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Talent Development as Adaption: The Role of Educational and Learning Capital

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Running head: Educational and Learning Capital

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Abstract

In this chapter, we discuss the development of excellence of individual actiotopesunder the aspects of adaptation and regulation. First, several identifying characteristics of the development of excellence are given. It is proposed that the development of excellence be interpreted as a process of adaptation to certain environments, specifically the acquisition of functional action repertoires in talent domains. Two types of regulation are distinguished,homeostatic and allostatic regulation, followed by replies to two central questions: Who regulates and what is regulated during the development of excellence? Here endogenous and exogenous resources are discussed and the concepts ‘educational capital’ and ‘learning capital’ are introduced. To conclude, a thorough re-orientation of gifted education is advocated. In support of the regulation processes necessary during the development of excellence, attention to four principles is recommended: 1) The principle of the co-evolution of the components of the actiotope, 2) the principle of dynamic-interactive regulation, 3) the principle of capital orientation, and 4) the constructivist, or learning-pathway principle.

The notion that people change over time is relatively uncontroversial; however, less trivial are observations that many of these changes are possible only as the result of the *coordinated* actions of a very great number of processes, and, as a result, predicting their emergence is extremely difficult. The development of excellence exemplifies this type of process. However, compared tomany processes that take place without our own intervention, developing excellence is an active process preceded by an immense number of successful regulations or adjustments that, importantly, can be facilitated through appropriate attention. This emphasizesthe necessity of the correct approach to gifted education.

Explanations of excellence typically focus on two paradigms: (1) Some researchers consider it as an 'expression of gifts' (e.g. Gagné, 2011), while others conceive it as (2) the end result of the process of skill acquisition (e.g. Gruber & Ziegler, 1996). Both viewpoints have been repeatedly questioned because of their organismic asymmetry (Davids&Araújo, 2010; Dunwoody, 2006; Ziegler, 2008). The core of these critiques is both paradigms locate excellence 'within the person' (cf. Araújo&Davids, 2011; Baker & Horton, 2004; Ziegler, 2005), which leads to an unjustified narrowing of the research horizon, either limited to processes describingthe transformation of internal entities (e.g. of genetically fixed gifts into talents, cf. Gagné, 2011), or, reduced to the responsible internal conditions (e.g. the construction of an elaborated knowledge base, cf. Ericsson, Nandagopal, &Roring, 2009). This, however, represents an artificial decontextualisation of gifts and abilities (cf. Brunswik, 1955; Turvey& Shaw, 1995).

Bickhard (2008) draws attention to the fact that decontextualised conceptualisations of the object under examination are in no way unusual. They are typical of the beginning phase, a still immature state, of a scientific (sub-)discipline, where the research object is still being considered as a kind of stable substance or characteristic, a notion thatcurrently applies to the approaches of the vast majority of giftedness and excellence researchers and their view of gifts, talents and excellence development (cf. Ziegler, 2008). The necessary, subsequent step, according toBickhard (2008), is the development of a *processual* conceptualisation of the research object.

Ecological and *systemic* approaches in psychology, and especially, *excellence development* (e.g. Gibson & Pick, 2000; Vicente & Wang, 1998; Ziegler, 2005) have been important developments in this regard. They conceptualise excellence as the result of successful adaptations to specific (performance) contexts (cf. Gruber, Jansen, Marienhagen, &Altenmueller, 2010). These models consider not only the personbutthe environment to which the person functionally adapts. Excellence is thus also never a 'possession' of the excellently-performing person, but rather only a (strongly culturally defined) label that applies to specificbehavioral contexts.

Excellence development as an adaptation and regulation process

An individual's demonstration of excellence, in any domain, is underpinned by numerous interactive possibilities with the dynamic, complex environments that constitute a talent domain. However, it should be kept in mindthat actions that we call excellent, make sense, or are functional, only within the domain in question. To illustrate this with a somewhat drastic example: We will understand why, as members of our cultural community, a diver plunges into the pool after a forward dolphin spin with one-and-a-half twist. The very same manoeuvre would be incomprehensible if the same diver did it from the balcony of theirhome. Therefore, the person involved and the context of their action must always be kept in mind. For this reason also, the question 'Smart people or smart contexts?' posed by Barab and Plucker (2002) regarding the main determinants of excellence development, cannot really

be determined. Since the person and environment form one system, an actiotope[1]'smartness' can only be ascribed to the system as a whole: An effective action repertoire acquired over a long period of adaptation is functional only in the particular (performance) context of a domain.

