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EDITORIAL

Do we need a paradigm shift? Arguments for and against a systemic theory of giftedness research and education

With this issue of *High Ability Studies* we continue our tradition of having distinguished colleagues comment on target articles. In the first two target articles, Robert J. Sternberg (2003) and Françoys Gagné (2004) initiated a discussion about their conceptions of giftedness. In the third target article, Anders K. Ericsson, Roy W. Roring, and Kiruthiga Nandagopal (2007) established connections between giftedness research and expertise research. They argued in favor of basing work on empirical evidence of giftedness which meets the standards of laboratory science rather than upon definitions and models of giftedness, as giftedness research has traditionally done. The three researchers' contribution elicited a response which was, in part, quite critical. Yet by and large colleagues concurred that giftedness researchers can benefit a great deal from expertise research – in particular with regard to research designs and the amount of attention paid to intensive learning processes and deliberate practice.

In this issue, Albert Ziegler and Shane Phillipson make their case in the target article, "Towards a systemic theory of gifted education", and therewith for a paradigm shift in giftedness research and gifted education. The authors illustrate the necessity of such a shift by describing the problems inherent in current approaches to gifted education. The authors draw attention to evidence (provided by meta-analyses, for instance) of the ineffectiveness of traditional gifted education. Already their consideration of the reasons why current approaches to gifted education fail to achieve desired results offers valuable insight into the potential benefits of a systemic approach. Ziegler and Phillipson note that although giftedness research is, in many respects, more progressive than gifted education, it has a lot to gain from a paradigm shift towards a systemic giftedness theory especially because of its current variable focus. After clarifying the system concept as well as ancillary terms and constructs, the authors explain how the Actiotope Model of Giftedness fulfills a systemic conception of giftedness by describing its components as well as the systems and dynamic perspectives germane to the model. The concluding part of the target article, in which the authors derive the basic principles of a systemic gifted education from their theoretical concept, is particularly stimulating in that they differ considerably from the current practice of gifted education.

High Ability Studies received 49 peer commentaries from 17 nations in response to Ziegler's and Phillipson's article. A majority of these viewed the idea of a paradigm shift wholly or largely positively. This enthusiastic and positive reaction bespeaks the promising and innovative nature of Ziegler's and Phillipson's position. At the same time, some colleagues expressed reservations about such a paradigm shift. Due to overall length restrictions, we are unfortunately only able to print 27 of these peer commentaries in the current issue. Selecting the smaller number of

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commentaries for publication proved difficult as all of the peer commentaries were interesting and thought provoking. In order to offer readers a representative picture of all 49 commentaries we selected a representative number of comparably positive, neutral, and critical stances towards the target article for publication. We have forwarded all published and unpublished peer commentaries to the authors of the target article to give them an idea of the broad and intense scientific discussion surrounding their topic.

The additional ideas and, in particular, the points of criticism offered by the peer commentaries offer interesting possibilities for further discussion of a paradigm shift towards a systemic perspective. Hopefully these ideas will prove useful to the scientific community in various ways. We are looking forward to perhaps even further new ideas when the authors' rejoinder appears in the next issue of *High Ability Studies*.

This issue not only presents a new theoretical approach to the field of gifted education. It also inaugurates a number of organizational changes. Our longtime editorial assistant, Dr Robert Grassinger, will no longer be able to carry out his duties due to new professional responsibilities. I would like to offer him a special word of thanks for his impeccably competent and unwavering support over the last five years. At the same time, I am very pleased to present and welcome our new editorial assistant, Judith Schmirl, whose highly engaged and informed work already started with the preparation of this issue.

An additional development to be noted is our new online submission system, which will help us to manage and edit submitted manuscripts more efficiently and quickly. In the future, manuscripts should be uploaded via http://mc.manuscriptcentral.com/chas. We look forward to many exciting new contributions.

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Towards a systemic theory of gifted education

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In this target article, we argue that current approaches to gifted education are based on the erroneous view that to understand the development of exceptionality we need to understand firstly the components of giftedness, including cognitive such as intelligence and non-cognitive factors such as motivation. In contrast, systemic approaches to understanding exceptionality focuses on the interactions of these components where it is important to firstly understand the system that leads to exceptionality before it is possible to understand its components. After analyzing the weaknesses of current approaches to gifted education we then present three central arguments for the need for a paradigm shift. This is followed by an introduction of constructs of a systemic approach of gifted education. Using the Actiotope Model of Giftedness to understand the development of exceptionality, this article describes the basic principles of a gifted education that is based on this systemic approach.

Keywords: Actiotope Model of Giftedness; gifted education; systems theory; exceptionality

Introduction

Talent and giftedness research has traditionally focused on an exclusive group of *individuals* with the potential for exceptional accomplishments in one or more area (Heller, 1989). An alternative perspective views *systems* as the origin of excellence and of its potential to develop excellence (e.g., Phillipson & Callingham, 2009; Phillipson & Sun, 2009; Ziegler, 2005; Ziegler & Stoeger, 2004a). Such a system comprises (1) the individual, including her or his subsystems, and (2) an individual's external environment.

This target article describes our effort in constructing a systemic theory of gifted education. This conceptualization offers a theoretical and practical alternative to an entrenched method of educational support – more or less unchanged for a century – based on acceleration, enrichment, ability grouping and on targeted financial support, usually provided in the form of scholarships (Petersen, 1916; Ziegler, 2008). Since the change we describe is monumental, it is appropriate to speak in terms of a paradigm shift.

The need for new paradigms is both legitimate and necessary whenever existing paradigms become entropic or stagnant and no longer address current demands (Kuhn, 1962; Lakatos & Musgrave, 1970). Thus we will use the first two sections

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of this article to justify and develop the systemic approach to gifted education by juxtaposing it with current methods.

Current approaches to gifted education

An understanding of the theoretical premises upon which current approaches to gifted education are founded helps explain its problems. We commence by discussing the bases of current approaches to gifted education and will proceed to an analysis of its educational objectives. Lastly we will explain in what regard current *research* into giftedness is more advanced than the current *practice* of gifted education. Nevertheless, there are still serious deficiencies in this research that precludes any sustainable development in gifted education.

The roots of current approaches to gifted education

Pioneers of giftedness research such as William Stern (1912) in Europe and Lewis Terman (1922) in the United States were firmly rooted within the tradition of the scientific revolution of the modern era. Their strengths as well as their weaknesses influenced their output and were formative for the nascent discipline of giftedness research.

The scientific revolution of the modern era reflects the contributions of two illustrious thinkers. Galileo Galilei directed scientific attention towards those phenomena which could be measured, quantified, and described through the maxims of natural laws (see Sharratt, 1994; Weidhorn, 2005). Exploration of the human mind, as we find it today in phenomena such as IQ measurements, would be impossible without his contributions. René Descartes's fruitful development of these ideas a generation later was a logical next step. His analytical method was based on the premise that a complex phenomenon is best understood by identifying its component parts and explaining the overall phenomenon through understanding the combined effects of these (see Gower, 1997; Gullberg, 1997).

At that time it was not a coincidence that the machine was the dominant metaphor for explaining the natural world: To understand the world it is sufficient to simply identify its component parts and how they are put together. A mechanistic view relies on discovering and applying the laws that govern the interactions of its parts.

The undisputable success of the mechanistic metaphor – especially in physics, which was long viewed as the preeminent scientific discipline – explains why this view of science remains popular. Indeed, almost all current models of giftedness function within this tradition. Giftedness is dissected into its measurable component parts. Viewed together, these component parts are meant to facilitate the prognostication of above-average or excellent achievements.

Given this context, it is not surprising that multifactorial models of giftedness (e.g., Gagné, 2004; Heller, 2005; Mönks, 1992; Tannenbaum, 1983) are currently the most influential theories of giftedness by a wide margin. These models identify an ensemble of factors which represent giftedness. Typically they distinguish between three types of factors, including those factors that:

- Pertain to giftedness in the narrower sense (e.g., verbal, nonverbal, and quantitative abilities).
- Include non-cognitive internal factors (e.g., motivation, control beliefs, anxiety).
- Include external factors (e.g., friends, classroom climate, home environment).

The assumption is that knowledge of the nature and effects of these factors will allow for the prediction of exceptional accomplishments. The fingerprint of an approach to science rooted in the tradition of Galileo and Descartes is clearly recognizable here.

The mechanistic approach is most easily recognized in the processes for identifying giftedness (Ziegler & Stoeger, 2008a). For example, Heller's and Perleth's (2007a, 2007b) Munich Giftedness Test Battery (MHBT) follows this method. The authors reduce a given case of giftedness into numerous components (e.g., thought and learning potential, knowledge, originality, social, verbal, quantitative mathematical, and nonverbal capabilities, as well as originality, cognitive flexibility, social cognition, expectations of success, fear of failure, attentiveness, quality of instructional support). Reflecting on the inadequacies of the mechanistic approach, commonly referred to as Laplace's "demon", we believe it is flawed to suggest that measuring each of these factors can provide the basis for predicting exceptional performance.

The practice of gifted education

Traditional approaches to gifted education are based on the implicit assumption that protecting gifted individuals from inhospitable surroundings should suffice for ensuring that the most can be made of their potential.[1] Such a strategy represents an autocatalytic approach to gifted education and it is precisely in this respect that we can see how the current approaches to gifted education have fallen behind the mutifactorial models of giftedness that specify both the internal and external requirements which need to be fulfilled before potential can be realized. Yet it remains the case that more than 90% of the funds allocated for gifted education are channeled into a number of well established strategies (Ziegler & Stoeger, 2004b). These strategies and their justifications include:

- scholarships which are supposed to protect talented individuals from disadvantageous financial circumstances and the threat such conditions pose to their financial independence during their studies;
- ability grouping (e.g., schools or classes for gifted individuals) which ensure that gifted individuals are not held back by the slower pace of learning among individuals of average abilities;
- accelerating programs which are also intended to prevent gifted individuals from being held back by the lower learning speeds of their peers;
- enrichment programs aimed at adding breadth and depth to the learning experience and to forestall any peer influence which could slow the pace of learning;
- pull-out programs which combine the benefits of acceleration, enrichment, and ability grouping through the temporary removal of gifted students from regular instruction for special instruction.

Typical of these support efforts is that they are hardly tailored to individual needs and instead applied to groups. We argue that not one of these strategies truly focus on improving the learning competencies or motivation of individuals. In reality, these approaches are mainly defensive because they are aimed at *protecting* gifted individuals from deficiencies in the learning environment. In particular, an education system

that focuses on the learning of individuals with average abilities is seen as detrimental to those students with the potential for exceptional achievement.

Using the parlance of inclusive education, this approach focuses on the "deficits" of the education system. Hence, any support measures for gifted students are designed to overcome these deficits and based on the premise that giftedness is a personal trait that compels individuals in an autocatalytic manner towards exceptional performance.

This premise also makes it necessary to identify gifted students before implementing support measures. In Hong Kong, for example, the gifted education policy is heavily reliant on trait models of giftedness, referring concurrently to the Marland definition of giftedness, psychometric intelligence and multiple intelligences (Phillipson, Phillipson, & Eyre, 2011). At exceptional levels of giftedness, corresponding to Tier-3, it is increasingly more problematic to identify the target students.

The focus on variables in traditional research

In the current paradigm, educational research has focused on identifying a list of variables that can support the development of excellence. Such variables include interests, creativity, and attributions (see the overviews provided by Colangelo & Davis, 2003; Davis & Rimm, 2004; Heller, Mönks, Sternberg, & Subotnik, 2002; Shavinina, 2009). Indeed, the problem with these measures is that they usually focus on just one variable. In this sense they remain stuck in the tradition of analytic approaches going back to Descartes. The implicit hope accompanying such efforts was that a focus on precisely one or another variable should have a generally positive effect on learning ability. The problem, however, is that this hope has remained unfulfilled. A general improvement in performance based on the encouragement of any one particular variable has yet to be documented. Probably the single most unambiguous result is that, to the contrary, pedagogic support focusing on one particular variable or a small number of variables demonstrates little to no efficacy. In the few cases (see Lipsey &Wilson, 1993) in which such measures have shown a salutary effect, the benefits have remained temporary and limited to the particular target variable.

Reasons for a paradigm shift to systemic gifted education

Largely rooted in the mechanistic research paradigm, current approaches to gifted education have been in place for about a century, thereby accruing a considerable body of practical experience. Clearly, any shift from this approach should not be made lightly. In this section, we will establish that current approaches to gifted education are largely ineffective and provide what we believe are compelling reasons why a systemic approach to gifted education offers a better understanding of the causes of this lack of efficacy. We also provide evidence that a systemic perspective will lead to a better understanding of the development of excellence.

Ineffectiveness of traditional gifted education

The 1990s witnessed a severe crisis of confidence within gifted education. Lipsey and Wilson's (1993) meta-analysis on the best research available at that time concluded that gifted education was not even remotely capable of supporting talented students in reaching their potential. Based on evaluation studies which fulfilled certain standards of quality, Lipsey and Wilson calculated average effect sizes and showed that the effect sizes ranged from minimal to, at best, moderate.

Moreover, Lipsey and Wilson (1993) conjectured that there was a systematic over-evaluation of the actual effects since the research failed to account either publication bias or placebo effect.[2] Once these two factors had been accounted for, traditional gifted education proved to be almost completely lacking in efficacy. Simply put, the empirical basis of traditional gifted education had been discredited.

How could this situation have developed? How was it possible that giftedness researchers could seemingly fool themselves for so long? Joan Freeman (1998), a former president of the European Council for High Ability (ECHA), concluded that most research on gifted education consisted of anecdotal reports, single case studies, or advisory processes and, significantly, lacked control groups. It is not surprising that researchers in related fields are generally critical of the quality of the research in gifted education (Craven, Marsh, & Print, 2000).

Several countries have since commissioned reevaluations and field surveys of existing gifted education programs. For example, Comford Boyes, Reid, Brain, and Wilson's (2004) report to the British government found only tenuous evidence for the efficacy of accelerated learning which, in Lipsey's and Wilson's (1993) meta-analysis, had performed best among gifted education strategies. There was, in addition, clear evidence of a placebo effect and of "enthusiastic marketing" of the support strategy. A new meta-analysis of accelerated learning (Steenbergen-Hu & Moon, 2011) also found small to moderate effect sizes for the individual support strategies which would, however, almost disappear when publication bias and placebo effects were taken into account. The net gain of a century-long investment in gifted education is very discouraging.

Reasons for not achieving support goals

Whether or not the commonly accepted strategies for supporting the learning of gifted students are effective is a question of fundamental importance. If the answer is no, this suggests that a paradigm shift in these strategies is necessary.

The success of any shift in current strategies depends on being able to recognize the reasons for the low level of efficacy achieved thus far. Disturbingly, it appears that few researchers have realized that its educational strategies are largely ineffective. A review of standard literature reveals this state of denial (see Colangelo & Davis 2003; Shavinina, 2009). And if this lack of efficacy is admitted, it is only for single programs not the current gifted education in general. The explanations for the failures can be categorized into three groups: A program has failed because (1) it is fundamentally ineffective; (2) it is applied in the wrong context; or (3) it is incorrectly implemented.

As an alternative, systemic gifted education offers a considerably more differentiated apparatus for analyzing educational measures: it envisions five important additional possible causes of failure, which are very important in practice as well. We will now take a closer look at all of five reasons, including the three reasons cited by traditional gifted education and two additional reasons indicated by the systemic perspective. In concert, all of these explanations permit more effective explanations of *why* a potentially successful educational measure can remain ineffective.

The possible reasons for the ineffectiveness of current approaches to gifted education include:

Reason 1: The simplest case

The simplest explanation is that a particular educational measure is ineffective. This avowal of failure focuses on its fundamental lack of efficaciousness rather than inappropriate conditions or happenstance, for example. However, abandoning current approaches strategies and moving on to new possibilities is anything but trivial. The modest effect sizes associated with the traditional strategies in gifted education raise the question as to whether they (perhaps with the exception of acceleration) really do represent the simplest case.

Reason 2: Applied in wrong context

The strategies taken to develop excellence need to be based on a correct diagnosis of what an individual needs in order to develop. However, individuals are frequently assigned to educational program without fully justifying these needs (Ziegler & Ziegler, 2009). In such cases, the educational measure can either fail to have a beneficial effect or, in the worst case, they can be detrimental.

Reason 3: Incorrect application

Improper application can also cause educational programs to fail, rather than the program per se. For example, acceleration is sometimes introduced without sufficient pedagogical supervision or attention to the needs of the individual. This can lead to an underestimation of its potency as a strategy for the development of excellence.

The next two reasons are derived from a systems perspective.

Reason 4: Asynchrony

The selective encouragement of one system over another can lead to asynchrony. A partial change in a system may not suffice to effect permanently the desired change of behavior in a system. For example, motivating a student to study for an important math test, without providing adequate guidance on learning strategies may be of little benefit to her or him. Although a successful motivational activity will cause the student to invest more time in learning, a lack of proper contextualization of such efforts may not necessarily lead to better performance. As such, improper contextualization may even have a negative effect on motivation over the longer term.

For gifted individuals, it is important that support strategies be co-evolutionary or co-adaptive in nature. For example, as learning is completed successfully, the achievement needs to be anchored in an individual's self-efficacy beliefs and the learning environment needs to be redesigned to incorporate new learning opportunities in anticipation of the next step in the learning process. Furthermore, the teacher needs to be fully aware of the new level of competency and be aware of the need to adapt future learning activities at the appropriate level of difficulty and with the relevant feedback.

