be referred to as an Actiotope.

### 3.1 The components of an Actiotope

Figure 1 illustrates the components of the Actiotope Model of Giftedness. In order to keep the figure intelligible, their interactions and functions were limited to a noteworthy subset. Detailed specifications can be found in the corresponding text.

Insert Figure 1 about here

#### 3.1.1 Actions

Excellence refers to a specific quality of actions. For this reason we need to take a closer look at some important attributes of actions. The three-dimensional organization is striking:

- They have a phase structure, i.e. they consist of a sequence of partial actions. From the perspective of the observing scientist, this is expressed as the well-known accordion effect (Davidson, 1990). The action in question can be described in either wide terms or tight terms, similar to how an accordion can either be pulled wide apart or squeezed tightly together.
- They are actually a composition of parallel or multiple actions. A simple example of this is found in the feat of playing the piano, which we often describe as a single action. Actually, several actions are occurring parallel: the movements of the fingers, a monitoring of the notes being played, enjoying the self-produced music, etc.
- They require regulations on several levels (e.g., the correct execution of motor, cognitive, auditory and other activities; effort and intensity; the capacity to cope with negative effects; examination of whether the desired effect was attained).

The three-dimensionality has a phenomenal significance for the specification analysis of efficient actions. Here an example: let us assume that we want to determine which actions a later world master in chess will need to have. Trivially, he/she will need to win more chess matches than the toughest challengers. Do we hence want to consider a chess match itself as the action element to be placed under analysis? Or do we need to deconstruct a chess match into an opening, middle and end game? Or are we interested in the individual moves themselves? Obviously, the quality of our results is dependent on the specification analysis and a functional subdivision of the phase structure.

Which actions are to be executed in parallel; which should never be executed in parallel? What abilities does the execution of these actions require? In a game of chess, one must be able to mentally foresee a relatively long series of moves, and also have the capability to compare and evaluate individual moves with the consequences with which they are

associated. In all probability, a pre-eminent chess player is not in the position to simultaneously enjoy any form of aesthetic pleasure, since it may well reduce the player's level of concentration. And concentration is one of the most important factors a chess player must be able to regulate during a match.

In summary: the specification analysis of efficient actions requires, first, the selection of a functional description of the phase structure of the actions; second, a specification of the action to be executed and, third, a specification of the regulations of the actions at hand. Only then can an adequate appraisal be made of whether a person will ever be in the position to execute these actions.

### **3.1.2 Action repertoire**

What we understand by action repertoire are the objectively sustainable possibilities for action persons have at their disposal, in other words all the actions persons are capable of executing when a) they consider engaging in this possible action in a subjective action space (see 3.1.3), b) they formulate a corresponding goal (see 3.1.4) and c) the composition of the environment permits the execution of this action (see 3.1.5).

Of extraordinarily high scientific interest are the intrapersonal determinants of the action repertoire. In fact, the greater part of the conceptions of giftedness is almost exclusively concerned with these factors, for example genetic factors (Thompson & Plomin, 2000) or cognitive abilities (Sternberg, 1986). If one takes further areas of excellence into consideration, such as artistic abilities, then determinants such as perceptual abilities and motor skills win a high level of significance. In general, most models of giftedness can be integrated into the Actiotope Model of Giftedness at this point as a sub-theory.

However, one must be well aware of the hazard that these sub-theories usually are, at best, very general theories about the conditions of excellent actions. In some cases, this may suffice, and a limitation in the number of variables is of course simpler and more convenient when one can be content with rough prognoses or has other practical grounds. However, the call for detailed scientific consideration of excellence in a specific domain requires a fundamental specification analysis of the abilities considered to be excellent. This is the only basis on which the determinants of the required actions can be soundly specified.

### **3.1.3 Subjective action space**

In order to be able to deliberate actions, generate meaningful intentions, execute actions, etc., there must be a psychological entity which represents the action opportunities available to a

person. This point of view is not new to psychology. Expectancy value models of motivation (Heckhausen, 1991), for example, assume that prior to the development of an intention, possible actions are subjected to assessment. Meanwhile, elaborate models have also been published on anticipative action control (Hoffmann & Sebald, 2000). This psychological entity is designated as the subjective action space in the Actiotope Model of Giftedness. Important here is that we are not speaking here of an entity which corresponds to a material substrate of the human brain. The subjective action space is much better understood as a functional unit with a system character, whereby these functions are to be seen as real.