The fruitfulness of a theoretical approach is measured above all by two criteria: Can it generate new, interesting research questions, and, what can it contribute to the understanding of observational data in a research field?

The contextualist perspective

A systemic-ecological approach brings a long overdue, largelyneglected perspective into discussions regarding the 'development' of excellence. Traditionally, excellence research has focussed exclusively on the individual. The desire was to know whether, and how, a certain person could achieve excellence. In fact, however, one could just as well ask from a contextualist perspective:

- How high is the probability that in the next 30 years a woman from China will win the Nobel Prize for physics?
- How high is the probability that a ski jumper from Saudi Arabia will win a medal in the Winter Olympic Games of 2014 in Sotschi?
- How high is the probability that in the PISA results of 2018 the average performance in mathematics in the 97th percentile of British pupils will lie above the average performance of the 97th percentile of French pupils?

Such questions fall outside the individualist perspective on excellence and show its need to be extended. The probability of excellence is decided evidently not only relative tothe individual, but alsorelative to an individual's (or group of individuals') position within a system.

The individualist perspective, that is, whether an individual can achieve excellence, requires thus the *complement* of the contextualist perspective. Together they can form a dynamic-interactive perspective on the individual and environment equally. This paradigm shift is particularly crucial whenever the question of 'how can a society increase the probability of the emergence of excellence?'is approached, for here traditional 'gifted education', with its individualist approach, collides very soon with its own limitations.

Selected evidence

Below we provide some examples highlighting thefruitfulness of a contextualist perspective. However, research in the development of excellence has, to date,notled to any robust empirical evidence on the level of usual methodological standards of empirical research. Instead, the rather anecdotal findings concern the learning process, the social as well as cultural surroundings, and the role of resources.

Learning process: The development of excellence is interpreted by most researchers in this field as the end result of an enormous learning process, usually taking at least ten years (cf. Ericsson, Charness, Feltovich, & Hoffman, 2006). During this period, a person spends a minimum of 10,000 active, concentrated hours of learning. In recent years,several research studies across a host of domains have produced a quite dependable picture of excellence development.

The learning activities are not isolated, randomly begun episodes, but rather targeted behaviours designedto improve the current state of learning. They can be described as a

[1] For the concept of the actiotope, see below.

coordinated movement through carefully arranged learning sociotopes[2] that are modified in accord with the increasing competence level (Ziegler, in press). Each new learning step requires the creation of a new learning situation precisely adjusted to the current state of competence. When, for example, a talented pianist has mastered an etude, the piano teacher will carefully select the next one that should reflect the new, higher competence level and offer an optimal learning opportunity. Excellence development should thus offer an orderly learning cascade of systematically arranged and sequenced learning environments conceptually sequenced as adaptations.

Social environment: In his seminal study, Bloom (1985a) interviewed 120 persons who had achieved excellence in various domains. He found that, in most cases, they had grown up in individually structured learning environments, for which a personal mentor had been responsible (Bloom, 1985b). For Bloom, the ability of these mentors to again and again set new learning challenges and create theappropriate learning occasions, was a precondition to the children's obtainingexcellence. Further research confirms that the social learning-environment makes a crucial contribution to the achievement of excellence (cf. Sosniak, 2006). Its function, however, is not only that it somehow'awakens' the exceptional gifts resting below the surface in the person showing talent, for these will awake from their slumber at some point anyway. Rather, it provides the active interaction partners who can develop excellence together with the talented individuals.

Important 'persons in the shadow' (cf. Gruber, Lehtinen, Palonen, &Degner, 2008; Gruber &Westermeier, in press) are, however, not limited to those who take a direct teaching function in the domain, they also include persons such as spouses, partners and parents who stabilise the actiotope of the talented individual by facilitating things like daily routines, or who can unlock access to fields where excellence can emerge, such as athletes' or performers' agents (Hancock, Ste-Marie, &Schinke, 2010).

Cultural environment: There are multiple indications that excellently performing individuals develop their excellence only through, and in the confrontation with, the surrounding culture. A very good example is the existence of so-called 'golden ages' in which prominent representatives of a domain emerge in astonishing numbers. Two famous groups of artists are the musicians Quantz, Hasse, the Marcello brothers, the two Scarlattis, Cimarosa, Lotti, Galuppi, Caldero, Jommelli, Parpora, Albinoni, Tartini, Haendel and Vivaldi on the one hand; and The Byrds, Kinks, Motoerhead, Nirvana, The Police, The Who, Rolling Stones, Sex Pistols, David Bowie, George Michael, Phil Collins, Cat Stevens, Peter Frampton and Elton John on the other. The members of the first group developed their musical excellence in, among other places, 18th-century Venice, where they were all active within a 50-year period. The second group comprised London musicians and bands from the second half of the 20th century. Even if the two groups differ in the characteristics of their music, internally they exhibit great similarities (e.g. in composing style and instrumentation). Each 'individual' artist's or band's style is thus definitely not purely individual, but rather can only be adequately understood as an interaction of the individual and the musical culture dominating in a specific geo-cultural area of the time.