Reason 5: Structural deficits

From the systemic point of view, a significant cause of the ineffectiveness of any strategy may be because the appropriate structures are lacking. The two most obvious examples of structural deficiencies in the context of school learning are a student's lack of the necessary prerequisite knowledge and a lack of attentiveness. If these components are not taken into account, then any strategies are likely to be ineffective.

We can observe also a dysfunctional structure working against the strategies used to encourage talented girls to participate in the domains of science, technology, engineering and maths (STEM) (Stoeger, 2004). For girls, this structure has its basis in the socialization processes that dictate their appropriate behaviors and careers, and the strategy involves the using exceptional female scientists as role models (Eckes, 1994). For example, Marie Curie, the (twice) winner of the Nobel prize, is often presented as such a role model but girls are not able to relate to her because her achievements make her appear inaccessible. Instead, girls develop the notion that to make it as a woman in the natural sciences would require a rare and unlikely sort of genius.

Interestingly, boys can be motivated to pursue a career in science after being exposed to models of successful female scientists (Ziegler & Stoeger, 2008b). For these boys, the depiction of highly successful female scientists leads them to conclude that success in science cannot be all that hard.

Reason 6: Stimulus deficit

Strategies in gifted education may also be ineffective because the level of input may have simply been too low to effect a change. For example, enrichment strategies may be ineffective because they are typically used on an occasional basis rather than as they are intended (Council of State Directors of Programs of the Gifted, 2001; Gagné, 2007). Stimulus deficits arise when an inadequate amount of time is allocated to a particular strategy, when the frequency level is too low, when the circumstances are unusual, or when individual students receive do not receive the required frequency of teacher feedback. An example of the latter occurs when teachers of large classes are not able to provide students with the feedback necessary for the development of a more effective learning style.

Reason 7: Hysteresis

Hysteretic systems are unaffected by unexpected changes in one or more components of the system. The following classroom example illustrates this point. Consider a female student who is hoping to correctly answer 80% of the questions on a test. If she achieves only a score of 78% she has fallen short of her goal. However, we do not expect her to alter fundamentally her study habits. From a systems perspective, we are observing a system which is not sensitive enough to react to a modest change.

Reason 8: Neutralization

From a systems perspective, gifted education is concerned with the development of a fully functional system. As a system, it should be remembered that systems have

myriad ways to maintain their current state through processes of compensation, tending to hobble the development of learning. Two examples illustrate how the processes of compensation can work:

- A male student receives a poor grade in his geography test. Instead of attributing the grade to his insufficient preparation, he invokes bad luck as the cause of her poor performance. Such an attribution precludes any change in study habits and a continuation of the status quo.
- A female student is given special encouragement that is designed to raise her interest in physics. Yet when she watches television in the evening she only sees men working in STEM fields. Her sense of social reality neutralizes any attempts to encourage her interest.

The two examples make clear just how important it is for educators to consider neutralization effects when devising educational measures of encouragement.

Excellence is the product of a system

Many studies have examined how individuals have accomplished unusual achievements. Vaillant (1977), for example, observed that the most successful Americans did not usually distinguish themselves because of their exceptionality during their adolescence. However, they were educated in environments that offered a high degree of positive social encouragement. Roche (1979) corroborated Vaillant's observations through an analysis of the 4000 persons listed as leaders in US business and industry in the "Who's News" section of the *Wall Street Journal*.

In perhaps the most cited analysis in this field, Bloom's (1985a) account of interviews with 120 people who had distinguished themselves in various fields such as swimming, tennis, sculpture, piano, mathematics, and molecular genetics indicates that such people tended to be nurtured in learning environments which were highly effective and well suited to their individual needs (Bloom, 1985b).

Reflecting on the results of his own study of exceptional individuals, including Nobel laureates, and famous artists, Csikszentmihalyi (1996) concluded that excellence is not situated in the individual but rather a manifestation of a system which consists of the individual and their environment. In his view, one is "gifted" when a series of complementary factors co-occur, including a nurturing home environment, good teachers and schools, excellent learning conditions outside of school (e.g., good national programs for encouraging talent in selected domains), amongst others.

All subsequent studies have come to similar conclusions: individuals who have achieved excellence share environments that facilitate learning (Sosniak, 2006). Clearly, explanations which situate giftedness within the individual – the IQ concept for instance – represent a gross oversimplification. Rather, the learning environment plays a pivotal role in the development of exceptionality.

The systemic approach

Attempts to understand giftedness using a mechanistic perspective are based, we believe, on the erroneous premise that it is possible to understand the whole when each of the discrete components is understood. Systems theory offers an alternate perspective on the relationship between components and the whole: rather than

explaining the whole when the components are understood; an understanding of the whole allows us to understand its components. In other words, systems theory focuses on the contextual organization of its components and not about the components *per se*. Thus, systemic thinking is always concerned with the context and can be considered the antithesis analytical thinking.

A contextual approach to understanding the development of exceptional achievement sees more than just the implementation of some sort of internal "talent software". A staggering number of studies, some of which are cited earlier, make it crystal clear that individual pathways towards exceptionality are highly variable in nature. Each individual interacts with his or her environment uniquely and any achievements can be interpreted as the successful end-point of this interaction. Shavinina and Ferrari's (2004) collection *Beyond knowledge: Extracognitive aspects of developing high ability* offers a plethora of such examples.

The system concept: some introductory remarks

The term *system* comes from the Greek σύστημα. It describes a stable configuration of interacting elements which together form an entity. Its entitativity is perceived on account of a unifying meaning or goal. Typical examples encountered in gifted education are groups of students in the same grades, classes, and schools as well as individuals' families and actiotopes. The characteristics and behavior of the system are determined by the characteristics, organization, and interactions of its component parts. At the same time, the characteristics and behavior of the system provide the structural parameters which control the system's components and their interactions. These are the structures which organize and preserve a system.

We do not as yet have a unified, universally accepted systems theory. The identification of a system as well as the focus of analytic attention on certain components and their interactions (and the resulting exclusion of other elements and their interplay) remain subjective decisions to be made by each researcher in accordance with the goals of her or his research interest. This lack of clarity has given cause to question whether a system can be understood as a real entity. Indeed, there are distinct advantages in viewing a system as a *model* of reality and thus as something which is inherently neither right nor wrong but rather more or less scientifically useful. This view raises an important question within systemic giftedness research about how one can meaningfully identify relevant systems. What belongs to a system? What exists outside of the system and thus belongs to the system's *environment?* The latter question reminds us of the fact that each system is itself part of a group of systems which together manifest the characteristics of a higher-order system.

We do not claim to have ready answers to these questions. They have to be found by those scholars in research in gifted education researchers who seek the best educational approach for the development of exceptionality. Rather we want to point to the framework in which these answers have to be given. In doing this we will now look at six central concepts of systems theory, including equifinality, context dependence, interdependence, interconnectedness, levels of systems, and phase transition.

Equifinality

The mechanistic approach usually postulates a direct cause-and-effect relationship. One example of a mechanistic approach to giftedness is the WICS theory

(Sternberg, 2003), where exceptionality depends on the interactions of three basic components, including highly developed intelligence, creativity, and wisdom. In contrast, systems theory assumes that one and the same outcome can be achieved from various starting points and can take a multitude of trajectories. In the domain of chess, the minimum IQ score necessary to become an international chess champion was estimated to be as low as 95 points (Grabner, Stern, & Neubauer, 2007). Garry Kasparow, one of the all-time greats of chess, returned results on creativity tests which placed him behind the average college-preparatory high-school student. In other words, the ensemble of conditions regulating high achievement is highly varied from case to case. Thus, one can only determine for each individual case which components must productively collaborate in order to acquire exceptionality.

Context dependency

As we have already stated, systemic thinking is always contextual thinking. A child's personality as well as their intelligence, interests, and capabilities are always a reflection of the ontogenetic environment in which she or he has acted. There is a strong likelihood that a child who grows up in a family of musicians will learn an instrument; and a child of an avid chess player is more likely to become good at that game.

Within the field of giftedness research, Haensly, Reynolds, and Nash (1986) were the first to consider systematically the adaptation of the individual to specific environments. As we will demonstrate later, this idea is of central importance in the actiotope approach. Similar to the manner in which a species adapts to living conditions in its own ecological niche over the course of its phylogeny, some individuals continue to adapt to the circumstances within a particular talent domain until they achieve an optimal working relationship between themselves and the domain (e.g., Araújo & Davids, 2011; Davids & Araújo, 2010; Dunwoody, 2006). The end result is a functional action repertoire in one particular talent domain. In a very real sense, they become specialists within this domain, and would likely lose their competitive advantages if they were to venture beyond the given area of specialty: while Einstein ranked high among physicists, he was not preeminent among biologists.

Context dependency becomes more particularly apparent when component systems show very different responses to different environmental systems. Some school children, for example, have a hard time regulating their attention during instruction, but may demonstrate high levels of focus when working on computer games. A similar example is the different behaviors one individual may show when confronted with soccer (football) or school textbooks: for a young sports enthusiast, the soccer match may be more in line with her or his motivational system and thereby capture her or his undivided attention, but the school textbook may fail to elicit a comparable amount of interest, focus, or enthusiasm. Thus, the hope of measuring *the* degree of concentration or motivation with one particular test of concentration or motivation seems absurd, even if many psychological tests promise to do just thus. Such an outlook completely ignores the context dependency of systems.

Interdependence

Interdependence means that manifestations of behavior and changes do not happen in isolation. The effects of the behavior of individual system components are not a localized matter; each event within a component always has an effect on the larger system. Various types of feedback effects are not exceptions but the rule. The consequence of this insight is that the idea of a local intervention is a misnomer since even the most focused intervention always affects the entire system.

The most elemental intervention in gifted education is telling someone that she or he is gifted. Freeman (2006a), Freeman (2006b) has shown that this information alone is sufficient for causing serious disturbances within the larger system. These can manifest themselves as, for instance, developmental difficulties, behavioral abnormalities, and serious problems within the family. Some effects are of course desirable. Looking at a sample of "talented" young people representing various domains, Csikszentmihalyi, Rathunde, and Whalen (1993) noticed that their learning environment reacted to such a proclamation of giftedness in a supportive and encouraging manner. Typically, these young people were required to help out less in the home so they would have more time for the development of their talents.

The idea of interdependence also applies to the relationship between systems and their environment. A well-known example is the lack of reliability in the instruments used to identify gifted individuals. One of the reasons affecting reliability is that the scores from these instruments are dependent on the person who is doing the testing – a phenomenon recognized by Catell in 1937. When instruments were used by different testers, variations in the test results of the same person ranged from 13 to 40 IQ points (Michel, 1971).

Interconnectedness

Interconnectedness complements the concept of interdependence. The latter term reminds us of how manifestations of behavior do not occur in a "vacuum". Rather, the interconnectedness of the components within the network stresses the fact that a change in any one component can affect a series of secondary changes, the consequences of which are indicative of the system in which the initial change took place. Thus, the effects of a given change are not coincidental, but reflect an orderly reaction of a system to a given change.

An analysis of the higher frequency of high-level achievement in particular social systems illustrates the veracity of the concept of interconnectedness. Consider, for example, the high number of internationally renowned professional pianists who hail from China; the initial amazement one senses when first thinking soon passes when one learns that around 50 million people in China take playing the piano very seriously (Charness, Krampe, & Mayr, 1996). Already the sheer size of this number describes a network of a size large enough to guarantee a certain number of world-class experts. But that is only half the story. We know that such a large network of people involved in the same pursuit will also bring together individuals with various types of expertise, thereby increasing further the probability of the system producing individuals demonstrating exceptionality.

Furthermore, the large network of serious piano players in China begets increases in musico-pedagogical and musico-didactic knowledge; teaching materials (collections of études, for instance) are improved; connoisseurs increase in number; a system of standards enforcement develops and improves (e.g., music critics); the social appreciation of this area of endeavor increases; and more money is invested in supporting and encouraging the best pianists. A country with a good system of encouraging talent in a particular area can allow for the parallel development of an

entire series of minutely coordinated processes. All of these processes are geared toward increasing the likelihood of a talented individual achieving exceptionality.

The concept of interconnectedness can also be quite helpful when examining circumstances which have traditionally been viewed from the perspective of personalities. Continuing with music-related examples, examination of the question of why great musicians often grow up in the families of musicians offers a good sense of how this perspective can help. Lehmann and Gruber (2006) argued that musical dynasties such as the Bach family are not necessarily based on a hereditary predisposition to musicality: a simplistic genetic explanation is implausible since the female lines in the family history do not necessarily reflect instances of musical giftedness. A plausible explanation is offered by the home environment which, over generations, was typically characterized by the presence of musical encouragement and a larger tradition stressing craftsmanship as the family's economic foundation, with sons learning the professions of their fathers. The plausible explanation turns on a process of learners working their way (and being guided) into their parents' and older relatives' professional and social networks.

The idea of interconnectedness also makes sense at the level of the individual. If a girl who is learning to play the violin is praised for her interpretation of a particular piece, the consequences extend beyond the development of musical competency. For instance, she reacts to the praise with positive emotions; this provides her with further motivational encouragement; her interest in similar works increases; her violin teacher then plans the next step in her training and considers programming the piece she played well or a similar one for her next public performance.

Various system levels are crucial for the development of excellence

A systemic view starts with the notion that individuals are combinations of various component systems. In gifted education we know a lot about the component systems of an individual, and for each component there is an associated research tradition. The metabolic system is negotiated with concepts such as physical fitness, nutrition, and rest and relaxation. Our ideas about well-being, dealing with stress and fear, for example, describe the psychological–emotional system, whereas memory, learning, and intelligence reflect the cognitive system. Not only are there interactions between these systems, each component system can be subdivided into subsystems.

Of course, individuals can be considered partial systems within larger systems. We should keep in mind, however, that the same individual can hold a different relevant position within each system in which it is integrated. As described previously, systems theory reverses the traditional notion whereby a whole can be explained by the description of its parts in isolation. Elements can only be understood by considering their place within a system. Depending on the respective system, a gifted girl can also be a sister, granddaughter, student, member of the swim team, or best friend. In each instance she demonstrates different typical behavioral characteristics, and an understanding of the nature of these characteristics depends on understanding the particular component system. It is important that her place in each of these systems be viewed contextually so that favorable learning conditions can be established in many, if not all, of these systems. So if we want to assess whether an individual can achieve an exceptionality within one domain, we need to look at more than just the effectiveness of her or his cognitive subsystem, and include, for

example, the level of educational quality achieved within her or his school class, school, and family as well as in the respective educational system and country.

Phase transition

Following the tenets of classical physics, linear thinking assumes that events can be explained in terms of explicit causes and that the effects of particular events are also linear. However, with biology firmly established as a branch of science on par with physics, there is now little doubt that such concepts are outmoded (Kauffman, 1995).

Unlike linear models, systemic thought focuses on the sorts of networked, typically *nonlinear* processes described above. If, for instance, we are interested in encouraging the technical and technological interests of gifted girls, the two ways of thinking suggest fundamentally different approaches. Strategies designed to facilitate this encouragement have primarily focused on just these interests (Stoeger, 2004). However, such an approach is too shortsighted, as we saw when discussing the concept of interconnectedness. Consider a girl who has decided to read a book on a technical subject, simultaneously making a decision against pursuing other possible activities such watching television, listening to music, and socializing.

Clearly, steps taken to encourage interest in technical pursuits need to reflect also a larger set of realities. First, such steps need to be informed by an awareness of a larger network of typically possible interests and activities within which the technical topics need to appear most desirable. Second, the effects of increased amounts of interest are not linear. Let us assume that the levels of interest in certain post-secondary courses of study are quantified according to a six-point scale on which the minimum is zero and the maximum is five. The technical interest of a particular student is 4.03, his interest in language is 4.04, his interest in math is 4.16, to name just a few examples. Even a relatively slight increase in his technical interest of 0.14 might be enough to displace medicine as his major of choice. At this point his decision "tips" in favor of another field.

Applying analytical constructs adapted from classical physics would not make sense at this point. If the measurement of increased technical interest had been 0.10, 0.30, or 0.15 instead of 0.05, we would not have observed a difference in the effect proportional to the measured difference in interest – in fact we would not observe any difference in effect. People working on the theoretical and practical aspects of gifted education should heed this example when they are tempted to follow such concepts that might make sense in the realm of the problems dealt with by the classic natural sciences.

Phase transitions are the norm, not the exception. When a student finds out, for example, what score he earned on a test, the experience may cause abrupt (not gradual) increases in his self-confidence and motivation, leading to a sudden expansion of his action repertoire. Perhaps the same boy is teased by another child in his class, unleashing sudden effects such as defensive actions or feelings of sorrow. One of the most crucial tasks for future research is to understand how conditions leading to certain phase changes can be regulated and created in a controlled manner.

The actiotope model as a systemic conception of giftedness

The most salient feature of high-achieving people is their constant ability to perform with a high level of competency (Ericsson, 1999; Ericsson, 2009). This is the point

of departure for the actiotope model. It explains, first, how an excellent action repertoire arises and, second, how it is used. Last, it offers insight into which measures are most apt for encouraging the development of high achievement. In the process, the actiotope model takes advantage of various synergies offered by a number of scientific disciplines.

As organisms, humans display the characteristics of an open system which, in turn, consists of various subsystems. A person's characteristics and behaviors are the result of innumerable successful adaptations to environments (see Gibson & Pick, 2000; Vicente & Wang, 1998; Ziegler, 2005).