The conceptual roots of the subjective action space can be traced back to the construct of problem space. This can be seen as the universe of all possible steps to solve a problem which an individual can theoretically navigate. The subjective action space of a person can also be seen as the universe of possible action steps and actions a person can anticipate traversing in the planning and regulation of an action.

This action space is termed subjective, because it is a personal construct which doesn't necessarily have to be in agreement with reality. In a specific situation, a person may either overestimate or underestimate their action repertoire. When we look, for example, to studies of girls gifted in mathematics, science and technology, we find that they perceive a limited subjective action space, despite having demonstrated similar achievement levels (Zorman & David, 2000). Girls underestimate their competencies and are of the opinion that they have to apply more effort in order to attain the same degree of success as boys. They have lower control convictions and describe themselves, even at this early point in time, as being more helpless than their fellow students (Schober, 2002).

### **3.1.4 Goals**

Human behavior is always engaged in the intention of attaining a specific goal (of course not always consciously), whereby several goals can be pursued with the same action. Goals have four main functions: they are involved in the selection of action alternatives, they energize actions, they provide direction to the action being engaged prior to and during its execution as an orientation for regulation, for example in the comparison of the action results attained so far with the result envisioned for the current action.

There have been numerous attempts to classify human goals. However, current research in this area is probably still rather far-removed from a final classification system. For giftedness research, however, two clusters of goals seem to be of central importance. They are directed to

- the development of excellence and
- the employment of an excellent action repertoire.

Ericsson (1998) assumes that only goals which aim to improve the current state of performance encourage the development of excellence. Our investigations have indeed demonstrated that, for example, musicians and chess players had accumulated a large amount of practice time, without being able to demonstrate an improvement in their performances (Gruber, Weber, & Ziegler, 1996). They had been primarily pursuing the goal of using their abilities in order to generate the highest degree of pleasure possible from their activities.

In the utilization of an excellent action repertoire, goals may come into conflict with one another. When, for example, a violinist is pursuing the goal of leaving his audience with a good impression of himself over the course of a concert, he will apply less concentration to the musical expression of his craft.

Besides these two clusters of goals, numerous other approaches seem to be relevant for giftedness research and deserve much more attention. One example is theories on motivational orientations. Persons who are goal oriented with regard to learning attempt to expand upon their competencies, to learn new things and to understand new concepts. Persons who are goal oriented with regard to performance, in contrast, want to make a display of their successes and to conceal their failures. There are notable indications that a goal orientation toward learning is more advantageous to the learning process. On the other hand, one must keep in mind that goals also have an energizing component. From the perspective of endurance, when confronted with rather protracted learning processes, it may be beneficial to be able to demonstrate both orientations. More on this can be found in Ziegler, Heller, & Stachl (1998).

### **3.1.5 Environment**

In Figure 1, the environment is represented by the designation of several of its central components, such as social actors, resources and settings, the significance of which has already been indicated in the discussion of the development of excellence.<sup>2</sup> They can and should also be considered from the perspective of a system theory. Of particular importance for giftedness research is the section pertaining to the system environment, which constitutes the talent domain in Figure 1.

In the literature, a talent domain is usually seen as an action field which, first, can be contrasted with other action fields, second, offers a standard of excellence and third, must be "socially valuable" in some form or another (Ziegler & Heller, 2002). As much sense as these

criteria must make from the perspective of a sociologist, from the perspective of a psychologist they are far from reasonable. What is, for example, the psychological definition of the concept of "socially valuable," or how can a psychologist who is interested in excellence distinguish between outstanding actions in socially valuable and less valuable action fields?

If one wants to approach a more meaningful definition of a talent domain, then the system character must be brought to light. Furthermore, it must be demonstrated that this system interacts with the Actiotope of an individual; this means the action repertoire, the subjective action space, the goals and finally the actions in this domain. Only the area in which these interactions occur can define the action field in which a person may possibly have attained excellence and this is designated the talent domain. For example, in most cases it is rather easy to just say that someone has attained a level of excellence in physics. Although she may really be a brilliant theoretical physicist, she may just be an average experimental physicist. If we want to be able to scientifically describe the excellence of such a person, we need to pay attention to such details. Important indicators of the individual talent domain of a person can be found in their learning or the successive enhancements of their Actiotope.