Resources: The important role of resources (a systematisation of resources is to follow) to the development of excellence is a further significant indication of the necessity for a dynamic-interactive perspective. For example, the complete absence of Ethiopian Olympic champions in luge can in no way be taken as a lack of individuals with luge talent in Ethiopia. But even the most talented would find there no adequate support conditions. By contrast Germany and

[2] Ziegler (2009) defines a learning sociotope as a stable situative arrangement that permits learning increases.

Austria are considered the most successful luge nations in the world, since they have won approximately 60% of all Olympic medals in the past. In Germany, initial successes led to improvements in the already excellent infrastructure, so that theycould not only stabilise, but even advance its head start. For example, the German women have lost only one of all World Luge Championships since 1997. Currently, Germany is the only European country that possesses more than one facility for holdinginternational competitions (it has four). Furthermore,they offer excellent training conditions year round while many other nations are limited to training during the winter months. The great success of the Germans is therefore definitely not only due to their individual sledding talents, but also, and not insignificantly, to the creation of training facilities that are unique by worldwide comparison.

A systemic approach: the Actiotope Model

Csikszentmihalyi (1996) in his interviews with especially successful persons – Nobel Prize laureates, exceptional creative artists, etc. – arrived at the conclusionthat excellence is not localised in the person, but in the system of the person and environment: A person exhibits actions that in certain contexts are accorded the label ‘excellent’. This perspective raises a series of theoretically important questions including ‘how can acquisition and demonstration of excellence, as well as the conditions supporting these processes,best be analysed?

The Actiotope Model attempts to provide these answers on the basis of a systemic approach where excellence is understood as the consequence of an enormous number of successful adaptations to environments. Expressed differently and more concretely: A constantly richer action repertoire is built up that permitsmore, and also more effective, actions in a talent domain.

An actiotope consists of the acting individual and the environment with which he/she interacts in his/her actions.

An actiotope is not static and unchangeable, but changes as each new goal is set during the process of developing excellence. The resulting adaptation comprises the four components of the actiotope (for details see Ziegler, 2005).

First, an *action repertoire* is built up that permits functional actions in the talent domain. Second, *goals*are adjusted repeatedly, which is important so learning opportunities are optimized. Third, constantly new *environments* thatoffer optimal learning conditions for each learning stepare necessary for the permanent widening of the action repertoire. Fourth, each possibility of a further action opens access to the challenge of a new goal. These can be realised in a continually growing number of contexts. If, for example, multiplication has been learned, this skill can be applied to many new goals in very different situations. There is thereforea need to coordinate a richer action repertoire, more diverse goals and more numerous contexts. In terms of the Actiotope Model this means that the *subjective action space* must be adapted, where the possibilities for action are generated and selected. The latter occurs when the best action for reaching the currently pursued goal is selected from the action repertoire.

Regulation types

During the development of excellence, individuals find themselves in a continuous process of targeted (self-)modification, the most visible result of which is an increasingly functional action repertoire in some domain. Such adaptations to a domain are,

however,evidently not autocatalytic (i.e., processes proceeding by themselves), but rather require multiple regulations (cf. Alexander, Dinsmore, Parkinson, &Winters, in press).

Regulation relates to the directed influencing of system behavior, i.e. the transition from one condition to another.

Gifted education must realise that the development of excellence consists of an extended sequence of highly structured, successful learning episodes based on the principle of co-evolution (Ziegler, 2005). Such orderly processes are not self-evident, but the result of regulations. Unfortunately, most regulations are still unknown, and of those that are known, almost all are poorly understood. However, we will see below that there are at least two types of regulations: homeostatic, and allostatic, with the second especially relevantfor the development of excellence.

The concept of homeostatic regulations and their limitations in explaining the development of excellence

During the development of excellence, the usual regulation processes typical for human beings are always 'running in the background', so to speak. Among these are thermo- and osmoregulation, emotive regulation and the maintenance of social relation structures (e.g. familial interaction patterns). In these, it is (mostly) a matter of homeostatic processes that serve to maintain the required steady states.

Homeostatic regulations serve to maintain nominal states of systems.