Many of these adaptations occurred before a given individual was born. The human species accustomed itself to numerous different climatopes, ecotopes (i.e., the inanimate parts of ecosystems), and biotopes. The nature and development of a human being's organs, susceptibilities for various illnesses, sleep patterns, language capacity, limits to running abilities and so on can only be understood in terms of a species which adapts itself to its environments.

Humans, of course, are more than just biologically-defined organisms. As social beings, they adapt also to their sociotopes (Grassinger, Porath, & Ziegler, 2010). In other words, as we will explain in more detail below, humans adapt to environments which are defined by concrete situations and established social preconditions. Our musical examples serve us well here, too. Even listeners without formal training can recognize significant differences when listening to and comparing the works by Quantz, Hasse, the Marcello brothers, both Scarlattis, Cimarosa, Lotti, Galuppi, Caldero, Jommelli, Parpora, Albinoni, Tartini, Händel and Vivaldi, on the one hand, with works by The Birds, The Kinks, Motörhead, 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 hand. The members of the first group share a common musical heritage, including time in Venice during the eighteenth century spanning a period of 50 years. The second group consists of bands hailing from London in the second half of the twentieth century.

All of the musicians and composers enjoyed a musical socialization which included access to one of the preeminent musical action repertoires of their respective times. All demonstrate an active adaptation to the music of their social environment. The assumption appears highly plausible that the two groups of aforementioned musicians, were they to have been born in the eighteenth instead of the twentieth or in the twentieth instead of the eighteenth century, would have developed in completely different directions.

Despite their shared characteristics, however, we can also observe clear differences among the work of the musicians and composers *within each* of the two periods. Even cursory listening will reveal differences between, for example, the music of the Rolling Stones and the Sex Pistols. In this sense, action repertoires are not simply indicative of a given time period: they also reflect the characteristics of highly individual styles. Indeed, they are undeniably the result of progressive adaptations to a particular actiotope (Ziegler, 2005).

An individual's actiotope reflects qualities that are more than unique. Many of the characteristics observable in an individual's actiotope will only be explicable in terms of the concept, as described above, of an individual belonging simultaneously to various system levels (ecological, biological, and social systems). The following definition of an actiotope captures this notion:

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

The component perspective

A system is made up of interacting elements. The actiotope model envisions four components which, together, enable intelligent actions:

(1) the action repertoire,
(2) goals,
(3) the environment, and
(4) subjective action space.

Before we discuss each of the components, we want to make clear that the actiotope model represents an analytical frame of reference for the investigation of *all types* of premeditated behavior, which we understand according to Sternberg and Salter (1982) as "goal-directed adaptive behavior". Thus the intelligent behavior of animals or artificial intelligence systems falls within our analytic purview. The internal conceptualization or structure of each of the model's various components is an object of investigation for a number of disciplines including biology, sociology, psychology, neurology, information science and social geography, because each of these components, logically, consists of numerous systems and subsystems. This illustrates the need to buttress the analysis of human actiotopes components (in particular when exploring their development towards excellence) with further theories from areas such as motivation and interest (which are particularly important when working on the "goals" component).

Action repertoire

The action repertoire is the totality of actions of which a person is, in theory, capable of displaying at any given point in time. An individual will, however, only realize a small portion of these actions. The extent of an action repertoire varies considerably among individuals. A child in preschool, for instance, typically possesses a mathematical action repertoire which is restricted to a few numerical operations covering only a limited number of integers. During the first years of school, a child's mathematical action repertoire expands to include basic arithmetic. Basic algebraic and geometric operations follow in later years. The development towards excellence can, therefore, be understood as a long-term learning process during which an individual acquires the repertoire which will eventually allow for excellence.

Goals

Individuals have needs which they are compelled to satiate (e.g., hunger, security, recognition). The fulfillment of such needs requires that they set a goal for their behavior – eating an apple, for instance. The process of setting goals is not as simple as people often assume. One example is food: knowledge of which substances can satiate hunger is culturally dependent and must be passed on from one generation to the next (Scapp & Seitz, 1998).The effectiveness and success of translating needs into action goals varies greatly. Numerous well-known examples illustrate

how individuals doggedly pursue dysfunctional goals over long periods of time (see Seligman, 1975; Staw, 1976). Such goals may be wholly incommensurate with the expected need fulfillment, or they may be unattainable. If one keeps these possibilities in mind when considering the process of ascertaining an action repertoire of excellence, it quickly becomes apparent that some goals which, when pursued, are capable of effecting expansions of an individual's action repertoire over an extended period of time eventually turn out to be lacking in adaptivity. One can, for instance, envision a sort of education strategy which is heavily predicated upon competition which produces a girl who is best in her class. In such a strategy, the girl may well rest on her laurels once she has attained this goal for lack of other motivational input (cf. Dweck, 2006). Other sorts of higher-order goals would have been possible, but as this strategy failed to integrate them, they will not be achieved.

Gifted education needs to ensure, first, that functional goals are being pursued in the area of expanding an individual's action repertoire. Second, that such goals are of a nature which allows them to be happily integrated into the individual's overall system of goals; otherwise the person who is being served by the system of gifted education will, sooner or later, rebel against that system. Third, the continued development of the goal-setting and goal-regulating system needs to be a priority, since the goal system needs to be constantly adapted to an ever-expanding action repertoire. Put simply, every successful learning step unveils the possibility of new and attainable goals.

Environment

Systemic approaches assume that individuals and their (social) action context cannot be meaningfully examined in isolation from one another. They need to be viewed as one analytic unit. The examination of environmental factors can, nevertheless, consider the varying degrees of dependence/independence which may characterize the way in which individuals and their social action context are related, since the systems envisioned by the actiotope approach are meant to be understood as *models* of reality. Therefore, we suggest three complementary views of the environment:

(1) It makes sense for giftedness research to start by consulting existing systemic views of the environment. For example, a substantial body of research exists on the systems family and school, from which gifted education can benefit.
(2) Particularly important is that aspect of the environment which we understand as the *talent domain*, because we understand the process of development towards excellence as a progressive process of adaptation to a talent domain. Piano, chess, tennis, physics – each of these domains encapsulates an almost dizzying spectrum of possible successful actions. Yet the novice will only be capable of availing her- or himself of a small fraction of these possibilities.

    For most talent domains domain-specific curricula exist which, as a sort of socialization, regulate the expansion of an individual's action repertoire. Such curricula compel the individual to develop her or his action repertoire; they evaluate the development process through positive and negative sanctions of behavior. Many talent domains reflect long-term processes of improvement. Learning to play the violin, for instance, involves instructional methods and materials which have been developed, disseminated, and improved over centuries. In Central Europe, professional instructors are ubiquitous, serving to improve continually their students' action repertoires. It is quite possible that the very best virtuosos of bygone centuries would be outclassed by today's leading performers.
(3) The actiotope model goes beyond the analysis of the "classic" systems of family and school class/grade postulated by the social sciences; it also adds more to the list than just the idea of talent domains. The actiotope perspective also considers the environment from the perspective of learning and learning opportunities. We avail ourselves of the concept of the *sociotope* to this end (Latin *socio* means of the community; Greek *topos* means location; Grassinger et al., 2010; Ziegler, 2008; see also Phillipson, in press).

A sociotope offers an objectively defined action space; in other words, each sociotope entails a specific set of possible actions. You can swim in a swimming pool, but under normal circumstances you cannot do figure skating. The opposite is true of an ice-skating rink. Such objective circumstances are understood to be *implemented*. Among all the objectively possible actions conceivable for a given sociotope only a small fraction will actually be realized by individuals acting in that sociotope. We can speak in this case of behavior patterns which typically correlate with certain sociotopes. All sorts of behaviors are imaginable during flute class, but generally flute class is about people (often children) playing the flute, even though, for instance, flute playing could be combined with dancing. In math class, kids calculate and hardly ever sing. Thus, it appears that certain behaviors become *institutionalized* within certain sociotopes. The institutionalized behaviors normally reflect some sort of logical connection between the nature of the locale and the sanctioned activity (the kitchen is where we make meals; the bathroom is where we see to our regiments of personal hygiene). During their socialization, individuals develop a rich action repertoire of socially acceptable behaviors which are linked to certain sociotopes; they also learn to repress other possible behaviors in certain contexts (e.g., getting to class too late and being disruptive during instruction) in a process which is known as *internalizing*.

Subjective action space

The fourth component of the actiotope is subjective action space (cf. Ziegler & Stoeger, in press). In a sense analogous to ideas about problem space in classic decision-making research, subjective action space is conceived of as a sort of cognitive space in which an individual can generate and make decisions about behavioral possibilities. This cognitive process takes several factors into account: an individual's action repertoire, the nature of a given situation, and an individual's current needs and concomitant goals. The subjective action space generates optimal behavioral possibilities from the sum of possibilities which the other three actiotope components provide.

The processes of generating behavioral possibilities and selecting an action from these is error prone in the sense that actions can be unsuccessful. There are various crucial reasons for this, among these:

- an individual may often incorrectly assess her or his own action repertoire (boys tend to overestimate their behavioral competencies in mathematics, and girls often underestimate their skills in the same area);

- possibilities for action may go unused in a given situation (a schoolgirl may think of a good solution at too late a point in time);
- needs are translated into inappropriate goals (a boy who plays the class clown in an attempt to get more attention and respect, but whose behavior causes him to experience even more rejection).

Each step in a learning process and each expansion of one's action repertoire increases the number of realistically achievable goals in any given situation of similar character. Gifted educators thus need to make sure that learning steps are well integrated into the subjective action space of each pupil. A particularly instructive example is that many girls persist – despite demonstrating competency levels in math and natural sciences on a par with those of boys – in their belief that they must undertake more substantial efforts in order to learn as much as their male counterparts (Ziegler, in press). The example reminds us of just how important it is that expansions of the action repertoire be accompanied by concomitant expansions of the subjective action space.

The systems perspective

Systems always have a structure. The structure reflects (1) the system components, (2) the relationships and interactions among these, and (3) the nature and number of the interdependencies of the system and its environment.

It is clear that the components of an actiotope correspond closely. Consider the following simple examples:

- People look for environments that are compatible with their goals. When you are hungry, you will not be surprised to find yourself heading towards your refrigerator.
- Within one's subjective action space, actions tend to be selected which appear practicable within a given environment. Swimming motions make sense in a swimming pool, climbing movements normally do not.
- Apartments and homes have amenities suited to the goals and needs of the people who inhabit them.
- If the structure within a system remains stable over a long period of time (e.g., in a school) and the system remains in a state of equilibrium, then we are observing a good fit between action repertoire, goals, environment, and subjective action space.

Over the entire course of the long learning process which precedes the achievement of excellence in a given domain (often a period of many years), the entire actiotope needs to be systematically and continuously modified (many examples can be found in Ericsson, Charness, Feltovich, & Hoffman, 2006). Action repertoire, goals, environment, and subjective action space undergo a continuous process of change. In technical terms, we can say that the actiotope remains in a *metastable* condition in which it is constantly moving from an older into a newer temporarily stable condition. As such, these conditions are ontogenetic way stations of sorts set between moments in which individual learning steps are mastered. The mastering of learning steps requires a co-evolution of effectively compatible system components, which is by no means a given. Systems can easily founder and lose their effectiveness. We will illustrate this with an example, drawn again from the domain of chess (Brady, 1973; Brady, 2011).

Bobby Fischer is considered to be one of the best chess players of all time, winning the chess world championship after a hard-fought match. When he was eight, Fischer's adaptation to the domain of chess was characterized by his study of the chess matches of the greatest chess masters. By comparing each of his moves with the solutions recorded for the grandmasters, he had found a source for excellent feedback. Each expansion of his action repertoire in chess led to co-evolutions in goals, subjective action space and environment as follows:

(1) Goals. He recognized the chess-specific goals connected with each move.
(2) Subjective action space. Fischer came to understand the strengths and weaknesses of the chess moves made by the grandmasters. In his next match he was able to use the knowledge to his benefit: he was quickly able to discount weaker moves from his subjective action space and review the applicability of better options to the move at hand.
(3) Environment. Fischer's childhood learning environment soon ran out of adequate opponents. His mother purchased classified newspaper advertisements to find chess opponents for her 8-year-old son. Young Bobby quickly found sponsors who helped him expand his chess action repertoire by a degree which, at that point in time, was unheard of.

This co-evolution led to an extreme modification of his actiotope where (a) his chess action repertoire reached a world-class level; (b) he could realistically pursue the goal of becoming the world champion of chess; (c) he was constantly surrounded by chess grandmasters and an endless supply of chess literature; and (d) within his subjective action space, he almost exclusively focused on the game of chess.

Our discussion of Bobby Fischer touched upon two concepts which need to be further explained. The *modifiability* of an actiotope describes its potential for the co-evolution of its components (see also Ziegler, Fidelman, Reutlinger, Vialle, & Stoeger, 2010). If, for instance, an appropriate learning sociotope for an impending learning step is lacking or if a gifted individual lacks motivation for the next step in the learning process, then their actiotope is not modifiable. *Stability* in an actiotope signals a situation in which the actiotope's components are co-adapted and complementary in nature. This can only be a metastable condition, however, since the talent domains in which individuals work towards excellence require a long-term process of actiotope development. Thus it is of particular importance that the actiotope, as a whole, not be destabilized by additional work-related responsibilities, family problems, or illnesses, for example.

The dynamic perspective

It is important to think about how co-evolutionary developments of the actiotope components are possible within a given talent domain. We envision a model consisting of five conditions of successful adaptation.

Goal validity

If an individual is to be effective within a talent domain, she or he must be capable of assessing whether a particular action has led to the desired learning goal or if

she or he has at least come closer to a certain goal. Such actions can be repeated or they can function more like a stepping stone on the way to further, more successful actions.

Individuals are often unsure whether an action was successful. A violin student who fails to recognize when she or he is playing grossly out of tune will not become a leading professional violinist. A soccer player who has a suboptimal kicking technique stands almost no chance of becoming a striker for a professional soccer team. A student who cannot say whether he has done a good job of studying for a test will probably perform poorly. In particular, mentors, be they violin teachers, soccer coaches, or art teachers, are capable of providing valuable feedback in the area of goal validity (Grassinger et al., 2010; Gruber, Lehtinen, Palonen, & Degner, 2008).

Ecological validity

A female basketball player who wants to maneuver a basketball around a member of the opposing team has to decide which move is most appropriate. When schoolgirls are preparing for an oral examination, they should take care not to invest their study time in activities designed to prepare people for multiple-choice tests. In other words, one and the same action is not just as effective in every situation. It is thus important that individuals recognize for each situation anew which actions are best suited to succeeding.

Systemic education aims to establish strategic links between theory and practice. People working in gifted education often try to account for ecological validity by working to expand the action repertoire of their pupils in those areas which are most likely to maximize the effective use of their action repertoire in the selected goal contexts. Well-known didactic approaches include the anchored instruction and the cognitive apprenticeship approaches (Cognition & Technology Group at Vanderbilt, 1994; Collins, Brown, & Newman, 1989).

Replacement validity

Working towards excellence is always predicated upon the adaptivity and flexibility of the actions being taken in a given talent domain (Araújo & Davids, 2011). Striving towards excellence is not just about finding and unlocking the potential of new possible actions. It is also about replacing older, less effective actions. However, it has been observed that after an initial investment of roughly 40 or 50 hours, a learner reaches a competency level which they find satisfactory; at this point a majority of people become mired in a pattern of "arrested development" which holds them at their current performance level (Ericsson, 1998). Surmounting such developmental plateaus demands a great deal of effort from all stakeholders in gifted education (the gifted learners, their teachers, their mentors, and others). The process of overcoming such developmental malaise requires more than just extra effort, however. Profound didactic insight is also important since new actions need to be more effective than the ones they are meant to replace. Such necessities are particularly apparent when, for instance, it is time to move on from arithmetic to algebra or when, after having learned the Rutherford atomic model, we move on to the Bohr model; or when learning the game of tennis moves from general "play" to systematic training of the sport's canonical strokes.

Achieving exceptionality requires numerous replacements. Individuals who are both capable of achieving this level and are developing in that direction are always on the lookout for better action alternatives. People working in gifted education tend to favor action alternatives such as the use of better learning strategies, more beneficial attributions for successes and failures, and more effective volitional techniques.

Anticipatory validity

During the long and sometimes painstaking development of an actiotope, numerous preparatory learning steps have to be taken to ensure that other learning steps can happen at later points in time. For example, we learn English as schoolchildren because it anticipates the requirement to read international scientific literature when studying at college. Ice hockey players can only improve their playing skills once they have reached a certain level of competency in ice skating. The professional success of future research scientists depends in part on whether they work on their social skills during adolescence and early adulthood since they will eventually need to work in research groups. Furthermore, the development of an actiotope is also characterized by unforeseeable setbacks, developmental plateaus, and other critical events.

An actiotope that is anticipatively developed will be better able to overcome learning obstacles. If, for instance, we recommend that a gifted student transfer from her or his regular school to a boarding school for the gifted, we need to feel confident that the girl or boy also possesses the social skills necessary for effectively dealing with the new separation from the family home. If a theoretical physicist finds herself stumped by a certain problem, it may become apparent, in hindsight, that she was not anticipative enough in the choices she made about math classes during college. In sum, those working in gifted education need to show extreme thoughtfulness when helping their pupils to plan their educational careers.