The definition of a talent domain from individual and system-based perspectives does not, however, mean that its objective structure can be neglected. This borders on the success and efficiency of human behavior. This objective structure is of extraordinary significance from the perspective of giftedness research. It permits (1) an at least rudimentary analysis of the universe of possible actions contained in an environmental system and (2) the establishment of a relationship between the current action competencies of a person and their developmental potential. Well-known examples can be found in the world of athletics (cf. Ericsson et al., 1993), where analyses have been able to reveal which physical body measurements would be ideal for the optimal execution of important movements for sports such as cycling or rowing.

The rapid alteration of domains is another reason why the analysis of the objective structure of a talent domain and the postulation of the characteristics of efficient action are so important. One can, for example, well imagine that a grand master in the game of chess, who is a specialist at a specific opening, is capable of finding a way to refute this very same opening. In an extreme case, he may well lose his claim to excellence because he is inferior to his opponents in the other opening systems which he now must draw upon. This example is also a good illustration of the systemic networking and the diverse kinds of feedback which are prominent in the area of excellence.

### **3.2 Interactions among the components of the Actiotope**

The components of an Actiotope compose a system which is distinguished by manifold interactions among these components. For example, alterations in the goals being pursued sometimes have very reticulate effects on the other components, and the resulting reactions in turn have an effect on the development of goals. One might easily be prone to assume that the Actiotope as a system is primarily in a constant quest for equilibrium. This is in fact the case in many areas, but not in the development of excellence in a talent domain.

Individuals attempt – as do all living systems – in the process of preservation and maintenance of well-being to keep several types of equilibriums in balance, for example in the procurement of nutrition, the contentment of social relationships or their emotional states. However, individuals who attain excellence effectively adapt their Actiotope to the talent domain. The achievement level which they want to attain is always higher than that which has just been reached. The Actiotope of an individual who is pursuing excellence is a dynamic, ceaselessly evolving system. Therefore it is permanently being removed from its state of equilibrium. In this process the Actiotope must, on the one hand, demonstrate enough flexibility to enable change, but also retain enough stability in order to be in the position to successfully implement these modifications and transformations. The development of an Actiotope can therefore be described as a type of a complex adaptive system, whereby the development of excellence represents "the product of progressive adaptations" (Holland, 1995, p. 29).

A progressive adaptation is based on five points, which play a particularly central role for promotion of excellence:

(1) The individual must realize when an action has been successful for the attainment of a goal. Young violinists who have never been told that they are playing cleanly will probably never be able to recognize this themselves and will have little chance of being able to attain excellence in this domain.

(2) Many studies show that knowledge remains inert. Although declarative (knowledge of facts) and procedural (knowledge how to act) knowledge can be acquired, this is not necessarily the case for conditional knowledge (Mandl & Gerstenmaier, 2000). Individuals must also be able to recognize situations in which the implementation of this action will generate success.

(3) Individuals must be able to generate variations of actions within their subjective action space and be able to make explicit selections from their action repertoire. In the first

place, this is necessary in order to be able to act successfully in altered environments. In the second place, the generation of action variants is also of extreme importance for the development of excellence, because they compete with one another in an evolutionary process governed by the survival of the fittest action. This is of particular importance when our instructional knowledge is insufficient and we leave the learners to find out on their own which of their action variants is the most successful.

(4) In order to remain adaptive, the Actiotope must not only be reactive, but also anticipative. If specific actions were successful in previous environments, this is no guarantee that this will also be the case in future environments. In our educational institutions, curricula support individuals in the acquisition of anticipative competencies. For example, psychology students attend courses to acquire statistical skills long before they are in the position to conduct their first investigative studies.

(5) Individuals must have effective feedback and feed-forward loops (in some instances also recursive) at their disposal in the talent domain, so that adaptations are just as feasible as reorganizations. It has already been mentioned how important adequate feedback is and how feedback loops are employed to bring forward the acquisition of competence for the execution of an action. This can also – at least in part - be attained by the individual himself in the form of self-regulated learning processes (Stoeger & Ziegler, in press). In many cases, however, the assistance of competent persons is needed, such as teachers, parents and coaches, who meticulously work on weaknesses and faults with their protégés, often over a period of several years (Ericsson et al., 1993).