In the explanation of the development of excellence however, the homeostasis concept evidently has its limits, since the development of excellence aims to purposely change normal states of function,not maintain them. In fact, researchers of differing theoretical provenance have already notedthat the homeostasis concept is insufficient in accounting for all the behaviors that serve to change the subject and lead to modifications of goal states (cf. Kanfer, 1987; Maturana& Varela, 1991). This leaves two paths open: If a theoretical concept shows itself to be insufficient, it is usually either replaced by a better concept that allows a greater range, or, it is augmented with a complementary concept, so that the phenomenon is (more) completely captured (Stegmueller, 1976).

In the present case, the first path indeed seems less advantageous. While various further developments in the homeostasis concept have been discussed, the most prominent being 'homeodynamics' (cf. Maturana& Varela, 1991), they all share the same disadvantage: the unsuccessful attempt to extend the homeostasis concept from the maintenance of nominal states to the new concept. For this reason the second path, the introduction of an additional concept, is preferred.

Allostatic regulations during the development of excellence

We should thus seek a complementary concept to homeostasis. The combined reach of the two concepts should be great enough to describe all the regulations occurring during the development of excellence. In the search for a concept it is advantageous to remember two striking characteristics of the development of excellence, the *quantity*in terms of time of the necessary learning processes, and the *quality* of these experiences.

One of the first attempts to quantify the development of excellence was undertaken by Simon and Gilmartin (1973). They estimated through computer simulation the number of domain-specific units of knowledge thatan excellence-level performing person must have at

their disposition, at somewhere close to 100,000. This estimate is, however, probably too low (Ziegler &Phillipson, in press), but even if the number were not much higher, it would be mistaken to believe that acquisition is simply the end result of obtaining that many (i.e., 100,000) learning episodes. The many connections that exist between the units of knowledgealso have to be learned. In addition, erroneous items may be learned which have to be corrected – often with considerable trouble (Ericsson et al., 2006). But whereas most persons usually avoid dealing with their shortcomings and try to maintain a positive self-view, later experts consciously choose just those areas for learning they are still bad at. Thus, it comes as no surprise that later experts often describe the quality of their learning experience as largely negative – and to some extent downright aversive(Ericsson, 1998; Ericsson, Krampe, &Tesch-Roemer, 1993).

Quantitative and qualitative observations thus pose the question 'how are some persons able tosucceed in directing their actions steadily over such long periods, despite considerable negative experiences along the way?' To express this in technical terminology: Why do these persons maintain themselves in a meta-stable state during their development of excellence over several years?Why do further regulations lead repeatedly to attaining a further meta-stable state, while the process of transition is associated with (often) negative emotional qualities? Would it not be much simpler to forego the daunting adventure of the development of excellence, and aim instead for a stable state that does not feature the negative emotional quality of the former and perhaps even provides some level ofsatisfaction?

One of the popular answers to this problem says that talented individuals who hold through this task are precisely those possessed of an enormous motivation (the 'rage to master') that drives them ever further (c.f., Winner, 1996). Although the validity of this assumption is still questionable, motivation could offer an explanation for why someone regulates with great determination, but gives no clue about which form of regulation is involved.

The concept of allostasis, originally developed in medicine by McEwen and Stellar (1993), offers some promising analytic possibilities for the quantitative and qualitative characteristics of the development of excellence as discussed above.It refers to mechanisms of the targeted adjustment of the organism in reaction to challenges. An important characteristic here is that continually new resources must be activated in order to attain (meta-)stable states.To make allostasis a suitably complementary concept to homeostasis, we define it for our purposes as follows:

Allostatic regulations serve to attain new, adjusted steady states, which require the activation of new resources.

Usingthe homeostasis and allostasis concepts,all the regulations occurring during the development of excellencecan be considered (i.e. those that serve the maintenance or attainment of newly adjusted nominal levels), particularlythose that show one or both of the following two characteristics: (1) The regulations adjust the (new) target states (for example, yesterday's target state of learning, that is, yesterday's just attainable learning goal, is today too low because of increased competence). (2) The regulations activate advantageous resources (for example, 'didactic educational capital', see below) related to the new target state, so that the new target state becomesmore attainable.

In regard to the second characteristic, the nature of what these important resources are has not been systematically investigated either in giftedness or excellence research. We consider these resources below.

Resources

How is the development of excellence regulated and what resources are required? Above all, biographical analyses of persons performing at the excellence level provide various indications (e.g. Bloom, 1985b; Simonton, 1977; Wallace & Gruber, 1989). On their basis we propose a differentiation between two kinds of resources. *Endogenous resources* can be regulated only through a system and its subsystems. Because we are focussing on the development of excellence, we are referring in the following only to individuals. *Exogenous resources* can be regulated equally through the system (in this case, the individual) as well as further systems (e.g. family, society).