Learning pathway validity

Exceptional achievement in many talent domains requires extremely well developed levels of performance and depends, accordingly, on many learning steps. An individual is very unlikely to be able to traverse these steps on their own. Reaching this level of performance requires the active involvement of many other persons, including teachers, parents and mentors, as well as sociotopes that support learning (Phillipson, in press). A learning pathway is thus constructed of a series of necessary learning episodes.

Many individuals fail to achieve their learning goals and fall far short of excellence, despite making a Herculean effort. The attainment of exceptionality requires clear goals, a well-planned learning pathway as well as long-term, high-quality learning feedback on issues pertaining to the conditions of successful adaptation, including goal validity, ecological validity, replacement validity, and anticipatory validity.

The most important practical consequence of learning pathway validity is that decisions in gifted education must not be based on a single diagnosis and isolated, individual recommendations. Educators need, first, to be ready to help map out the learning pathway towards achievement goals and, second, accompany learners down these pathways.

The basic principles of a systemic gifted education

Current approaches to gifted education are constrained by a structural flaw; the need to select and place (Ziegler & Stoeger, 2004b). The first step in this approach is to select gifted individuals from a larger pool of students, with the second step being the placement of these students into programs based on one (or more) of the current strategies in gifted education. Since these programs are only available in some cases (i.e., at certain schools, in certain regions), their application is often only temporary rather than sustained.

As an alternative approach, systemic gifted education has no choice but to begin within the existing framework. What remains fundamentally different, however, is that a systemic approach is not focused on the issues of selection and placement. Rather, systemic gifted education focuses on the creation of highly individualized opportunities, allowing individuals to develop their action repertoire through interaction with specific, individually tailored learning environments. In order to show how the focus and goals of systemic gifted education differ, we will describe the five most important differences between the systemic and current approaches to gifted education.

Focus on the interactions between person and environment

Part of understanding the workings of a given system is learning about the neighboring systems with which it interacts. In this sense, we conceive of the development of an action repertoire capable of producing excellence as a very successful adaptation to specific environments (Araújo & Davids, 2011; Ziegler, 2005). Thus, the goal of gifted education cannot be limited to the development of the individual, but must include the interaction of the individual *and* their environment (i.e., actiotope). Here, we must remember that this interaction occurs as part of a system, with the relationship between individual and environment being only one amongst many possible interactions.

Arbitrarily attaching labels such as "talented" or "gifted" to individuals is neither conducive to research nor to gifted education. Nevertheless, such terms remain useful to facilitate the communication between research and practice. In accordance with Ziegler (2005), we recommend that the terms talent and gifted be used to represent points on the pathway to exceptional achievement. Specifically, a person is talented in one (or more) domain(s) when they have demonstrated precocious achievement, reflecting an action repertoire exceeding that of a similarly aged cohort. At this point, the person has a possibility of reaching exceptionality in one or more domains.

A person is gifted when they have achieved a critical state in this pathway. At this point, their action repertoire is sufficiently well developed that they have a very high probability of achieving exceptionality in one domain. Despite referring to the individual, we emphasize that both being talented or gifted depend on the interaction between the individual and environment.

Co-evolution of all the elements

Systemic gifted education assumes that developmental goals cannot be reached if attention is only focused on the development of a single element. Each localized

change has implications for the entire system, with secondary, albeit often unintended effects, alongside primary effects. Hence, a systemic gifted education needs to be holistic, designed to develop the entire system along meaningful lines without posing a threat to the system's stability.

In the context of the actiotope model of giftedness, this means that the action repertoire, goals, environment, and subjective action space need to be further developed in a manner which allows all of the components to interact meaningfully with one another at every step in the developmental process. It is not enough to just expand the developmental horizon to include the environment. A number of additional changes are necessary. First, we need to understand how an individual and her or his environment are to interact and how *both* can be further developed during and through their interactions to the end of achieving the next learning step. Second, the construct "environment" needs to be better understood. Gagné's (2004) model, for instance, deconstructs the environment into various catalytic processes. By definition catalysts energize processes without changing their makeup in the process. This static conceptualization of the environment may cause us to overlook the remarkable dynamics which such processes set in motion in learning processes, because – to cite one example – the same gifted student cannot expect to be offered the same learning stimuli every day; rather, her or his learning environment will be carefully developed according to her or his abilities from day to day.

Current approaches to gifted research contain many examples of how processes of co-evolution are by no means simple and of how even small changes can bring forth unexpected results. For example, Heller (2004) concluded that the process of labeling children as "gifted" poses one of the most serious problems in gifted education, noting risks such as "social isolation, [the] development of egocentric attitudes and behaviors, endangering or disturbing… personality development and self-concept through extreme achievement pressures or too much responsibility" (p. 308).

Resource orientation

A central focus within systemic education is on the expansion and improvement of the resources and competencies available within each system. Indeed, resource orientation is one of the main characteristics of systemic approaches.

From the perspective of gifted educators, a considerable number of essential resources needs to be made available to the actiotope: appropriate instructions, learning competencies as well as information on a number of related variables: on the validity of the goals, the ecology, the replacement strategies, and the anticipatory steps involved in a given educational measure; on the gifted individual's emotional and social stability; on her or his motivation; and on her or his social learning environment.

Ziegler (in press, b) has advanced a new way of systematizing the resources which are suggested for gifted education in particular: the term educational capital is used to described those resources involved in initiating and regulating learning which are available both to society and the individual. Learning capital denotes those resources used for initiating and regulating learning to which only the individual has access.

Constructing learning pathways rather than identifying gifted individuals

Practitioners of gifted education often worked along the lines of well-intentioned trial and error, as though they were mining for gold: the gifted are somewhere out there, and one must simply locate them by looking around enough and using adequate testing. By contrast, systemic gifted education is based on the premise that the issue is not to track down the gifted but rather to develop talents (defined as systems comprising individuals and their environments) in a co-constructive process. Thus "identification" has a markedly different meaning in a systemic approach.

The process of identification normally navigates the thorny issue of achievable learning goals by making a simplistic prognosis about the future based upon the status quo. Such a prognosis is usually the result of a single diagnostic session (Ziegler & Stoeger, 2008a). Rather, the decision to provide a person with a gifted education should be based on the co-evolutionary constructions of learning pathways which are substantiated through theories of learning. Such a decision-making process needs to be accompanied by an appropriate gifted education specialist and re-evaluated whenever necessary.

The duration of a learning process culminating in exceptionality poses an enormous pedagogical challenge. Didactic planning needs to extend across time frames which are much longer than those commonly used for interventions and didactic measures of encouragement in traditional gifted education. This applies to much more than just the cognitive learning aspect. Successful mastery of each successive learning episode needs to be supported by the availability of appropriate learning sociotopes, instructions and feedback, for example. Learning pathways that take this into account can offer realistic expansions of a given action repertoire which continue up to the realization of a particular learning goal.

Dynamic–interactive regulation instead of gifted education

The systems approach assumes that the magnitudes relevant for gifted education are simply too complex and thus incomprehensible from the analytical perspective offered by classical scientific notions of cause and effect. In gifted education we are dealing with networks of actions and their dynamic interactions with individuals' subjective representations of their action repertoire, goals, and environments. The interactions furthermore reflect primary and secondary effects which are accompanied by a variety of feedback-loop effects and autochthonous mechanisms of amplification. The notion that teachers, with a few isolated words of encouragement or interventions, could have a lasting positive influence on the course of an individual's development is a well-intentioned myth. What is desperately needed is a support system characterized by continuous interaction in which those working in gifted education see themselves as a part of the developing actiotope of each gifted individual and behave accordingly.

If these ideas are correct, then we should observe better outcomes in gifted education when based on dynamic-interactive processes. Although evaluations of programs based on this process are only beginning, the reported outcomes are very positive. In one such evaluation, (Grassinger et al., 2010) concluded that mentoring can produce long-lasting effects when tailored to both the needs of the mentee *and* their specific environment.

Conclusion

Current approaches to gifted education are based on the erroneous assumption that it is possible to understand the development of exceptionality by first identifying the components of giftedness. Once identified, it is sufficient to implement strategies that focus on the development of one or more of the key components. We have presented arguments that the deficiencies in our current approach to gifted education are because our conception of giftedness is based on mechanistic models.

The actiotope model of giftedness, on the other hand, represents a substantial improvement to understanding the development of a complex phenomenon such as exceptionality. Based on systems theory, the actiotope model is based around four components, including action repertoires, goals, subjective action space and the environment. The continual expansion of a person's action repertoire depends on the interactions of their goals, subjective action space and the environment.

Accordingly, gifted education based on a systems approach represents a paradigm shift from current approaches. We redefine the terms talented and gifted within a systems framework. We also argue that the basic principles of a systemic approach to gifted education require attention to the interaction between the person and their environment, a focus on the co-evolution of all elements in the system, closer attention to the continual expansion of resources and competencies within the system, and the construction of an individualized learning pathway rather than the need for identification.

Notes

1. We use the term "gifted individual" to refer to those with a statistical probability for outstanding performance, rather than an individual with a particularly personality or intellectual trait.
2. Publication bias describes the phenomenon in which researchers as well as the editors and publishers of scientific journals prefer significant positive results to those which are negative or inconclusive. This leads to the latter sorts of results being underrepresented in research literature. Reports about measures or programs in gifted education which turned out to be ineffective were thus less likely to be published. Consequently, such negative results could not be considered in the meta-analyses (Dickersin, 1990; Sackett, 1979).

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COMMENTARY

Lessons from goal orientation theory: expansion of systemic theory of gifted education

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In "Towards a systemic theory of gifted education" Ziegler and Phillipson propose a paradigm shift from mechanistic approach to systemic approach in gifted education. Such a proposal represents a shift of focus from the identification and placement of gifted students to the construction of individualized learning pathway in which students can develop towards excellence by the continual expansion of action repertoire through the interaction with their goals, subjective action space and the environment.

I commend the attempt by Ziegler and Phillipson to discuss gifted education from a systemic and contextual perspective, which is inspiring in terms of theoretical advancement and practical reconsideration. Yet, the theory, in its current state, is more descriptive than explanatory. The concepts like action repertoire and subjective action space are abstract constructs which probably require more concrete, precise and measureable operational definitions that allow empirical validation. Ziegler and Phillipson mention that all components in the actiotope model should co-evolve and interact with one another at every step in the developmental process. While I acknowledge the importance of these dynamic–interactive processes in the development of exceptionality, I would love to understand more deeply on how these processes actually take place within a systemic framework. I think the theory will gain more explanatory and predictive power if the psychological mechanisms underlying the co-evolution and the interactions among components can be specified and explained.

In this commentary, I limit my discussions on two components of the actiotope model, i.e., goals and environment, based on goal orientation theory (Dweck & Leggett, 1988). The purposes of my discussions are two-folded: First, to examine how the meanings of goals and goal structure in goal orientation theory can be incorporated into the conceptualization of goals and environment in the actiotope model; second, to identify some potential directions for research so that the actiotope model may be expanded and refined on the ground of empirical support.

In the actiotope model, goals refer to the standards of performance within a particular domain. Once goals are achieved, there will be updates of goals so that

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the expansion of action repertoire will continue. Such a vigorous cycle of achieving and updating goals leads to a successive development towards excellence along the learning pathway.

In goal orientation theory, goals refer to the reasons to achieve. Such a conceptualization of goals is distinct from that in the actiotope model. Let me take an example for illustration. Two students may have the same goal of being admitted to a prestigious teacher education program at a university but they may have different goal orientations, or reasons, for wanting to be admitted. One student may want to learn about good teaching practices (mastery-learning goals) while another student may want to demonstrate his/her high competence to others (performance goals). Due to the different goal orientations endorsed, these two students will display different patterns of motivation which may subsequently affect their achievement at the university, even though the two students have the same goal of being admitted to the program in the first place. (For a comprehensive review on mastery and performance goals, and their subsequent approach-avoidance distinction, see Elliot, 1999.)

The significance of goal orientation in predicting motivation and achievement is not limited to students in general but also to those who are gifted (see Chan, 2008). Because of this, I think a full understanding of the development of an individual's actiotope must take into account the reasons why a particular goal has been set, apart from the nature of the goal itself. Ziegler and Stoeger (2008) have introduced the concept *learning oriented subjective action space* and have found it to predict high achievement. Along this line of research, I suggest further studies may take *performance oriented subjective action space* into account. Careful attention should be paid to the operational definitions of these constructs.

Apart from mastery and performance goals, recent studies (see Dowson & McInerney, 2003) have demonstrated that students have some social reasons to achieve such as to fulfill obligations to parents or to maintain social relationship with peers. In terms of the actiotope model, social goals will correspond with the *socially-oriented subjective action space*. The functioning of socially-oriented subjective action space and its relationship with learning oriented and performance oriented subjective action space are definitely the areas that require further research.

Goal structure refers to the goal-related messages that are made salient in achievement settings, including classrooms and schools (Kaplan, Middleton, Urdan, & Midgley, 2002). Previous studies found that students' personal goal orientations correspond with their perceptions of the classroom goal structure (Urdan, 2004). When students perceive their classroom or school as emphasizing learning and effort, they are more likely to endorse mastery goals; by contrast, when they perceive their classroom or school as emphasizing competition and ability, they are more likely to endorse performance goals. While limited research in gifted education has done investigation on goal structure, it is an important construct that should be incorporated as part of the environment in the actiotope model. The interaction between personal goal orientation and goal structure in goal orientation theory is probably a subset of the interaction between the person and his/her environment in the actiotope model.

In the actiotope model, development towards excellence is a long-term learning process with the support of the system. Longitudinal study with cross-lagged design should be a promising research design in this area because it allows investigation on three types of relations simultaneously: First, concurrent relation (e.g., the relation between personal goal orientation and classroom goal structure within the same time period); second, cross-lagged relation (e.g., the prediction of personal goal orientation at Time 1 on student achievement at Time 2); third, longitudinal relation (e.g., the developmental changes of student achievement between Time 1 and Time 2).

In summary, the systemic theory proposed by Ziegler and Phillipson is a promising and groundbreaking paradigm in gifted education. Given that the theory is descriptive in its current state, vigorous research programs should be conducted to put it under scrutiny with proper development and expansion.

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COMMENTARY

Welcome change of focus from individual identification to a systemic process in gifted education

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Developing talent in young people and nurturing gifts is always in the interests of any nation. How best to do this is the vexing question. One of the difficulties is the existence of controversy around who are the gifted and talented. Many decades have been spent focusing on identifying these people and there is to date no consensus on this issue. The identification of gifted people is contentious, so too is the best way of developing their talents.

Ziegler and Phillipson offer an alternate way of viewing gifted education by proposing an alternate systemic theory of gifted education. What they offer is pedagogically sound. They suggest that if an appropriate system is in place for developing talents, then the issue of identification becomes a minor aspect of the entire system. Their systemic approach focuses on the development of "highly individualized opportunities" for individuals to develop their "action repertoire" by interacting with a planned individual learning environment (Ziegler & Phillipson, p. 24).

Historically there is evidence to show that differentiating a curriculum for learners, results in a much better fit of realization of goals and individual achievement (Bloom, 1956). Dweck (1986) believed motivation to achieve involves competence in relation to set goals. Goal setting and attainment happens within an environment and it is the essence of the environment and the interaction of the individual within that environment which has also been recognized as crucial for achievement. Gagné (2000) proposed that environmental catalysts such as family, school and teachers are important factors in developing giftedness into talent. He also refers to an element of chance of all these catalysts coming together to foster the development of gifts.

What Ziegler and Phillipson propose is creating the system where the interaction between action repertoires and the environment are systematically developed and individually determined so that the best possible fit can result for any individual. This systemic approach as outlined in the actiotope theory is that an actiotope includes an individual's actions and the environment with which the individual interacts. This system has the potential to bring together all the elements of the individual and her developmental goals, within her environment to a "subjective action space" (p. 19). The exciting part of this model is that the system is fluid and that

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adaptation is an important aspect of the learning process. The element of chance is limited in this model. The "hit" and "miss" nature of talent development is eliminated in the actiotope model of gifted education.

Children labeled as gifted are often seen as able to obtain good results with a minimum of effort and with speed. Motivation is lost when these children are faced with more difficult or demanding work to achieve a goal or to perform at a higher level. The steps in the learning process have not been learned and hence mastery of higher order thinking tasks can be lost on some of these children. This can be avoided when learning tasks are planned to cater for all styles of learning and systematically ordered in a logical sequence. This refers to what Ziegler and Phillipson call expanding action repertoires in a subjective action space. If this systematic process can be the basis of learning then the development of talents is much more likely to be the outcome. The actiotope model caters for this process in a far more organized way.

From another perspective, labeling children as "gifted" has also given rise to what in Australia is called the "tall poppy syndrome". This is an expression of elitism and privilege in our egalitarian society and is very difficult to overcome. It has been an ongoing difficulty in making provisions for gifted individuals trying to make the shift from privilege to catering for individual needs. There has been slow acceptance of the need to educate and specifically cater for gifted children and is now seen as necessary rather than viewed as promoting privilege.

This has specifically pertained to academic ability as distinct from sporting prowess as sporting ability is often identified early and systematically talent is fostered and developed in the sporting arena. This disparity between types of talents reflects emphasis on sporting ability as somehow different to creative or academic talent or gifts. The process for developing sporting ability in Australia has been much more akin to the actiotope system than the individualistic labeling system.