An important characteristic of the interactions within complex adaptive systems is the co-evolution respectively co-adaptation of their components. In older conceptions of giftedness, the development of excellence was understood by and large as being autocatalytic. If the environment (and to some degree also traits such as motivation) does not stand in the way of the gifts, excellence will somehow find a way to develop (e.g., Terman, 1925). Gagné, in contrast, accords a more active role to the environment and various intrapersonal catalytic factors for the development of excellence (e.g., Gagné, 2003). His concept of catalysts, borrowed from the field of chemistry, assumes that catalysts can either stimulate or inhibit processes, but cannot be changed by these processes themselves. In the Actiotope Model of Giftedness, in contrast, it is explicitly assumed that the individual components of the Actiotope must co-evolve. During the learning process individuals explore a huge space of possibilities in their subjective action space. Some of these possibilities are selected for execution. These can also effect changes in the action repertoire if the action permits learning.

The subjective action space and the goals must now be co-adapted so that new actions can be executed. If a learning goal has been reached, the action repertoire has evolved. More challenging learning goals must now be developed in order to spur the learning process on. In order to attain these new goals, new possibilities for action must be generated in the subjective action space or through instruction. In this manner, new openings to higher levels of complexity of actions are made accessible. However, the learning environment itself must also evolve. Sometimes, a complete change of the environment is necessary when an environmental system can no longer respond to the expanding action repertoire of an individual and the interactions are no longer conducive to learning. Familiar examples from everyday life include the movement from high school to university, the change of coaches of a professional sport team, or skipping a grade in school.

The break-off of interactions within a specific environmental system leads to non-linear changes in the Actiotope. However, non-linear changes can also be the result of increasing complexity. By way of illustration, learning experiences are processed and filtered at different levels and proceed, for example, from sensation and perception through cognition and conception to reflection. Complex adaptive systems can therefore also be described as "adaptive nonlinear networks" (Holland, 1995), in that several systems interact with one another and produce sudden, emergent changes in the Actiotope.

#### **4. Education**

It must first be maintained that, although excellence can represent an important goal in the upbringing of an individual, above and beyond this there are more momentous goals one can pursue, such as autonomy, tolerance, or the capacity to assume social responsibility. Excellence can exist as one goal among many, and other goals should not suffer under the promotion of excellence, but rather should also be advanced through this encouragement. Regrettably, due to the limitations of space we cannot present a model of integrated, systemic education at this time. Instead, we will concentrate on some of the important specifics inherent in an educational process focused on excellence.

In the Actiotope Model of Giftedness, eleven clusters of educational goals are postulated, of which four are related to the components of the Actiotope, five to the advancement of the adaptability of the Actiotope, and two to the Actiotope as a system. In order to make these goals more concrete, educators need to be in the possession of specific knowledge which enables them to make optional adjustments with respect to the Actiotope of the individual. To simplify matters, we will assume that this knowledge (specification

analysis of excellent actions, awareness of educational methods conducive to an effective action repertoire, etc.) is manifest. In the enumeration of these points, we will limit ourselves to short comments which should make the core ideas of these points discernible.

(1) Among the methods with which the action repertoire and its determinants can be advanced, one includes the techniques already known to support the competencies needed in the execution of actions (motor actions, cognitive operations, socially competent behavior, knowledge access, etc.), such as instruction and modeling. In addition, one needs to include promotional methods which can encourage the potential determinants of the action repertoire such as intelligence, concentration or creativity.

(2) In the first place, the subjective action space must be a representation of effective action alternatives and ineffective alternatives must be weeded out. In the second place, realistic assessments of the action alternatives must be enabled. In particular, goals such as the improvement of self-efficacy must be pursued. Since, in the third place, actions are also coordinated and directed in the subjective action space, the regulation of actions – such as an improvement in self-regulated learning – are further meaningful facets of this goal cluster.

(3) Each and every goal should be mediated, which enables an optimal evolution of the Actiotope with respect to excellence. Furthermore, should such dysfunctional goals surface, as, for example, those demonstrated by the phenomenon of perfectionism, they should be eliminated.

(4) A learning environment must be prepared which enables an optimal development of the Actiotope with respect to excellence. Repressive influences exerted by the environment (such as noise when one desires to study) must be disabled.

(5) A standard must be mediated with which the individual will be able to identify efficient and inefficient actions (Violinists must be able to sense when they are playing cleanly or not). Professional feedback must be made available when the individual is not able to do this for himself.

(6) In order to enable the identification of situations for the execution of efficient actions, conditional knowledge must be meditated (Mandl & Gerstenmaier, 2000).