'Resources' are, by definition, means that can be employed to attain goals. To borrow from a now widely-used terminology, in the following they will be called various types of 'capital' (cf. Bourdieu, 1983), but this concept will be further expanded to include variously appearing forms of capital. This is necessary, among other reasons, because for the first time exogenous and endogenous resources are differentiated. In the following, we refer to them as*educational capital* and *learning capital*.[3]

Exogenous resources: educational capital

Many sciences grasp their object not as a singular entity, but as part of a field or system (Kauffmann, 1995). This makes it possible for them to deal with research questions from the contextualist perspective discussed above. For the analysis of the problem that excellence is distributed unevenly over systems (e.g. different countries, or sports teams), Ziegler (in press) proposed the use of the concept of educational capital.

Educational capital is thatwhich can be (but needn't be) employed for improvement of education and learning. It can be regulated through individuals as well as further systems.

The 'degree of resolution' of an analysis of educational capital can vary according to the question at hand. The system of interest can be an actiotope, a family, school, political district or educational system of a country. Central are the two questions: (1) What educational capital is available, and (2), how it is applied. For this, five forms of educational capital – that at least partially overlap – are identified (see Ziegler, in press).

Economic educational capital is every kind of wealth, possession, money or valuables that can be invested in the initiation and maintenance of educational and learning processes.

Economic educational capital plays an overarching rolein the support of excellence, but has not received sufficient recognition in giftedness theories. If one compares societal systems, one finds particular clusters of excellence that closely correlate with the availability of economic capital (e.g. Hanushek&Kimko, 2000; Lynn &Vanhanen, 2002; Rindermann, Sailer, & Thompson, 2009), and educational systems indeed claim a considerable proportion of the public expenditures of nations. The same is true for the total of top-level support, for which unfortunately there are no meaningful statistics. Yet many relations are evident; for example, Nobel Prizes for science are won exclusively by researchers from institutions in economically strong countries with high per capita gross national product. Without the strong

[3] The concept "capital" was for four reasons preferred over that of "resource". First, it can reasonably take on a negative value (e.g. debt); second, various types of capital are (at least within limits) convertible; third, capital connotes, better than resource, that it - as a rule - must be earned and, fourth, can grow.

engagement of economic educational capital, many inventions and innovations are simply not possible. Some research fields (e.g. particle physics) require extremely large investments that only the richest countries can afford (cf. Ammermueller& Lauer, 2007).

Economic educational capital is naturally also applied as targeted support for individuals. It is used, for example, to pay for stimulating toys, special tutors and mentors, musical instruments and instruction, sports equipment, good schools and much more.

Economic investments in education and excellence bring numerous secondary effects, which underscore the necessity for a complementary, contextualist perspective. They attract, for example, human resources, as when top-class research institutions have a greater probability of attracting and engaging high-performing researchers, often from other countries. The superior research opportunities (and facilities) permit the newcomers to do even better research, resulting in a positive feedback effect.

Cultural educational capital includes value systems, thinking patterns, models and the like, which can facilitate – or hinder – the attainment of learning and educational goals.

The research literature contains many indications that culture influences the emergence of excellence. The example of the ‘golden ageof music’ was already mentioned (cf. Pfleiderer, 1877); however, culture can also refer to smaller systems, such as religious communities (as in Max Weber’s famous ‘Protestant work ethic’; Weber, 1934), elite schools and universities, orchestras or sports teams. Culture can also hinder the emergence of excellence and thus be ‘negative cultural capital’.

There are also now interesting research results on how culture affects individual action (e.g. in ‘stereotype threat’, cf. Martiny& Goetz, 2011; Steele, James, & Barnett, 2002, or ‘dysfunctional attributive styles’, cf. Campbell & Henry, 1999; Nauta, Epperson, & Waggoner, 1999). For example, culture is unfavourable to women’s development of excellence in STEM fields[4] when in the culture of origin the conviction dominates that they are less well suited to achieve in these areas (Dweck, 1999). And in fact the rates of women’s participation in STEM fields around the world are especially low wherever this stereotype is strongly manifested (Stoeger, 2007). It is no accident that, despite women possessing comparable gifts to men, during the whole of the 20th century only five managed to win Nobel Prizes in the natural sciences.

Social educational capital includes all persons and social institutions that can directly or indirectly contribute to the success of learning and educational processes.