There are differential ways of dealing with talent development. It includes immersing individuals in learning experiences, in adapting processes to the individuals' needs within a supportive environment with specific goal planning and support from adults (Chessor, 2009). While it can be seen that this process has been widely used with sporting talent, in other talent domains it has been far more limited. The evidence for a systemic process of talent development is obvious and yet there is still resistance to it in academic domains in Australia. The social and emotional development of all children needs to be considered against a developmental backdrop. A child can be "hot housed" in an area of talent to the detriment of other areas of social and emotional development. How to guard against this within this systemic approach is far more difficult to ascertain. It is unclear whether this area has been given sufficient consideration. With sensible adults within the system, it can be imagined that social and emotional issues will be considered. The system does not specifically address these issues and hence there is need for some more development in this area. An example brought to light in the media recently showed the development of "modelling" skills in a 3-year-old child. This seemed to be systematically supported with pageants for children, with agencies supporting these kids and with parents and environments conducive to developing modeling skills in 3-year-olds. This exemplifies the development of talents in one area without due consideration of the competing social and emotional needs of this child.

The model proposed by Ziegler and Phillipson has great merit and needs to be considered seriously in the education of gifted children. The actual implementation

within an education system needs to have further questions answered. These revolve around providing the subjective action space within the environment to support the development of action repertoires for individuals in a holistic way. Included is taking account of the social and emotional development of individuals specifically and broadly having facilities that will provide access to individuals fulfilling their goals.

It is refreshing seeing new ideas coming back into the arena of gifted education. The paradigm shift from individual identification to a broader systemic provision of actiotopes is welcome at this stage in gifted education research.

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COMMENTARY

A postcolonial perspective on the systemic theory of gifted education

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A systemic theory of gifted education, and in particular the notion of the actiotope receives surprising support from an epistemology until recently largely unrecognized and undervalued – that of Australian Aborigines. As part of an ongoing transdisciplinary collaborative research practice, a group Yolngu (north east Arnhem Land Aboriginal) elders have been advising education authorities on culturally appropriate approaches to the education of young people in remote communities, including the education of gifted children (Christie, 2011). Yolngu grow up speaking Australian languages within communities which maintain traditional cultural and ceremonial lives. Their knowledge authorities work to ensure that the practices of schooling enhance rather than undermine the always ongoing traditional collective practices of remaking strong Aboriginal culture into the new generation. First a story, then three comments on the systemic theory.

In a workshop funded by the Australian government, eight elders spent two days articulating their notion of giftedness, and appropriate educational provisions to support gifted students. One of the elders told this story:

> In days gone by, when many boys go through initiation ceremony, they get painted on their chest. The painting that they put on the boys are their own traditional paintings, the land where they belong to, or what creatures their totem is. That is painted on the chest of every boy.

The boys must wait silently for several days and nights, listening to the ceremonial preparations, long cycles of ancestral songs which link them to their land, totems and ancestral connections. Soon before the ceremony begins:

> ... the boys stand up, and they stood in a line, and the elders... observe them. If a painting peeled off the boy's body, that boy was never chosen to be a leader, because the painting really told the elders how the boy was going to grow up and do other things rather than being a leader. And to the boy whose body painting wasn't peeled, that was the leader for the future. And during the time they used to know who those leaders were going to be.

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In this rather strange story, we sense a connection between the Yolngu theory of the gifted knower, and the notion of the actiotope in a responsible supportive post-colonial education for gifted children. The chest paintings are sacred images, which have been executed under the most rigorous supervision by the image owners and their managers. In Ziegler and Phillipson's terms, they imply something akin to the child's "action repertoire", but one here understood as an ancestral gift – land resources, connectedness and ways of understanding and participating in that particular world of inheritance, connecting them to material, political, economic and spiritual environments. Through the ceremonial preparations the boys are transformed into sacred objects through the painting and singing processes. Some boys manage to sit quietly, thoughtfully, respectfully through the arduous process, they manage to sleep quietly straight on their backs and to protect the paint work which makes them who they are. These are the boys of the story whose leadership potential is demonstrated in their calmness, their respectfulness, their patience, and their dedication to the religious practices of their elders. (How unlike the stereotypical lively talkative, inquisitive gifted child of the Western tradition!) The boys who wriggle around, who lose concentration, who are not taken up by the totemic power of the ancestral songs, images and objects, whose paintings get messy are those who will "grow up to do other things rather than being a leader". Their distracting "goals" at this important moment, dislocated from their work of maintaining and renewing the cohesion between people and place, indicate that they may not be the gifted leaders of the future.

As they grow older, the gifted children will have the chance to excel in the ceremonial celebrations of the *garma*. The *garma* represents an open public (not secret/sacred) space, and also the creative and generative work which occurs when participants in collective action – people, songs, totemic objects, dances and other ritual practices - come together to celebrate, to renew old links and build new ones, and to answer the question of "How should we go on together?" in a setting of creative collaborative performance and mutual respect. This is where we find the second contribution of Yolngu philosophy to the systemic theory. Giftedness is realized and must be supported in the contexts of collective action in which it emerges and is addressed. A good Yolngu education pays particular attention to the choreographic work inside the "subjective action space" of the *garma*. Students and teachers work together in that space, they bring their (ancestrally inscribed) repertoires and environments (no distinction between the natural and the cultural environments) and in the collective action derive goals and practices which enable them to reach fuller potential, holistically and under the supervision of the great authorities of their day (Marika-Mununggiritj & Christie, 1995).

Finally, the individual talents which the gifted students bring to garma (Ziegler and Phillipson's subjective action space) belong not to the individual but to the community. The student must carefully use her imagination to perform herself alongside others, in a context where the action repertoire, the goals, and the environment are *emergent* in collective action under authority. The gifted are accountable for their gifts, and the community is accountable to the gifted. The Yolngu epistemology eschews the "highly individualized opportunities" in favor a collaboratively creative practice of collective action. And they often make the point that the inheritance of the gift and the community's responsibility to the gifted are equally relevant to the non-Indigenous world of education.

Ziegler and Phillipson advocate long overdue and fundamental changes to the provision of education for gifted students. The Yolngu perceive a community role in fostering and supervising the action spaces in which gifted students flourish. It entails the quiet ongoing work of helping them take on their responsibilities to each other, their elders and their place in the world. This requires some fundamental changes to the philosophy and practice of formal education for the gifted.

Note

1. Full details of the workshop sponsored by the National Centre for Science, Information and Communication Technology, and Mathematics in Rural and Regional Australia can be found at http://www.edu.edu.au/centres/yaci/projects_gifted_talented.html.

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COMMENTARY

Considerations of the Actiotope Model of Giftedness

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As Ziegler and Phillipson discussed in their article "Towards a systemic theory of gifted education," various paradigms, models and theories have been described in the extensive literature on giftedness. Many of these paradigms and conceptualizations, including a chapter on the actiotope model by Ziegler (2005), are detailed in the book *Conceptions of giftedness* (Sternberg & Davidson, 2005). While I did not conduct an exhaustive literature search regarding articles on the actiotope model, descriptions of the actiotope model have been previously published (Ziegler & Stoeger, 2004; Ziegler, 2005; Ziegler, Stoeger, & Grassinger, 2011).

According to Ziegler and Phillipson, there is a pressing need for new models of giftedness – they call for a paradigm shift. In the introduction to the current article and, as a justification for presenting the actiotope model, Ziegler and Phillipson are critical of the gaps and "deficiencies" in the current research literature and practice of gifted education. Articles by leaders in the gifted education field including Ambrose, VanTassel-Baska, Coleman, and Cross (2010) and Gallagher (2011) also support this view and emphatically state that the field of gifted education may be fractured, porous, and contested. In 2000, Ziegler and Raul concluded that the research in gifted education was fragmented. Since then, there has been apparently little progress.

There is a crisis in gifted education research – it is stuck in a contested, competitive landscape that is littered with fragmented research, rivalries and questions about the quality of published research studies. While Ambrose et al. (2010) are very specific in their critique of the current state of research and practice in gifted education, Ziegler and Phillipson briefly address their own criticisms of the extant research and quickly move to a description of the actiotope model which sketches the proposed model but provides little evidence for its development, application, and utility for guiding future research models in gifted education.

Ambrose et al. (2010), Gallagher (2011), and Ziegler and Phillipson offer various suggestions in order to move the field ahead. Ambrose et al. (2010) use the metaphor of island–continent and envision that "The most productive island–continent would contain some dynamic practitioner communities located in several theoretic valleys that had been well mapped by research surveyors" (p. 474). The

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lack of theory and the relatively few attempts to test extant theories in gifted education are highlighted by Ambrose et al. (2010). Gallagher (2011) advocates for a "NASA-type plan" (p. 563) that would aim to strengthen the educational system and erect high-quality infrastructure with appropriate resources and funding. Ziegler and Phillipson propose a solution – a paradigm shift. The actiotope model is advanced as a way to move the field forward.

An overarching paradigm in research is the research cycle. While numerous researchers champion this approach, this commentary is framed by the work of Kuhn (1962). In his seminal book *The structure of scientific revolutions*, Kuhn (1962) invoked the term "paradigm shift" to convey changes in assumptions about existing theories and models. Although most of Kuhn's work was in the history and philosophy of science, his visionary views of scientific research are relevant to research and progress in gifted education. He stressed that the fundamental centrality of research is critical to progress in achieving scientific breakthroughs. According to Kuhn, a paradigm directs research and is composed of unquestioned assumptions about the discipline. Kuhn wrote that paradigms, at first, may be incomplete and inaccurate but as, evidence is assembled, the paradigm becomes robust and may become dominant in a discipline. In exquisite detail, Kuhn wrote that essential work should be done to make research advances and fine tune paradigms. According to Kuhn, in order to develop precise paradigms, researchers should: determine the accuracy and scope of facts, align facts with theory, articulate and reformulate theory by addressing ambiguities, make refinements, solve problems using rigorous methods, and suggest solutions to which the paradigm has alluded. All of these steps lead to more refined, exact, and useful paradigms.

The need for new approaches in gifted education has been detailed by Ziegler and Phillipson, Ambrose et al. (2010), Gallagher (2011) and others. In this peer commentary, I affirm Ziegler's and Phillipson's call for new models and paradigms of giftedness. While Ziegler and Phillipson and others are critical of research in the field of giftedness, they advance a paradigm that has not been fully tested. Kuhn's vision, which has influenced researchers world-wide, offers a pathway to get "unstuck" from the insular, fractured, and contested state of gifted education (Ambrose et al., 2010). Kuhn's emphasis on the importance of rigorously testing paradigms and models should be heeded.

Ziegler and Phillipson could focus on the steps and processes, as beautifully described by Kuhn, and identify specific evidence, support their paradigm through substantiation, formulate and reformulate the paradigm in order to advance gifted education so that the research literature matures and deep knowledge can influence practices. While evolving conceptualizations of the actiotope model have appeared in publications for awhile, Ziegler, Phillipson and others should proceed to confirm assumptions and gather evidence. Researchers may not be able to achieve a scientific revolution, as Kuhn described. However, there are opportunities for the evolution and refinement of ideas. Now is the time to seize the moment to gather firm evidence in support of the actiotope model and its assumptions. Where is the evidence?

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COMMENTARY

Giftedness in the making: a response to Ziegler and Phillipson

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Ziegler and Phillipson provide a timely, thought-provoking critique of traditional approaches to gifted education. For a long time, the field has searched in vain for the Holy Grail of giftedness. Alas, the essentialist assumption fails because giftedness does not have a single essence that holds its identity, unity, and continuity. Reification of the construct as an entity sitting in the head significantly narrows our vision of what constitutes human potential for excellence. To maximally realize human potential, it is important to reconceptualize giftedness as contextually and dynamically shaped through learning and development in a complex, reciprocal interaction of the person and the environment. Ziegler and Phillipson show us how it might be done. Although much is yet to be spelled out, some principles can be laid out. In my recent book (Dai, 2010), I discussed the following five principles, which I believe are congenial to what Ziegler and Phillipson advocate.

Probabilistic epigenesis

High potential or giftedness is not fixed at birth. Someone can become "gifted" or demonstrate "giftedness" with the right kind of multi-level interactions of genetic, neural, behavioral, and environmental factors through development (Gottlieb, 1998). Simonton (2005) postulates the making of giftedness as a probabilistic process of having the right person (relative to one's age peers), in the right place (goodness of fit vis-à-vis a domain), and at the right time (good developmental timing).

Corollary

We should not treat giftedness as a static quality sitting there to be identified once and for all, but rather as a dynamic quality that needs to be nurtured through rich environmental experiences and then identified in the active person–environment

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interaction. Competence we touted as "gifted" is itself an evolving quality in context.

Increasing differentiation

Increasing differentiation means that a person will develop ever refined responses and action patterns vis-à-vis environmental opportunities and challenges (or affordances and constraints). These are emergent properties of the developing person that cannot be predicted from general traits manifested in early years. There are two kinds of emergent personal qualities: representations and strategies (i.e., action repertoire) that are highly tuned to task or performance conditions, and affective experiences that shape unique inner visions of the world and the self (i.e., subjective action space; Ziegler, 2005).

Corollary

Identification and curriculum differentiation should be based, not on the categorical assumption of giftedness, but on proximal assessment of increasingly differentiated competence or potential and on educational goals commensurate with the demonstrated learning trajectory, as Ziegler and Phillipson put it.

Human agency

Human beings are not puppets mechanically manipulated by a set of control parameters; they are capable of effecting changes in their environment as well as in themselves. Personal agency can take the following forms: (a) *selective affinity*, denoting a spontaneous pattern of interests and preferences, and emergent functional relations; (b) *maximal grip*, denoting a tendency or action (mental or physical) toward mastery of the topic or object at hand to an optimal level; and (c) *being at the edge of chaos*, denoting a psychological tension created by being situated between the known and unknown, and the old and the new, or between two systems of thought. As Figure 1 shows, these action patterns represent functional relations with environmental situations and thus constitute a person–environment union as an appropriate unit of analysis (i.e., actiotope).

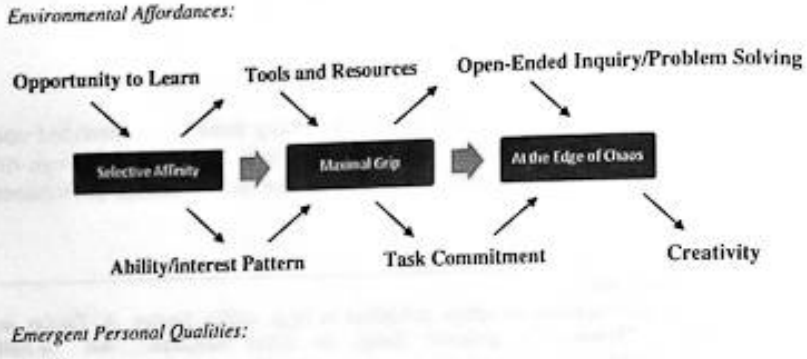

Figure 1. A dynamic process theory of the emergence of gifted behaviors (based on Dai & Renzulli, 2008).

Corollary

Releasing human agentic power should be the main goal of education. Giftedness demonstrates itself in various forms of agency, conscious or subconscious, that need to be instigated by the right kind of environmental stimulation and support.

Participation

School age children are not just developing their intellectual, technical, social, expressive, and psychomotor agencies; they are learning the cultural ways of feeling, thinking, talking, and doing. In other words, they are participating in various domains of social practice (Gee, 2003). The social context of a group of committed individuals pursuing their visions and ambitions together in a particular line of human endeavor should never be obscured as a source of inspiration and aspiration for individuals involved, including "gifted" ones. Working at the edge of one's competence and the desire for perfecting one's trade can only be fully understood in that context (Bereiter & Scardamalia, 1993). Many talents and creative expressions often attributed to individuals are the result of many years of active participation in a domain, which internalizes and transforms the cultural ways of thinking and doing, lending support to a systemic approach to gifted education used by Ziegler and Phillipson.

Corollary

More attention is needed on the issues of how to build a strong community of learners in which students demonstrate strong commitment and responsibility, to provide opportunity for gaining "threshold experiences" for authentic inquiry and productive activities that resemble what experts do in their respective domains, and to offer mentorship in a timely fashion that inspires as well as enlightens.

Equifinality

Gifted children are not a homogeneous category. Etiologies as well as ontogenies (individual development) of gifted individuals can be diverse. Multiple pathways are the norm, not an exception. All roads lead to Rome; indeed sometimes it is even desirable if they lead to Paris or Shanghai. As I stated in my book, "gifted education should be about excellence, not about 'giftedness'" (Dai, 2010, p. 193). As long as one demonstrates good potential for high levels of excellence in culturally valued domains, whether one makes the cut on some arbitrarily set up test score cutoffs is secondary, even irrelevant.

Corollary

Too much time and resources are expended on futile attempts to figure out a gold standard or a litmus test for an unfailing determination of who are "gifted". We

should look at the current performance and proximal behavior of a child in deciding what kinds of education provisions are appropriate for the child instead of seeking the Holy Grail of giftedness and using the abstract notion of aptitude such as general intelligence or generic giftedness to guide policy and practice.

To conclude, the above five principles are highly compatible with the argument Ziegler and Phillipson make in their article. How to translate these principles into practice is a challenge ahead of us.

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COMMENTARY

Heritability: an underestimated effect in the actiotope model

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A promising future has been drawn by Ziegler and Phillipson through illustrating how gifted education works as a system to be beneficial to everyone. Gifted education is individually designed and fostered. The whole system requires continuous adaptation and adjustment of both the individual and environment including schools, teachers, parents, and so on. Naturally, I totally agree with the authors' opinion that it is necessary to understand the system which leads to exceptionality before understanding its components. Since the authors have emphasized the interactions between the individual and environment, my comments will focus on the genetics or inheritability of giftedness which has been underestimated by Ziegler and Phillipson.