(7) In order to be able to generate action variants, the individual must be able to apply his knowledge in the most diverse of situations. Possible methods of encouraging this have been developed by proponents of the cognitive flexibility approach (Spiro, Feltovich, Jacobson, & Coulson 1991).

(8) The advancement of an anticipative Actiotope has many facets, which can best be depicted through three examples. (i) An individual must be prepared to execute an action

under new circumstances. Here the storage of signals which give rise to specific actions on a conceptual instead of perceptual level can be helpful. (ii) An individual may find him/herself in a situation in which he/she cannot effectively process new information, a function which is vital for the evolution of his/her Actiotope. Here the mediation of learning strategies could be of service. (iii) An individual must also be able to cope with learning setbacks. In order to maintain the pursuit of goals and to avoid the surfacing of resignation, the mediation of coping strategies is a sensible strategy.

(9) Effective feedback and feed-forward loops in the talent domain can be attained through learning sequences which consist of cycles of instruction, actions and feedback.

(10) A chess player who has been playing in the same class for several years, who is satisfied with the level of performance he has attained, who really just wants to enjoy playing his game and for this reason no longer expands his Actiotope, is a prime example of the equilibrium-like state of an Actiotope. The expansion of an Actiotope, in contrast, is a process which always brings about a disruption in the state of equilibrium. Often impulses must be given to activate these developments and to assist in their maintenance. One must, however, keep in mind that permanent adaptations could lead to the destabilization of an individual's Actiotope (see below). Consequently, there seem to be limitations on the amount of effective daily learning an individual can endure. Furthermore, an individual may very well need assistance in managing the tempo with which an Actiotope is expanded, or else the individual may suffer the consequences of excessive demand or fatigue.

(11) An adaptive system which is as complex as a developing Actiotope necessitates sufficient stability to be able to successfully execute modifications and transformations. In addition to the above-mentioned temporal management of development, one needs to pay attention to the co-adaptation of the individual components. My personal hypothesis is that such a-synchronies in the development of the components of an Actiotope provide far better explanations as to why many talents never reach excellence than what is offered by personality traits such as intelligence. The following are all examples which corroborate the necessity of systematic encouragement: peers who develop feelings of envy, teachers who experience threats to their self-esteem, a subjective action space in which the required learning actions are not adequately represented and the failure of the goals to adjust to the improved action repertoire.

## 5. Identification

The Actiotope Model of Giftedness refutes the dominating view that gifts or talents are attributes of a person. For this reason, and in direct contrast to alternative approaches to the identification of giftedness, the goal is not to categorize persons as gifted, but rather to identify a learning path for an individual which leads to excellence. Two points will be taken under closer inspection. First, analog to the normally posed question of whether individuals can be differentiated qualitatively (talents, gifted persons), the question of whether one can identify meaningful phases in the development of an Actiotope will be discussed. Second, some criteria which are important for identification in a practical setting will be depicted.

### 5.1 What is meant by excellent, talented and gifted?

We define excellence as the state of an Actiotope which is characterized by particularly effective actions.<sup>3</sup> Excellence is thereby a term which refers inherently to performances, rather than to the potential for astounding learning. Therefore, excellence is identified by outstanding actions. This is no trivial task, as seen, for example, in the difficulties experienced by talent scouts who look for and identify the proper players for professional sports leagues around the world.

In their meta-theory of giftedness, Ziegler and Heller (2002) examine two earlier phases which are more important for identification in practice. The first phase encompasses the prenatal and early childhood developmental phase through to the attainment of a critical state, a point from which one can expect an evolution of the Actiotope to excellence to be plausible. During the period of time prior to the attainment of the critical state, an individual could become conspicuous by exhibiting particularly quick learning progress or precocious achievement. Their actions can be labeled as being talented. The actions of a person whose Actiotope has reached a critical state are described as being gifted. Although we are talking about persons when we assess if someone is in the talented, gifted or excellent phase, as a matter of fact we are describing our subjective assessment as diagnosticians of whether a person can possibly realize excellence (talented), will probably realize excellence (gifted) or has already realized excellence (excellent).