Social educational capital can be employed to directly improve learning processes as well as creatingmore favorable surrounding conditionsfor learning to occur.Social educational capital applied directly to improve learning processes includes mentors, trainers, pedagogues, teachers, professors, teacher organisations, etc. The greater their number, their personal engagement and their teaching and supporting abilities, the greater is the probability of excellence emerging.

Learning is a situationally embedded process. Social educational capital can be the means to gain access to specific learning situations (e.g. through sponsoring, scholarships, social connections, support associations or networks) or for improving the situative learning conditions (e.g. supportive partners, engaged parents, neighbourhood helpers). A striking example is the typically very contrasting availability of social educational capital to central European men and women interested in STEM fields (Stoeger, 2007). While a woman is often the positive social educational capital for her male partner, by supporting his career in a

[4] STEM is the acronym for *S*cience, *T*echnology, *E*ngineering and *M*athematics.

STEM field, the male partner unfortunately often represents negative social educational capital for a female partner, if for example he makes excessive claims on her availability for household and (child-)care duties and thereby negatively influencing her learning opportunities.

Infrastructural educational capital relates to materially implemented possibilities for action that permit learning and education to take place.

Infrastructural educational capital influences the chances of excellence in two ways. The availability of infrastructure can, first, awake interest. A sports field in a neighbourhood increases the probability that a child will come there to play football; a nearby swimming pool raises the chances that a child will learn to swim. Second, infrastructural educational capital offers specific learning possibilities. The example of the excellent infrastructural conditions for sledging in Germany with the worldwide highest number of professional facilities has already been mentioned. Many more examples could be given, ranging from the equipping of preschools with high-quality play and learning materials, schools with learning media, to the institution of tertiary education facilities, all the way to special research programs such as CERN.

Didactic educational capital is the assembled know-how involved in the design and improvement of educational and learning processes.

For almost all domains that attract enough interest, in recent decades the average and top performance levels have risen. What were earlier practically unplayable music pieces now belong to the standard repertoire of professional musicians, world records have been repeatedly dramatically surpassed and, if IQ tests were not continually adjusted, the average IQ would also have significantly risen in recent decades (e.g. Flynn, 1987, 2007). These rises in performance levels are due partially to enormous increases in didactic educational capital. Improved training methods, superior teaching planning, perfected instruction techniques, pedagogically better organised learning feedback, more finely structured learning sequences, targeted improvements in individual learning competence etc., make possible ever higher returns on learning effort in ever briefer periods. Thus, today's advanced high-school students can demonstrate possession of mathematics skills that the best mathematical minds of earlier centuries needed decades of study to master.

Endogenous resources

Learning capital includes that which is exclusively accessible to individuals for improvement of education and learning.

Endogenous resources are subject exclusively to regulation by the system (in our case, the individual) and its subsystems. This does not mean, however, that they cannot be *indirectly*, exogenously regulated. For example, parents attempt this by such pedagogical techniques as praise and blame. However, praise and blame first need to be processed by the recipients, as illustrated by, for example, paradoxical praise effects (cf. Binser&Foersterling, 2004).

Organismic learning capital consists of the physiological and constitutional resources of a person.

The body of a person is an important constituent of every learning process. This seems trivial in domains such as sports, where health, conditioning, flexibility, endurance, power, etc. are the all-important determinants of effective training and performance. Bodily fitness is,however, also an important precondition for top-level cognitive activity (e.g.,Bellisle, 2004; Gottfredson, 2004).

Actional learning capital means the action repertoire of a person – the totality of actions they are capable of performing.

Actions are not limited to voluntary motor movements. Arguments are available for a broad concept of action, as employed, for example, by the Actiotope Model (Ziegler, 2005) where actions comprise all bodily changes intended to serve the attainment of action goals. This explicitly includes cognitive activities.

Persons differ as to what actions they could possibly carry out at a given point in time. That can be organismically grounded, for example, in differences in mobility, power or endurance. These inter-individual differences, however, can also rest on differences in procedural or declarative knowledge (e.g. Anderson, 1976). Research studies have shown that the current action repertoire of a person is an excellent predictor of later performance (e.g. Ziegler, 2008). For this reason, talent support is often directed towards those groups of persons who have already demonstrated notable performance, that is, have shown a high level of actional learning capital (e.g. Gershon, Kiderman&Beller, 1996; Roecker, Schotte, Niess, Horstmann, &Dickhuth, 1998).

Telic learning capital comprises the totality of a person's anticipated goal states that offer possibilities for satisfying their needs.