The genetics of giftedness is the topic of Francis Galton's *Hereditary genius: An inquiry into its laws and consequences* (1869), one of the most famous psychology books. In this book, the conclusion is that genius is hereditary. Nowadays, numerous twin and family studies have discovered genetic contributions to individual difference in a variety of measures of intelligence or giftedness. Through a study of 9-year-old children, Peper et al. (2009) have found that the global brain volume, white matter density, and gray matter density of frontal and temporal areas are highly heritable. The heritability of g, the general cognitive factor, is substantial throughout the whole lifespan. Its value increases from about 30% in early childhood, to over 50% in adulthood and continues to increase in old age (Deary, Johnson, & Houlihan, 2009). Researchers have also found that the well-known relationship between inspection time and intelligence can almost be completely explained by a common genetic factor (Posthuma, De Geus, & Boomsma, 2001). The same research group has also proved that the association between cortical structures and intelligence is affected by the same genetic factor (Posthuma et al., 2002). This finding has been corroborated by Leeuwen et al. (2009). Leeuwen et al. (2009) have found that the correlation between brain volume and intelligence is entirely due to the common gene set which influences both sets of phenotypes. A meta-analysis has showed that there are moderate to high genetic influences in neuropsychological processes which are indicated by electrophysiological measures

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such as electroencephalographic (EEG) and event related potential (ERP) parameters (Van Beijsterveldt & Van Baal, 2002).

The above evidences are derived from groups of normal children or adults. There is also research about individuals who are gifted or exhibit high ability. A recent study focused on the genetic variation contribution of high g, which was defined as the top 15% of the distribution (Haworth et al., 2009). They found substantial genetic influence (50%) and moderate shared environmental influence (28%) in 11,000 twin pairs aged 6–71, recruited from four countries (Haworth et al., 2009).

One point which should be mentioned is that emphasizing the genetic contribution does not mean the environment effect and/or the gene-environment interaction can be neglected. For instance, an additional 9% of the variation observed in Raven Progressive Matrices test, a popular intelligence test, was due to gene–environment interaction (Van Leeuwen, Van Den Berg, & Boomsma, 2008). We can also find the emphasis of individual–environment interaction in the actiotope model, as Ziegler and Phillipson described the model as co-evolutionary or co-adaptive. In my opinion, the actiotope model is ideal for gifted education. If we firstly consider individual differences of heritability before further examining individual–environment interaction, the model will be more efficiently executed in education practice.

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COMMENTARY

Comments on the actiotope model

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From past knowledge of these authors' work, I knew before reading the manuscript that there would be significant conceptual disagreements. Yet, I was hoping to find enough points of convergence that they could lead to enriching exchanges and, maybe, future shared efforts at bridging gaps between our respective views. Unfortunately, it soon became clear that the authors were rejecting offhand all current multifactorial conceptions, including my DMGT, as mechanicist, thus devoid of any redeeming values. Their attitude left me little choice but to defend my theoretical perspective against their erroneous judgments and unfair accusations. As basic psychology observes: "when threatened, it's fight or flight". Because of space limits, I have singled out only four comments that address crucial weaknesses in the authors' proposal:

(1) The first comment has nothing to do with the crux of the debate between alleged obsolete "mechanicist" views and these authors' systemic approach, which they "modestly" present as a monumental paradigm shift. It concerns the concept of aptitude/potential, especially its outstanding manifestation in human giftedness, as defined in my DMGT. Most scholars in gifted education acknowledge the twin presence of both high aptitudes and high achievements. Briefly, aptitudes are defined in the DMGT (see Gagné, 2009) as the possession of natural abilities in four mental domains and two physical ones; giftedness corresponds to an outstanding level (top 10%) of such abilities in at least one domain.

Aptitudes manifest themselves most characteristically through individual differences in ease and speed of learning. As the late John B. Carroll stated in the case of intellectual abilities: "IQ represents the degree to which, and the rate at which, people are able to learn, and retain in long-term memory" (1997, p. 44). Within the DMGT, outstanding aptitudes (gifts), which represent stable human characteristics, serve as building blocks for outstanding achievements (talents), another form of stable human characteristic. In this way, aptitudes play a precious role as predictors of human achievements. See the above reference for a detailed discussion.

In spite of its general acceptance, the concept of aptitude appears nowhere in the target article. In fact, the authors go even further by refusing to acknowledge

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the existence of stable human traits. In their first reference note (p. 27), they define "gifted individuals" as "those with a statistical probability for outstanding performance, *rather than an individual with a particular personality or intellectual trait*" (my emphasis). The highlighted text confirms my affirmation. But where does that "statistical probability" come from? How is it observed or assessed? How stable is it over time? It has to be; otherwise it would lose its value as a predictor of future outstanding performance. That denial of aptitudes and stable human characteristics becomes a fundamental diverging point between our theoretical positions.

(2) Through most of their text, the authors avoid using the labels gifted and/or talented, no doubt for the reasons given above. Yet, since their systemic theory targets "gifted" education, they cannot remain totally silent about them. So they discuss them in section "Focus on the interactions between person and environment" (p. 24). First, they state that these two labels/constructs are employed "arbitrarily". I strongly disagree; there is no arbitrariness, neither in the case of the DMGT, where these two terms receive very clear and well-operationalized definitions, nor in the case of their use by most professionals in their identification procedures. They go further by stating that these labels are "neither conducive to research nor to gifted education". They do not explain that broad statement. Anyway, in the very next sentence, they make an about turn and declare that these labels "remain useful to facilitate the communication between research and practice" (p. 24). How can they be useful if they do not have any clear meaning? Only clear and well-understood concepts can facilitate communication.

Then comes the most bizarre part. The authors propose to use *both* labels as indices of achievement, thus creating the strangest pair of gifted/talented definitions I have seen in my professional career. My interpretation is that they were forced to do so, having put aside the concept of aptitude. They propose to designate as "talent" a lower level of "exceptionality", with "demonstrated precocious achievement... exceeding that of a similarly aged cohort"; the term gifted will apply when individuals "have achieved a critical state in this [their learning] pathway... thus have a very high probability of achieving exceptionality in one domain". So, you first become talented, with "some" probability of reaching exceptionality; then, if your achievements increase to that "critical state", you attain the gifted level. What is a "critical state"? How different is it from "demonstrated precocious achievement"? How does one assess the presence of "a very high probability" as opposed to a "simple possibility"? (p. 24). What will be the operational criteria for such a distinction? Do they represent stable phenomena? Notice that I chose to identify levels of talent with adverbs (e.g., mild, moderate, high) instead of distinct terms; are they not the same reality, with just *quantitatively* distinct expressions?

(3) The authors state in their abstract that "current approaches to gifted education are based on the erroneous view that to understand the development of exceptionality we need to *merely* [my emphasis] understand the components of giftedness" (p. 24). That statement totally misrepresents the DMGT, one of these "current" approaches. Most of my efforts have gone well beyond the "mere" understanding of the four causal components of talent emergence (gifts, developmental process, intrapersonal and environmental catalysts). In the 2004 article quoted by the authors, I devoted fully 40% of the text to a discussion of the complex dynamics between these causal components. Not only do I give more importance than most

colleagues to these interactions, but I consider myself the only scholar to have discussed at length the crucial question of the causal hierarchy between major components and sub-components. I have framed that question: "What makes a difference?" In brief, the authors' use of that "merely" unfairly truncates the complexity of the DMGT.

(4) My last comment targets the underlying similarity between their "systemic" approach and the DMGT. They present a system as "made up of interacting elements" (p. 17), which is exactly the case with the DMGT. They propose four main components: (a) an action repertoire (a synonym for the term "competencies", common throughout education); (b) goals (a very small part of the DMGT's intrapersonal catalysts); (c) an environment (one of the DMGT's two sets of catalysts); (c) subjective action space (I couldn't quite fathom the exact significance of that element). So, where is the alleged chasm? How does their model differ so much from the multifactorial models they reject? I would submit (also modestly) that one will find a much richer analytical complexity of component interactions in the DMGT, especially in its updated version that the authors do not mention. If there is one major diverging point, it appears in their view that "it is important to firstly understand the system that leads to exceptionality [talent] before it is possible to understand its components" (p. 3). In my view, the "system" does not create the components; they help build the system.

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of a particular culture as well as the importance of the *field* – individuals who function as gatekeepers in the said domain. There is likewise an emphasis on the interaction between the producer and the audience in defining and explaining the concept of creativity (Csikszentmihalyi, 1999, p. 314) – a very useful lens that we have likewise adopted in studying the experiences of flow among talented teenagers in Singapore (Garces-Bacsal, Cohen, & Tan, 2011) from within the larger context of Renaissance Singapore and the enormous amount of resources being channeled by the larger society to nurturing and developing the creative vision among these young artists-in-training.

In Ziegler and Phillipson's introductory remarks on the system concept, they noted that:

> ... the characteristics and behavior of the system are determined by the characteristics, organization, and interactions of its component parts. At the same time, the characteristics and behavior of the system provide the structural parameters which control the system's components and their interactions. (p. 11)

This has also reminded me of Fritz Perls' (1969) Gestalt approach to therapy whereby he noted that the whole is greater than the sum of its individual parts.

It is also important to demonstrate that there is a wide range with which a phenomenon could be explained using the systems model, depending on the lenses one uses. Even a single individual can be considered a micro*system* in and of itself: consisting of various systems and subsytems (e.g., physiological component, cognitive component, etc.). The traditional dichotomy of nature as opposed to nurture in accounting for giftedness and talent has been constantly challenged in light of the neural plasticity of the human brain suggesting their bidirectional and fluid interactions (Kalbfleisch, 2008) as well as the implications of recent findings on brain research on classroom practices (Tomlinson & Kalbfleich, 1998). As Ornstein (1986, pp. 8–9) has pointed out:

> Our illusion is that each of us is somehow unified with a single coherent purpose and action... [but] we are not a single person. We are many... All of these general components of the mind can act independently of each other, [and] they may well have different priorities.

We could also take a wider lens and see it from a more macrosocial vantage whereby the sociocultural perspectives in developing talents could be amplified significantly (Phillipson & McCann, 2007; Sternberg, 2007) – something which I have also done in my own work with gifted children coming from culturally different and socio-economically disadvantaged backgrounds (Garces-Bacsal, 2011).

In future, what I would then like to see are the parallels and divergences between the Actiotope Model of Giftedness (Ziegler, 2005) subsumed within the systemic theory of gifted education by Ziegler and Phillipson – and the existing systems model in understanding human behavior and development I have highlighted above.

Moreover, it would be good to specify and highlight the implications for actual practice of the systems model among gifted and talented educators to solidify the theory–practice nexus. It would also be important to anchor concepts such as *equifinality* and *phase transition* to actual behavioral indicators that educators and researchers could be on the lookout for – to provide it greater potency and meaningfulness for practitioners.

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COMMENTARY

Developing systemic theories requires formal methods

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Ziegler and Phillipson (Z&P) advance an interesting and ambitious proposal, whereby current analytical/mechanistic theories of gifted education are replaced by systemic theories. In this commentary, I focus on the pros and cons of using systemic theories. I argue that Z&P's proposal both goes too far and not far enough. The future of gifted education depends not on whether theories are mechanistic or systemic, but on whether these theories can explain the phenomena under study. In particular, there is a need for more precise theories expressed formally, either mathematically or computationally.

By proposing a radical rejection of the classic method in science, Z&P's proposal goes too far. There is no doubt that the standard analytic and mechanistic approach of science has led to tremendous advances in our understanding of natural and artificial phenomena. Examples abound from physics, biology and psychology, to mention just a few. Ever since von Bertalanffy's classical work on general systems theory in the 1920s (Von Bertalanffy, 1973), scientists have attempted to apply systemic ideas to natural and social systems. While interesting results have been obtained with the systemic approach, I think it is fair to state that, broadly speaking, its heuristic power has been inferior to that of the classical approach. A good example is offered by the systemic approach in psychotherapy (Bõszörményi-Nagy & Framo, 1965; Watzlawick, Beavin, & Jackson, 1967), which started in the mid-1950s. In spite of great promises and some indisputable successes, several reviews have shown systemic psychotherapy to be less effective than cognitive behavioral therapies, which are essentially analytical and mechanistic in nature (e.g., Grawe, Donati, & Bernauer, 1994; INSERM, 2004).

At the same time, and paradoxically, Z&P's proposal does not go far enough. Complex systems *are* complex! Rigorously implementing systemic methods requires more than just theorizing about the relations of a few components of a system and their environment. It requires a careful analysis of *all* the components, systems, subsystems and relations involved. This is colossal work. Because of the postulated nonlinearities (e.g., phase transitions, chaotic behaviour, positive feedback loops), ignoring a single component or relation might have the consequence of totally mispredicting the behaviour of the system.

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Consider the example of chess world champion Bobby Fischer discussed by Z&P. When describing the "Fischer system", they mention Fischer, his mother, sponsors and chess grandmasters. Granted, this example was not meant to be exhaustive. However, it is clearly an oversimplification. At the least, the system of young Bobby Fischer should include his elder sister, his coach Jack Collins, his fellow high school students and chess players of various ages. It should also include the relations between these individuals. Changes in some of these relations might have had crucial consequences for Fischer's development: a more directive mother might have interfered with Fischer's interest for chess and different friends in high school might have diverted Fischer's attention to other activities. Again, because of the nonlinearities postulated by systems theory, any of these could have had considerable impact on Fischer's chess career, and it is not possible to ignore them *a priori*. One could argue that at least some inanimate objects should be included in the system as well. In Fischer's case, he spent an inordinate amount of time studying chess books, and there is no doubt that some of them must have affected his development particularly strongly.

As should be evident by now, describing a system is extremely hard. In fact, assuming a "flat" system of N components – that is, ignoring a possible hierarchy of subsystems – and assuming that a link from component A to component B is different to a link from component B to component A already implies N × (N-1) relations. And this is a vast oversimplification, as diverse types of relations must be considered as well (affective, cognitive, motivational, etc.). In addition, these relations will change as a function of time and will be the source and object of feedback loops, either positive or negative. This raises at least two issues. First, how is it possible to collect all this information? And, second, how is it possible to process all this information in a meaningful way and without oversimplifying matters?

Considering the practical difficulties in collecting all the relevant information, it is understandable that Z&P never describe a system in its full complexity. In fact, it could be argued that their account is often analytic, focusing only on the aspects of a system that seem important, either intuitively or theoretically, and ignoring many aspects that could in principle matter. Given the known limits of human cognition, it is not surprising that systems are simplified and approximations made. For example, when Z&P talk about the "environment" rather than discussing every component and relation of this environment in detail, they take advantage of the hierarchical and decomposable structure of most natural and human-made environments, which is a powerful way to simplify the phenomena under study (Simon, 1969). Simplifications of this sort are acceptable because natural and human systems tend to be homeostatic and robust to perturbations – a fact that is all too well known in therapeutic settings where change is difficult to induce.

Mechanistic analyses of systems can often be useful approximations to the full complexity of these systems, which cannot realistically be tackled except for simplified textbook cases. Indeed, there are many current examples of scientific domains where the boundary between analytical and systemic approaches is very fuzzy indeed. A good example is offered by network theory (Newman, Barabasi, & Watts, 2006), which is the study of systems *par excellence*. Thus, rather than opposing analytic and systemic approaches, it is more fruitful to see them as complementary approaches.

Von Bertalanffy (1973, pp. 84–86) warns us from the dangers of using analogies, as opposed to explanations, to describe phenomena. He also argues that systemic theories can be expressed unambiguously and exactly only using mathematics. I agree, with the qualification that we now have other precise formalisms, most notably those offered by computer languages. A systemic theory of gifted education would be truly useful only when it is expressed formally and in enough detail to allow its predictions to be tested against empirical data. Given the complexity of the phenomena under study – number of variables and interactions involved, dynamic character of the data and presence of non-linear effects – computational modelling offers an ideal formalism for developing such theories (Gobet, Chassy, & Bilalić, 2011; Lane & Gobet, 2003).

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COMMENTARY

Systems, perturbations, and excellence

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The field of giftedness and gifted education is about 100-years (plus/minus) old. Whether traced back to Stern or to Terman, or to anybody else, it has encompassed a millennium of thinking about and studying the intellectually gifted and educating them. In their centerpiece for this issue, Ziegler and Phillipson take these 100 years of research and practice and attempt to bring the field to a new level. This new level is distinct in its systems approach to the field – the point is not to focus exclusively or predominantly on an individual and his/her potential, trajectory, and products, but to refocus the field on the systemic context of giftedness. This perspective changes the accent of the field by thinking less about "who" is able to demonstrate exceptional intellectual performance and more about "what" conditions permit the emergence of such performance.

This new systems approach clearly brings many interesting topics to the discussion, some new and some old, but now organized in a complex structure. Thus, the concept of an actiotope, a component of the system that is potentiated with exceptionality, is a system itself. This "system-within-a-system" includes the action repertoire, goals, the environment, and subjective action space – all complex systemic structures on their own, which are introduced and described in detail by Ziegler and Phillipson. This "system-within-a-system" to the n^{th} degree approach is well thought through and provides much food for thought. Yet, while reading the text, I had a thought about what might be missing in this elegant and complex structure crafted by Ziegler and Phillipson. The remainder of this commentary will explicate that thought of mine.