The assessment of which phase the Actiotope of a person is currently in can only be made on the basis of current knowledge concerning the level of achievement development in a specific talent domain. Even among persons who are outstanding, an appraisal needs to be conducted to determine whether normal persons would be capable of attaining the same high level of achievement under optimal training conditions. It may very well be the case that no

persons can be found to be in the excellent phase in a specific domain because the performance level in this domain is rather low and just about every person who is active in the domain is capable of attaining this level of performance. It may, however, also be true that despite incredibly impressive achievements in a domain, actions will not be recognized as excellent, as exemplified by the competence of being able to use correct grammar when speaking. All persons are capable of attaining this impressive accomplishment within the framework of a normal development. In this case, the concept of excellence must be transferred to a species. Consequently, a figure as to how many persons attain or are capable of attaining excellence in a specific domain – 1:100, 1:1 000, 1:10 000 – is not one which can be rigidly fixed a priori for all domains.

A related question of considerable practical importance is that of who, with the best promotional support, we can expect to find among the group of the best achievers in a specific area, i.e. who the experts will be. In order to answer this question, one can obviously use the Actiotope Model of Giftedness and the identification processes which are founded on its principles. However, it makes no sense at all that a conception of giftedness should be able to answer questions like, “What is the percentage of gifted mathematicians?” or, “What is the percentage of gifted cooks?” in a population. Rather the giftedness researcher who wants to help should reply, “How many cooks do you need?”

## **5.2 Central criteria for practical identification**

Ziegler and Stoeger (in press) have presented a method of identification in their ENTER Model, which permits diagnoses on the basis of the Actiotope Model of Giftedness. The methodological process is constructed in a manner that will assess not only the actual state (e.g., momentary IQ score), but also examines the dynamic of the development of the entire Actiotope. This includes the components of the Actiotope, opportunities to increase the adaptability of the Actiotope, as well as the Actiotope as a system. This information is considered in relation to the goal of the identification at hand. A few examples may be:

- The attainment of excellence: here one needs to make use of a specification analysis and, on the basis of existing theoretical knowledge, make an assessment on whether an individual will ever be in the position to execute these tasks.
- Skipping a grade: here one needs to assess whether the Actiotope is already developed enough, or will be sufficiently developed, so that the action demands which will be made in the class that the student will now enter can be properly fulfilled.

In the ENTER Model five steps are suggested for the identification process. The name of the model is an acronym made up of the first letters of the terms Explore, Narrow, Test, Evaluate and Review. In the first step, Explore, the Actiotope is examined and the second step, Narrow, concentrates on the Actiotope in the talent domain. In the third step, Test, identification is concerned with the learning path which leads to the goal of the identification at hand. In the fourth step, Evaluate, an evaluation is made to determine whether the aim of the identification has been attained, and in the fifth step, Review, the significance of the aim of the identification is analyzed within the entire adaptation of the Actiotope, whereby the psychological theories applied in the prognosis are also placed under examination (for details and specific application see Ziegler & Stoeger, in press).

## **6. Conclusions**

At the outset of the chapter it was pointed out that the concepts gifts and talents have their origins in mythology, theology and metaphysics. The main reason for their adoption into science was the compulsion to find explanatory concepts for the phenomenon that some persons attain a level of efficiency in a specific domain which normally cannot be achieved, even with extreme learning efforts and the best of support. In order to explain this phenomenon, the Actiotope Model of Giftedness places the focus on the actions of an individual and their evolution. The development of excellence is understood as an adaptation of a dynamic system, which intensifies in complexity through interactions with the objective structure of a domain, whereby with increasing excellence, the individual will also increasingly effect changes in the objective structure of the domain itself. This chapter considered the co-adaptation and co-evolution of the components of the Actiotope, such as the action repertoire and its determinants, goals, subjective action space and environment, as well as the interaction of these components within a network. Gifts and talents, which are traditionally understood as attributes of an individual, therefore, have several mothers and fathers. It is now time to recognize them by their true names. It is also time to give their talented children the chance to attain excellence, by providing them with an individually-tailored promotion of their entire Actiotope.