Goals refer to states of the world (internal as well as external) that we wish to realise through actions. They have often been conceptualised as the result of very rapid decision-making processes in which we weigh up the probabilities of success and the values of possible alternative actions (cf. Atkinson's pioneering studies of 1957, 1964). These and similar conceptualisations hide the fact that functional goal-settings are preceded by a learning history. People are constantly forced to adjust to changing environments. A part of the change is the result of a deliberate design of the environment to satisfy personal needs (e.g. agriculture, snack stands, clothing shops or public transportation). If itsfunctionality is decreased, it is altered, which has the consequence that the anticipatory (i.e. expected) goal states in which the satisfaction of needs can take place are permanently subjected to change. For example, as small children we all learn what things in our environment are edible. Noodles are edible, while grass is not.

Telic learning capital, that is, the accessibility of functional goals for the learning process, is in at least two ways a significant resource during the development of excellence. It is, first, useful for the creation of favorable framework conditions of learning (e.g. planning rest-periods, so that the next learning step is undertaken in a condition of optimal fitness; setting up a functional workplace). Second, it can be employed to set up functional learning goals that promise greater competence growth (Cleary & Zimmerman, 2001; Kitsantas& Zimmerman, 2002; c.f., also the functionality of learning goal vs. performance goal orientations; e.g. Stoeger, 2002).

Episodic learning capital concernsthe simultaneous goal- and situation-relevant action patterns that are accessible to a person.

In many different domains (e.g. music, natural sciences, team sports, chess; numerous examples in Ericsson et al., 2006),experts possess an enormous repertoire of standard solutions for typical situations. While actional learning capital comprises only *possibilities* of action, standard solutions contain effective couplings of (1a) infrastructural educational capital with (2a) actional and (3a) telic learning capital. More concretely, episodic learning capital consists of effective episodic knowledge that comprises (1b) potential action contexts as well as (2b) possible successful actions therein for the (3b) attainment of functional goals. Such episodes include, for example, automatic actions, accessible solution routines or intuitions. It has been demonstrated, for example, in many interactive sports that experts better recognise and remember strategic moves (e.g. Starkes, 1987), are better able to anticipate actions of their opponents on the basis of their relevant experience(Abernethy, 1990; Loffing, Schorer, Hagemann& Baker, 2012), and to structure flexibly and highly functionally the typical temporal progressions of play and their consequences (Gruber & Ziegler, 1993).

Attentionallearning capital denotes the quantitative and qualitative attentional resources that a person can apply to learning.

Attention,as a limited resource, has been conceptualised mainly from three perspectives. It is thought of in terms of: (1) the object for which one seeks attention (e.g. Franck, 1998); (2) as a temporally limited entity (can be evoked only for a certain time) (Ericsson, 1998); (3) as a selective limitation on tranches of perception (i.e., one cannot simultaneously focus on all of what one perceives; Navon&Goher, 1979; Schneider &Shiffrin, 1977). For the development of excellence, all three aspects play important roles.

A domain must (1) attract the attention of a person so that they focus optimally (2) for a sufficient lengthand (3) selectively on the improvement of their performance. Just some degree of occupation with a domain is not enough to attain an excellent action repertoire in it. Research by Ericsson (e.g. Ericsson et al., 1993) in particular, has repeatedly shown that to attain substantial performance gains, routinely extensive, well-planned sequences of learning behaviors are necessary (‘deliberate practice’). Their execution requires a very high level of attention. Interestingly, in turn,better attentional performancebecomes characteristic of an increasing development of excellence (e.g. Abernethy & Russell, 1987).

Four consequences for gifted education

The development of excellence has been described in this chapteras an adaptation during which a functional action repertoire for specific talent domains is built up. Because this is not an autocatalytic process, numerous partial processes require regulation. On the one hand, it is a matter of homeostatic regulations aiming to maintain target states while on the other,allostatic regulations try to achieve modified target states by the application of new resources. The latter regulation type is characteristic of the actual development of excellence, that is, the acquisition of a functional repertoire of actions in a talent domain. As described in the previous sections, the resources applied during the process can be summarized aseducational capital and learning capital.

The adaptive process *is directional* and follows an incremental principle: The modification of the actiotope through regulations proceeds continuously in the direction of excellence (Ziegler, Fidelman, Reutlinger, Vialle, &Stoeger, 2010). Most persons who occupy themselves with a particular domain will, however, at some point cease with their learning efforts at some level of performance that seldom fully challenges the individual developmental possibilities. The regulation efforts thereby cease to be effective, are stopped from without or by the learners themselves. These crucial points provide the best

opportunities for gifted education to intervene and assist. Its task is to improve the adaptation of the actiotope towards excellence through measures to support the regulations. Four general principles, on the basis of how this should take place, are dealt with in the concluding section below. They imply a radical re-orientation of gifted education.