When the words "systems" or "systemic approach" are used in psychology, inevitably, just by association, a whole family of works on the fundamentals of this generic approach is thought of (Oyama, Griffiths, & Gray, 2001; Spencer et al., 2009; Thelen & Smith, 1994). In particular, the concept of perturbation comes to mind – a reshuffling of the system, which can change or eliminate old and introduce new attractors, re-defining a self-regulating system and its feedback loops until a new perturbation occurs.

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important? For three reasons. First, such a concept provides a useful way of understanding the emergence of excellence in individuals as a response to perturbation. A theory of exceptionality, as no other theory, is a kind of set of case studies, or even historical etudes about exceptional individuals (otherwise, it would not be a theory of exceptionality but a theory about populations). And there are many remarkable examples in the literature of exceptionality arising from a systemic perturbation – a situation in which, from "old parts," a new "whole" arose or crystallized. Among many types of such perturbations, there are those that can be attributable to major societal events (e.g., Sergey Korolev); the emergence of new (e.g., Salvador Dali, Andrei Sakharov, and Maria Skłodowska-Curie) or the loss of trusted and loved (e.g., Maria Skłodowska-Curie[1] and Vladimir Ul'yanov-Lenin) people, or even minor mundane phenomena that trigger deep insights (e.g., Isaac Newton). Yet, whatever the type of perturbation, what is important for this discussion are two common characteristics of these perturbations, namely (1) their apparent "random" natures (e.g., nobody can predict if or when or how these will occur); and (2) their need to "work within a system of elements" that is already in place (i.e., no existing system – no perturbation).

Why is the consideration of perturbation in a systemic theory of giftedness

Second, this last point (that there can be no perturbation without an existing system to disturb) is a testimony in defense of the "old-style" theories of giftedness, which assumes, although implicitly, that there is systematic aspect to elements of giftedness. Although conceivably limited in their explanatory power and even "mechanistic" (using Ziegler and Phillipson's descriptor) in their nature, these theories are certainly critical as a component of that very systemic approach Ziegler and Phillipson are building and exemplifying in this article. In fact, for a system to exist as a stable configuration, it needs to have elements (i.e., elements of giftedness) to configure! Clearly, a focus on what these elements consist of (intelligence, creativity, wisdom or whatever else theorists of giftedness deemed appropriate to theorize about) is important, so all these years of research on individual-focused theories of giftedness are central to both understanding the individual-oriented element of the system and promoting theories of giftedness to new heights, i.e., their systemic level.

Third, and finally, the very belief in the importance of perturbation assumes the impossibility of education for eminence. The systemic theory of giftedness contextualizes the individual and transforms him or her from an isolated unit with individual characteristics (e.g., levels of intelligence, creativity, and knowledge) into a contextualized acting system that is influenced by its environment and exerts its influences on the environment in turn. Thus, the systemic view asserts that the best strategy for gifted education is "the creation of highly individualized opportunities" (Ziegler & Phillipson, this issue, p. 24), stressing the importance of "individually tailored learning environments" (p. 24) for every gifted (or simply every?) child. Thus, the best possible education is *individualized* education[2] that maximizes the potential of each and every child and prepares the system for perturbation, should such a perturbation happen and trigger the manifestation of excellence.

Thus, for perturbation to be successful (i.e., transformative), a system has to have most (if not all) of its elements in place. In this sense – both the individual characteristics of a child and his or her educational pathway are necessary elements for preparing the system for a perturbation, giving it the capacity to transform and develop new points, and emerge in a light of excellence. According to this view,

excellence cannot be predicted or staged; it has to emerge as a dynamic system whose elements are reflective of an individual and the context in which the individual exists. As such, excellence may or may not emerge; there is a particular randomness (or magic?) to it. And that is what makes excellence rare – it cannot be predicted, guaranteed, or staged.

In short, it seems to me that Ziegler and Phillipson's systemic view does not cancel out the ideas and findings of "traditional views" of giftedness, but takes the field, capitalizing on its previous accomplishments, in a new direction, fruitfully perpetuating the field's development.

Notes

1. Notice that in this case the loss of the relationship with Kazimierz Żorawski, and then the acquisition of the relationship with Pierre Curie both generated new developmental directions in Marie's pathway toward excellence.
2. Think about the education of the future portrayed by Dr Spock's school education on Vulcan in *Star Trek*.

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COMMENTARY

The current need for a system–theoretical background in counseling the gifted

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Current gifted education clearly has its problems as outlined by Ziegler and Phillipson. The focus on personal traits and the assumption of an autocatalytic development of gifts into extraordinary achievement has not been proved a valid approach for designing effective supportive measures (see Lipsey & Wilson, 1993). At least one of the reasons proposed by Ziegler and Phillipson – lacking consideration of the very individual contexts the gifted persons find themselves in – is also acknowledged by counselors in the field of giftedness. Their needs and common approaches to handle this matching problem will be exemplified in the following.

A recent review of 12 counseling centers for giftedness in Germany, Austria and Switzerland revealed that many of them are about to or already perform a shift towards systemic thinking in their counseling strategies (Ziegler, Grassinger, & Harder, 2012). These practical approaches are mostly based on a multidisciplinary theoretical background to reach a holistic perspective as pre-eminently trait oriented theories of giftedness do not provide sufficient guidance to counsel adequately and effectively.

The centers' understanding of giftedness almost exclusively relies on multicomponent-models (see Heller, Perleth, & Lim, 2005; Mönks, 1992; Perleth, 1997) as they specify not only personal traits but also environmental factors that must be taken into account. But with these analytic-mechanistic models (cf. Ziegler & Phillipson) the problem remains that solely an indefinite number of relevant causal factors is proposed: Neither concrete environmental influences nor their interactions with each other and with personal factors are specified. But this is exactly the critical point: Clients need advice in how to match personal needs of the gifted with the environment to ensure a positive development towards exceptional accomplishments. Counseling centers fill this theoretical gap by turning towards systemic counseling principles while the applied theory of giftedness remains non-systemic. They emphasize the importance of a holistic perspective, try to involve all social systems the client is associated with in the counseling process, focus on available resources, potential and possible solutions within the individual context (cf. Ziegler, Grassinger, & Harder, 2012). Typically, this results in a counseling of parents and

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child, sometimes in accordance with the teacher while other environmental agents are only scarcely involved due to limitations of time and effort. As concrete theory-informed instructions are missing for productively enriching the interaction between these environments and the gifted learner, counseling centers heavily draw on best practice approaches to provide the child with what is supposed to be a supportive environment. Although evaluation studies discredit the available fostering provisions in western educational systems like acceleration or special classes (see Lipsey & Wilson, 1993) very few alternatives are put forward. In this respect two counseling centers stand out from the rest: First, the counseling center in Ulm, Germany (Ziegler, Stöger, Grassinger, & Harder, 2012) bases the complete process of counseling parents, pupils, and teachers on the system-theoretical Actiotope Model of Giftedness (Ziegler, 2005) and aims at a co-evolution of all system parts to enable the development of excellence. Therefore an individually tailored learning path is created to support the individual in attaining the necessary competences for the next developmental challenge which has been shown to be a very effective proceeding (Grassinger, 2009). The second exception among the counseling centers consists in the approach of the Austrian center (Weilguny & Rosner, 2012). Geared towards influencing the complete educational system of the country it pursues a fundamentally different course of fostering giftedness. The center understands itself as a think tank where experiences from different system levels are bundled and structured to put the drawn conclusions back into practice. The improvement of something as complex as an educational system rests on systemic principles like equifinality, context dependency, interdependence or phase transitions (cf. Ziegler & Phillipson).

To sum up, all counseling centers show at least tendencies towards systemic counseling strategies. Obviously, these principles are viewed as essential to reach long-term effects in fostering giftedness. Despite this practical need for a holistic–interactive theoretical approach common theories of giftedness do not explain the complex process of talent development in a realistic way. Although systemic ideas have been put forward for years in the field of giftedness (see Dai & Renzulli, 2008; Plucker & Barab, 2005; Ziegler, 2005; Ziegler & Stöger, 2011), still there is only very little research leading to precise indications for the creation of effective environmental support in a system-theoretical sense. Gifted education as well as counseling practice show the need for a paradigm shift which has already begun. But the empirical and theoretical foundation must extend dramatically to ensure the required professional standards an educational system should fulfill.

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COMMENTARY

Different research paradigms concerning giftedness and gifted education: shall ever they meet?

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Each descriptive definition of giftedness and related terms is dependent on the intended use, e.g., from scientific aims, the goals and type of gifted support programs or from social considerations and norms. Such definitions will also be determined by the choice of measurement instruments, i.e., by the operationalization of the experimental or diagnostic and evaluation variables (indicator problem in the psychometric paradigm). Questions about the decision algorithm are connected too with the mentioned problems which illuminate the dependence between subject matter and methodology in definition attempts.

Explanatory concepts regarding giftedness are hardly less problematic than the descriptive conceptions. They differ from one another in the significance of the attachment to personality and/or socio-cultural determinants in the structure of giftedness versus their manifestation in exceptional aptitudes or excellence – see the so-called "multiple" conceptions (cf. Callahan et al., 2011), among others.

Hence, our knowledge regarding giftedness and gifted education is supplied by different sources of information and different research paradigms. Particularly relevant approaches are here the psychometric paradigm, the expert–novice paradigm, and the explanatory approaches from cognitive sciences, also the quasi-experimental social and developmental studies as well as the longitudinal (program) evaluation studies. According to that we conceptualized giftedness or talent as a multifactorized ability construct within a network of non-cognitive (e.g., motivations, learning emotions, control expectations, self-concepts, coping with stress and others) and social (learning environments of family, school, and work) moderators as well as performance-related criteria in different areas like mathematics and information science, natural sciences, languages, music, arts or sports and social relationships (cf. Heller, Perleth, & Lim, 2005, pp. 148–149).

Whereas the sketched Munich Model of Giftedness (MMG) has been developed in the psychometric paradigm, Perleth (2001) pursued a synthetic approach concerning the Munich Dynamic Ability-Achievement Model (MDAAM) – an extended version of the MMG. With that an attempt is made to bridge the gap between the psychometric research into giftedness and the process-oriented approach of

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cognitive science and the expertise research into the development of excellence; for greater detail see Heller, Perleth, and Lim (2005, pp. 151–154), Heller (2010, pp. 3–136) or the recent monograph by Subotnik, Olszewski-Kubilius, and Worrell (2011, pp. 3–54). For a meta-theoretical perspective see Ziegler and Heller (2002, pp. 3–21).

In the current target article "Towards a systemic theory of gifted education" by Ziegler and Phillipson the authors criticize the "erroneous view" of the research paradigms mentioned above with respect to gifted education as well as to our understanding of the development of excellence or exceptionality. Instead of them, they plead for a "paradigm shift" and describe "basic principles of gifted education" based on the "actiotope model" in a systemic view. This reminds me of the controversial debate on psychometric research approaches (e.g., so-called status diagnostics) versus process diagnostics (dynamic assessment or "learning test") and "action research" in the field 25 years ago (cf. Heller, 1989). Over that period of time, systemic approaches have been discussed too in the domain of creativity as well as in the field of medicine, family psychology, etc.

Which new insight and benefit of gifted education can we expect from systemic approaches like the actiotope model? What is the added value of knowledge compared with the criticized research paradigms? Are the triarchic theory of human intelligence and the WICS model by Sternberg (1985, 2003) or the Munich Dynamic Ability Achievement Model (MDAAM) indeed "mechanistic" models as the authors of the target article asserted? These and other related questions should be discussed in the following section.

In the first part of their article Ziegler and Phillipson review the "state of the art" and complain the deficiencies of many current fundamental principles of gifted education including talent search and identification approaches in educational and school psychology. Consequently, they try for redefining the terms of giftedness and gifted education within the systemic paradigm based on the new developed "actiotope model". This has been described in the second part in greater detail.

The main principles of the actiotope approach are: (1) the focus on the "interaction" between the individual and the social learning environment; (2) the "co-evolution of all elements" of the individual person and the environment; (3) the "resource" orientation, e.g., appropriate instructions, learning competencies, etc.; (4) constructing "learning pathways" instead of the traditional approaches of identification and talent search; (5) "dynamic–interactive regulation" instead of gifted education according to the current practice. Finally, the authors conclude: "If these ideas are correct, then we should observe better outcomes in gifted education when based on dynamic–interactive processes". Who could not agree with this statement? So far I agree with the authors. But I cannot see substantial differences between Sternberg's theory of human intelligence and the MDAAM on the one hand and the authors' systemic approach on the other hand, especially with regard to the dynamic and the context components. In my opinion, Sternberg's triarchic theory and the MDAAM already go beyond the mechanistic paradigm. By all means, the actiotope model by Ziegler (cf. Ziegler et al., 2006) provides many innovative insights into gifted education: theoretically as well as for the practitioners in the field.

All in all: Ziegler and Phillipson offer a very stimulating article, which provides the reader with many new insights into gifted education and useful information relevant to its improvement. The elaborated framework is a very comprehensive model. But the "reality" of giftedness and gifted education is complex and needs comprehensive models. In my opinion, the principles mentioned above could also be used as an – if necessary slightly modified – guideline for gifted education in the "traditional paradigm", e.g., in talent search. Perhaps the most important principle – not only in the systemic paradigm – seems to me the focus on the interaction processes (no. 5). In the point of an advocate's view of synthetic approaches, the heuristic function of the actiotope model is especially advantageous for further conceptualizations in the field of gifted education. I see rather controversy than contradictory contrasts between many criticized "traditional" identification and gifted education strategies on the one side and the "new look" of the systemic paradigm on the other side. With respect to the expected nurturing effects of the actiotope model, further empirical research seems to be necessary before a final decision could be made. I totally agree with the authors' demand for more "attention to the interaction between the person and the environment" as well as for the "construction of individualized learning pathways" as far as possible – with (not without) differentiated identification measures. The authors of this target article deserve our gratitude and respect.

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COMMENTARY

Integrating practice-to-theory and theory-to-practice

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In "Towards a systemic theory of gifted education", Ziegler and Phillipson offer a useful critique of current research and the current paradigm in gifted education. The authors provide an interesting and useful merging of systems theory with their actiotope model, and using this paradigm the authors suggest many fruitful areas for future research. However, we disagree with the authors if they intended to suggest that gifted education should only have one paradigm. In general, we believe that social and behavioral science disciplines should be multi-paradigmatic, at least in the current stage of development. Nonetheless, at a meta-theoretical-level, the article offers an important *vision* for connecting many current theories and practices. In the US, it is not uncommon for a single school system to have many isolated improvement programs implemented concurrently, and integration of programs into an overall, meaningful, systematic whole should help improve outcomes. The systems way-of-thinking offers an excellent meta-theoretical strategy for integration, especially for producing long-term changes.

We will offer a few categories and areas of research that we think will complement what the authors have provided. For example, we think that both a nomothetic and an idiographic view of science can be useful when they are viewed together. The goal of traditional science has been to provide the nomothetic view (or the lawful view, or "the view from nowhere"), but local, complex, and intentional causation is where practitioners operate. A general or theoretical or nomothetic level should inform the local or idiographic level of practice, but the complement is equally true: the local or idiographic should inform the general or theoretical or nomothetic. This too is a systems concept because these two processes should interact continually in a cyclical fashion. The two levels must operate in together (theory and practice) if we ("experts" at both levels) are to learn from each other and produce science that works.

Regarding the first link, from theory-to-practice, we recommend readers examine the *translational research* literature to better facilitate the nomothetic/theory to idiographic/practice link. The US National Institutes of Health, for example, has defined two areas of translational research. Type I translational research seeks to apply basic

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laboratory science findings to developing applied programs. Type II, and more relevant to the current discussion, seeks to enhance adoption and implementation in real world settings (Rorhrbach, Grana, Sussman, & Valente, 2006). Type II is analogous to the authors' urging research that evaluates the interaction between person and environment. Type II research seeks to directly address how the contextual systems in which programs are delivered hinder or enhance the impact of the program on the person. Traditional research paradigms have focused on either (a) factors within the person, or (b) factors within the program/intervention. The translational paradigm shift demands that the context in which programs occur become a target of inquiry.

Regarding the second link, from practice-to-theory, we recommend that readers examine the *practice-based evidence* (PBE) literature which serves as a paradigm to facilitate the idiographic/practice to nomothetic/theory link and as a counterpoint to the dominant paradigm in biomedical and mental health intervention research – evidence-based practice (EBP). The dominant paradigm now present in mental health and biomedical intervention research is evidence-based practice. EBP involves a conscientious effort to make decisions and deliver treatments based on the best available evidence. Part-and-parcel of this model is the assumption of a top-down "pipeline" (Green, 2008) of knowledge and practice from researchers to practitioners, from "lab bench" to "bedside". In the context of biomedical interventions the relative homogeneity of the target phenomenon makes the "pipeline" theory more logical. However, the logic of this approach falls apart when we consider, as Ziegler and Phillipson also argue, that most psychosocial phenomenon are relatively heterogeneous and highly embedded in social contexts in terms of their etiological development and descriptive presentation. The artificial settings in which many randomized clinical trials are conducted yield results with exceedingly poor external validity, and typically cannot capture the dynamic systemic interactions as described in the actiotope model of giftedness. In contrast, practice-based evidence involves using data gleaned from everyday practice, or naturally occurring successes to draw conclusions about BOTH process and outcome and about the varied and individualized ways a target phenomenon manifests and develops (Horn, Gassaway, Pentz, & James, 2010). This emphasis on correcting the narrowness and potential reductionism of the EBP approach that is present in the practice-based evidence model appears in-line with the actiotope approach that emphasizes analysis of natural systems and how they produce exceptionality through interactions among multiple systems and the individual child.