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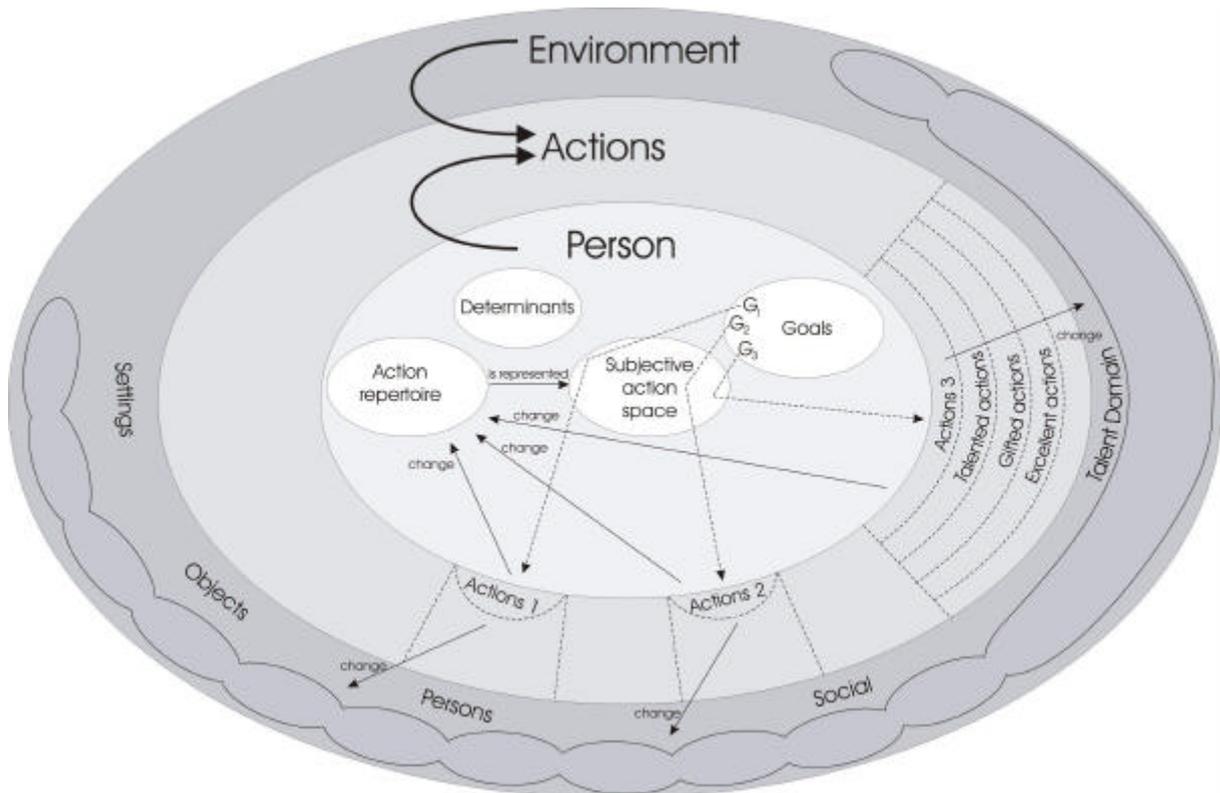
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## Figure captions

Figure 1

Components of the Actiotope Model of Giftedness



Note: Interactions and functions were limited to a subset

## Footnotes

1

It is remarkable that investigations have almost exclusively concentrated on gifted individuals, but no gifted groups have been subjected to investigation. This appears to be overdue in a time in which we are just as familiar with the excellence of teams (e.g., research teams, sport teams, orchestras) as we are with the excellence of individuals. In my opinion, this unwillingness to confront the excellence of social groups is tightly bound to the trait orientation of conceptions of giftedness. The composition of groups is often subjected to rapid modification and are thereby ill suited to the search for explanations which are based on stable factors.

2

Due to the limitations of space, suggestions on possible environmental structures will not be discussed here. These explanations would have required a trans-disciplinary discussion of the topic, which would have necessitated the introduction of additional concepts. The goal of this contribution is however to provide a wide range of readers with a discernible overview of the Actiotope Model of Giftedness, whereby formal abstract representations are avoided and the application of system theory based terminology will be accordingly limited.

3

We are concerned here with individuals. In an analog characterization of the excellence of groups, the term Actiotope would have to have been replaced by the term Sociotope in this passage.

Abt. Pädagogische Psychologie (Prof. Dr. Albert Ziegler)  
am Seminar für Pädagogik der Universität Ulm  
Robert-Koch-Str. 2  
D-89069 Ulm  
Telefon: +49 (0) 731 50-31135  
Fax: +49 (0) 731 50-31137  
E-Mail: [heidi.seitz@sem-paedagogik.uni-ulm.de](mailto:heidi.seitz@sem-paedagogik.uni-ulm.de) (Sekretariat)  
WWW: <http://www.uni-ulm.de/paedagogik/>