1) What is regulated?The principle of co-evolution of actiotope components

Systemic-ecological approaches proceed from the assumption that each localised change has an effect on the total system. Each learning step creates, therefore, the need for new regulation. In order that this not proceed chaotically, co-evolution is necessary, that is, the system must develop further in an orderly way, so as to retain its stability. For gifted educations this means that educational objectives will not be attained if attention is concentrated only on the support of a single element. Gifted education support must therefore be holistic. Its goal is the further development of the total actiotope without threat to its stability. The focus here is not only the continued acquisition of an excellent action repertoire, but also the coordinated adaptation of goals, environment and the subjective action space.

Gifted education is full of examples of just how difficult the task of co-evolution is and how insufficiently known are the multiple feedback possibilities of actiotopes. An impressive example is the studies by Freeman (2006a, 2006b), which demonstrate how often even the smallest interventions in the course of development can overtax the regulation skills of pedagogues and produce serious negative consequences. Just the information, communicated to talented pupils, that they in fact are talented, is an enormous risk factor for their further development. Some of the empirically well-demonstrated risks indicated by Heller (2004) are "social isolation, development of egocentric attitudes and behaviors, endangering or disturbing the personality development and self-concept through extreme achievement pressures or too much responsibility" (p. 308). Indeed, he recommends that exclusively professional counsellors should inform persons about their special gifts (Heller, Reimann, &Senfter, 2005). Their expertise in regulation is simply greater.

2) Who controls the regulations?The principle of dynamic-interactive regulation

It should be evident that the development of excellence is not achieved by the learneralone. Trainers, mentors, giftedness counsellors etc., put didactic educational capitalat learners' disposition, provide access to learning sociotopes, etc. (see Grassinger, Porath, & Ziegler, 2010). In short, the regulations require many types of cooperation and coordination between the learner and persons directing the learning process (e.g. mentors), but also with persons who create the necessary framework conditions (parents, comprehending and supportive partners, etc.).

For gifted education, this means that the hope held by many that talented persons should be able to regulate the development of excellence largely by themselves, is illusory. The occasional suggestions or advice from experts, summer-schools or enrichment programs are not sufficient. Instead, stable conditions for dynamic-interactive regulation, such as mentor-mentee relationships enriched with multiple resources, must be established and empirically verified (Grassinger et al., 2010).

Unfortunately, the complexity of the necessary regulations is, even in many mentoring situations, dramatically underestimated (Stoeger, Ziegler, &Schimke, 2009). Therefore, a much greater professionalization is necessary than previously provided. 'Classical' regulation notions (simple cause-and-effect relations) hardly do justice to the reality. These regulations are characterised by effects, unintentional side-effects, consequences with multiple feedback loops, self-reinforcing mechanisms and non-linear transitions (Ziegler &Stoeger, 2009). In order to regulate actiotopes over a period of years, mentoring, coaching and the like offer, in

principle, a good framework, but high-level expertise in regulation must be added. Without professional, or at least very experienced, coaches, trainers, mentors or teachers, the achievement of excellence is extremely unlikely.

3) What resources do regulations require? The principle of capital orientation

This chapter has shown various examples of how, because of lack of resources, the process of excellence development can break down, or arrested-performance can appear (Krampe& Ericsson, 1996). The many overt forms of exogenous and endogenous resources(i.e. educational and learning capital) have already been mentioned. Because the development of excellence requires that all of them be sufficiently available precisely when needed, they must be correspondingly taken into account in the identification of talent as well as in gifted education. This means that in talent identification, the availability of all five forms of educational capital and all five forms of learning capital should be surveyed. Gifted education must ensure that sufficient educational and learning capital is available to enable each new learning step to take place.

4) What is the chronological horizon of identification and support? The constructivist or learning-pathway principle

Identification of talent is mostly done with reference to the status quo; the future developmental possibilities are seldom examined in detail. In fact, however, future learning possibilities should be actively investigated and constructed. The projection should extend over periods that are much longer than the brief support and intervention periods of traditional talent support. The aim is to elaborate an *individual 'learning pathway'*thatdescribes the construction of a functional learning repertoire in a domain up to the attainment of excellence. The supply of endogenous and exogenous resources must be, over the entire learning pathway, permanently available in sufficient amounts. The absence of these resources makes the development of excellence extremely difficult if not impossible.

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