In the case of gifted education a practice-based research paradigm would complement and extend the actiotope model. It would complement the model in that a practice-based evidence approach would seek to glean understanding about how "natural" systems in schools either promote exceptional trajectories or inhibit such outcomes. Rather than seeking to apply an abstraction to an idiographic setting, this approach flips this pipeline on-its-head and seeks to use observation of how particular systems function as a means to create commentary on what the larger principles of program development should be based on this practice-based evidence. This has advantages to imposing a presupposed model, such as the assumptions of the actiotope model, and instead studying natural social systems and documenting how they actually function around an issue such as giftedness. Such findings can then be used to confirm or disconfirm elements of a theoretical account of giftedness as is present in the actiotope model.

The authors rightfully cautioned that they "do not claim to have ready answers" to many of the questions they raise. However, we recommend that the authors address how their criticisms of current gifted education might apply to their own paradigm. Here are several criticisms offered by the authors of the current paradigm that should be examined for the proposed paradigm:

(a) What metaphor should replace the mechanistic metaphor?
(b) Component models were criticized, but isn't the new paradigm a four component model (action repertoire, goals, environment, and subjective action space)?
(c) What would research that focuses on non-isolated individuals look like?
(d) How will the new paradigm better address the problem of Laplace's demon (e.g., Will the new paradigm better "predict exceptional performance")?
(e) How should practitioners, using the new paradigm, tailor programs to individual needs?
(f) Will new-paradigm research produce larger effect sizes?
(g) What is high-quality research, according to the new paradigm?

Our last question is this: How might gifted-education research become more effective in enabling society's least advantaged to have gifted life trajectories more frequently? These are challenging questions, with no absolute answers, but we look forward to the authors' thoughts. Furthermore, these are issues that all of us (not just Ziegler and Phillipson) need to address in our research and practice!

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COMMENTARY

My response to the systemic approach to gifted education

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As an alternative to the current paradigm of gifted education, Ziegler and Phillipson proposed a systemic approach and argued that factors in the current mechanistic model of giftedness are not good predictors for exceptionality. They pinpointed that a single factor identified as an indicator of giftedness, ineffective measures, inappropriate context, and over-reliance on products make it futile to maneuver appropriate educational practices for gifted population. Their perspectives have raised some important issues in understanding the theoretical framework of gifted education.

First, Ziegler and Phillipson assert that the systemic approach deals with the wholeness of giftedness without scrutinizing its components and that its main feature is in interactions between individuals and environments. However, crucial roles of environments have not been dismissed in the mechanistic perspective, either. For example, Renzulli (2005) expanded his original three-ring conception of giftedness, thereby including co-cognitive factors, collectively referred to as "operation houndstooth" consisting of six components and 13 subcomponents which interact with the traits associated with the development of human abilities. Tannenbaum (2003) proposed that a psychological filigree of factors (e.g., superior general intellect, distinctive special aptitudes, non-intellective traits, environment, chance) must be "all" represented in every form of giftedness. Sternberg's (2003, 2005) WICS model suggests that giftedness is captured by individuals with wisdom, intelligence, and creativity synthesized, and thus, it is fulfilled only if successful intelligence, accomplished by internal abilities to achieve goals, understand, and interact with the environmental context, is achieved. Also, the Munich model of giftedness (Heller et al., 2005) portrays giftedness as a multidimensional and typological conception that requires personal talent factors, non-cognitive personality characteristics, and environmental conditions. All these models are common in that multiple components such as intrapersonal, interpersonal, external/contextual factors are involved and each of them must be present "all at once" to form and fulfill giftedness although different weights are given to individuals by their characteristics and domains of giftedness. Thus, both mechanistic and systemic approaches support that giftedness occurs under certain circumstances, and only individuals who are able to balance elements of giftedness can be recognized.

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Second, Ziegler and Phillipson criticized that the mechanistic approach delineates a causal relationship between elements of giftedness and exceptional outcomes by referring to the former as the predictors of the latter. Similar to my first argument however, the mechanistic approach does not perceive giftedness as a mere sum of the factors but as the product of balancing all of the factors. It coincides with Runco's (2004) personal creativity that personal decisions to pursue behaviorally and cognitively are likely to be multivariate, an equation that comprises weights and factors affecting individuals differently. The multivariate equation explains the malleable nature of giftedness represented both by mechanistic and systemic approaches. None of the current models of giftedness declares one single factor as a cause of giftedness.

Third, since giftedness is no longer perceived as an individual trait but rather a social construct, context is pivotal in the systemic approach. Context can be comparable to the concepts of field (Gagné, 2005), performance areas (Heller et al., 2005), and domain (Csikszenmihalyi, 1996), which corroborate the domain specificity of giftedness. The systemic approach is not likely to differ from the mechanistic approach in pursuing multiple modes of giftedness in areas within the broader cultural and societal context.

Fourth, whether interdependence explains the relationship between systems and their environment is not convincing. The environment sounds like a (bigger) system where elements of giftedness interact with their smaller subsystems, and the referenced example about the lack of reliability of measures by different administrators is confusing. In fact, the argument seems to be referring to the "instability" of the system where various elements of giftedness are interactive.

Nonetheless, the systemic approach offers a comprehensive perspective of giftedness. First, it involves various personal variables, including cognitive and psychological-emotional systems and each of their subsystems. Lower level subsystems would be helpful to distinguish giftedness by its level (e.g., Big vs. Little Cs) and mode (e.g., giftedness in writing, reading, calculus). Second, the systemic approach is grounded in the developmental perspective of giftedness, assuming a nonlinear developmental process – a major difference between Piagetian child development and talent development (Bloom, 1985). It reiterates the premise that giftedness is not fully deterministic but changeable by the co-existence of various internal and external components regardless of chronological ages. Third, the systemic approach views giftedness as a contextual entity incorporating the systems of personal variables. The actiotope model clearly depicts that giftedness results from interactions between individuals and environments, and that importantly, individuals actively pursue their giftedness, thereby setting goals, understanding and taking advantage of dynamics of the (sub)systems, searching ideas and generating actions to make decisions about possible behaviors. This dynamic-interactive process between individuals and environments is comparable to the process of developing successful intelligence–abilities to adapt, shape, and select environments (Sternberg, 2003, 2005).

Overall, the systemic approach to giftedness seems to share more commonalities than differences with the mechanistic perspective, and its critical feature – accounting for components of giftedness by approaching the wholeness – has not been explicitly presented. It is not clear if the "system(s)" is an appropriate term or it is always possible to separate elements from their systems. Nonetheless, individuals' active involvement in developing giftedness and recognition of various modes of outstanding behaviors within the system are the noticeable features of this proposed model. It is also promising that persons within the system are committed to their gifted actions, which would be changeable via interactions with environments. Hopefully, the systemic approach would be instrumental in stimulating diverse forms of giftedness, often unrecognized by traditional approaches, and producing gifted behaviors conducive to the society as well.

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COMMENTARY

A new view on giftedness?

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What defines giftedness? What are the origins of a special talent? Can we educate children in a way that enables them to develop exceptional capabilities? How can we identify gifted persons? These are questions which have a long tradition in scientific discussions as well as in popular science. They influence political decisions and teachers behaviors in classroom. They are important because of their impact on conceptions of fostering gifted children.

Models of giftedness are aimed at creating a picture of aspects which are important for developing a special talent. Approved models of giftedness are based on influencing factors like genetic, environmental and individual orientated variables. Concerning cognitive talents, IQ as one of the main factors was imbedded in influences of individual variables like interest and motivation, as well as in environmental variables like peers, parents and school. Models like the Munich Model of Giftedness (Heller, 2004) and Gagnés Differentiated Model of Giftedness (Gagné, 2004) regard talent development as a process. Within the approach of these models lay a shift in the conceptions about giftedness from individual orientated perspectives to a multidimensional approach. These models are sufficient to describe the development of a special talent or of special achievements as a process built on the activities of a person learning in a social situation with opportunities and hindrances offered by other persons and further situational factors.

But the described models do not focus on the interdependencies of the mentioned variables. Therefore, for Ziegler and Phillipson these approaches are insufficient. They favor a broader view, taking into account interactions between the components of previous models and more, pointing on a variety of possible influences and their interdependencies.

This systemic approach is consistent with theories in several sciences. Discussions about the interplay of nature and nurture are important concerning questions of heredity Plomin et al. (2008). The school of Wygotski can be interpreted as a systemic perspective, regarding the influences of society on the organization of cognitive development Wygotski (1986). Even epigenetic research opens a perspective of biographic aspects on turning on and of parts of our genetic inheritance.

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In educational research, descriptions of influencing factors are mostly based on a systemic point of view. If, for example working with children with special needs, viewing influencing factors in a learning biography under a systemic perspective not only offer more possibilities of action than an individual centered perspective, but can later also be seen as a restricted perspective. The structure model of learning shows the learner, the subject and environmental persons like for example peers, parents and teachers and the reciprocal influences of actions and attitudes (Betz & Breuninger, 1982; Nühring, 2008). This model has a big impact on concepts of fostering children with special needs.

So it is well accepted that there are varieties of influencing factors in development and education. Focusing especially on the interdependency of influencing factors in a developing system the authors depict the dynamic of reciprocal affecting variables. The theory gives an impression about the complexity of influencing and interplaying factors. Thus this approach values reality, but at the same time raises the question how to represent so many factors in a model. Modeling implies restriction on the main factors. Nevertheless, the main factors can change depending on valuing a special intention. So one of my questions is how this model offers the possibility to control the interplay of so many variables (even via multivariate analyses and even using probabilistic methods).

One of the major aspects of the model lies in the possibility to highlight changes as a result of interaction, to highlight the dynamic of such processes. Taking into account also actions and the widening scope of actions during a developmental process demands permanent adaption of proposals of supporting giftedness. Thus, the process of gifted development is seen as a dynamic system of connected variables always in an interdependent relationship. It demands permanent adaption of acting persons who must be conscious about the restrictions as human beings to handle so many variables. This perspective implies uncertainties about ways of acting together and therefor the model demands courage.

Although it seems impossible to control so many variables, there are different approaches to handle complex systems. Especially in didactics of mathematics during the last years there has been a shift to learning environments with problems based on natural differentiation (for example Krauthausen & Scherer, 2010). Children are given tasks which can be solved on different levels and most of them also can be solved in several ways. In the research on mathematically gifted pupils similar approaches have a long tradition (Kießwetter, 1985; Nolte, 2004). Their concepts of fostering are based on the idea of differentiation as well as interactions and communication with others. They rely on the self-organization of the learning subject, of the learning group and of the tutors, taking into account the impossibility of controlling every aspect due to our restriction as human beings. Within these concepts, learning environments include goals, directions of development and not to forget are open for the concept of Wygotski's zone of proximal development (Wygotski, 1986).

The systemic theory offers a perspective on a way of working with one child, honoring her or his special needs, adapting pedagogical actions on a special situation fitting at a certain moment on an individual. It is the same for groups. The knowledge about influences, interconnectedness and interplay of certain variables is already a beginning of changes. Under a systemic perspective the system "mentor" or "teacher" and their actions underlie the dynamics of variability too.

The concept of persons as social beings acting in sociotopes, the actiotope model includes several theories of different disciplines for example the pedagogical point of view, because the idea of meeting every child at her or his interests and needs is a long known pedagogical concept. The systemic theory of gifted education is closer to reality of gifted education and its multidimensional aspects. At the moment, the actiotope model poses open questions and therefore inspires discussions about the process of development of giftedness. Especially due to the necessity to deal with complex and dynamic systems, the question of controlling the procedures comes up again. It is to credit the authors that they do not exclude influencing factors but encourage the scientific community to take them into account.

So it is time to start a discussion about a change of perspective on giftedness.

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COMMENTARY

The Actiotope Model of Giftedness: a useful model for examining gifted education in China's universities

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In March 1978, under the suggestion of Chinese-born Nobel Prize laureate Tsung-Dao Lee, China launched its first gifted education program at the University of Science and Technology of China (USTC). Based on nominations and interviews, 21 gifted students aged 11–16 were enrolled in USTC and comprised a special class. These early entrants spent their first year together studying basic curriculums (e.g., mathematics, physics, and foreign languages) and then were allowed to choose their own major and enter different departments when they became sophomores. Five years later, the early entrance program was recognized by Deng Xiaoping, and the Chinese Ministry of Education authorized another 12 universities to establish special classes for the gifted young in 1985.

The beginning of China's gifted education programs in universities seemed promising. However, its proceeding was frustrating. By the end of the 1990s, eight out of the 13 universities had ended their programs for various reasons. Up to now, only two programs have survived. One is in USTC, and the other is in Xi'an Jiaotong University.

Why aren't China's gifted education programs in universities very successful? According to Shuman He, who has been in charge of the special class in USTC for many years, this has something to do with four issues: identifying the gifted as the intellectually gifted, teachers' lack of expertise for gifted education, unreasonable expectations for the gifted, and deficiency in educational policies for special students. She emphasized that gifted education should not focus on the intellectually gifted but on the excellence and creativity of the individuals who have average or higher intelligence. Gifted education should integrate three aspects of these children's development – physical and mental, intellectual and personal, and social and academic (He, 2003).

It seems that He's (2003) opinions on China's gifted education programs are insightful and partially capture the reasons for the ineffectiveness. However, if examined in terms of the Actiotope Model of Giftedness (AMG; Ziegler, 2005; Ziegler & Stöger, 2004), we may find that her explanations do not quite hit the

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mark – because the leading problem of China's gifted education does not reside in any specific reasons, but rather in the lack of a systematic methodology. It is the persistent neglect of the systematic characteristics that got China's gifted education programs into trouble.

China's gifted education programs were founded in the times of "developing talent faster and earlier". Their approaches are largely associated with three assumptions: (1) there are some intellectually gifted children among young people; (2) the development of the gifted should and can be accelerated; (3) with individualized education, the gifted can fulfill their potentials and perform better. In line with these assumptions, the programs typically consist of two stages: select the gifted first, and then place them into corresponding special education programs. In the early 1980s, this paradigm might have temporarily worked well. On the one hand, the emphasis on intellectual education partly represented the zeitgeist of the time. On the other hand, the social support system protected the gifted children from any overload of learning and social expectations. Their learning and acts were usually intrinsically motivated. In other words, both the environment system and the mental ability system of the gifted children could function well independently or interactively.

However, the spirits of the times changed drastically in China in the late 1980s. Utility and efficiency were stressed in gifted education. Every child in the gifted education programs was expected to emerge as an excellent talent. More and more comparisons were made among the children and the programs. This environmental change broke the harmony of the originally successful system of gifted education, which in turn disturbed the components of the actiotope, as well as the personal system of the gifted. The gifted children experienced huge stress from the environment and thus lost the freedom to determine their own achievement goals and pathways. They could neither construct naturally well-structured action repertoires, nor make self-assessments of them. Their own subjective action spaces were largely deprived. In consequence, their study became less self-regulated, their thinking was less creative, and their performances were far below the social expectancy. The disappointing outcomes of gifted education frustrated program managers, instructors and parents. In such circumstances, the number of gifted programs in Chinese universities decreased rapidly.

How can Chinese gifted education best emerge from this predicament? Undoubtedly, AMG has some implications for the possible solutions. According to the AMG, there is no choice but to go in two directions. First, if we continue to put gifted children into special programs, we must pay more attention to the systematic characteristics of gifted education, particularly to the dynamic, interdependent, interconnected, and interactive characteristics of the system. For example, when selecting the early entrants, the interactions of their intelligence, motivation and personality should be highlighted. A more comprehensive identification method, such as Ziegler and Stoeger's ENTER model (2004), should be employed. Before the program starts, the managers should question themselves: is the environment we provide for the gifted better than the original one where they have grown well? Are we creating highly supportive and individualized opportunities for the entrants?

Second, we must lay more emphasis on the equifinality of the gifted education system. Giftedness is not a personal trait, but a product of systematic achievement behaviors (Ziegler & Phillipson, in this issue). A gifted education program, even if it is very specialized, does not necessarily bring about giftedness. Common college education, if meeting students' needs well, can also cultivate giftedness. Most of

the great figures labeled as gifted, such as Albert Einstein, stood out from the crowd in common environments. The "10-year rule to become an expert" (Piirto, 2004) also supports that continuous expansion of one's action repertoire is more important than high IQ. Thus, another realistic solution to China's gifted education problems is to offer good developmental opportunities for the ordinary students. In my view, this is a broader way forward.

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COMMENTARY

Can systemic education end up limiting the gifted person's autonomy?

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In our commentary, from the very start, we welcome the opportunity to face the inefficacy of the currently existing educational paradigm gifted people. For many years, we have verified and supported the difficulties of a paradigm whose philosophy and anthropological foundation are incapable of guaranteeing the promotion and development of gifted people's potential. It is now urgent to review, as the author has done, the results of an educational practice and a traditional research that have not met the experts' expectations (Lipsey & Wilson, 1993).

This proposal is timely because gifted people's education should be in tune with education in general, the paradigm of which (institutional, administrative, instructional and personal) has given way to the new paradigm of inclusive education (Banathy, 1984), and it should somehow reflect their coincidence, especially with regard to their common roots, goals, and guidelines. Obviously, both paradigms – the paradigm of inclusive education and the paradigm of systemic education – are closely related because they share the same unit of educational analysis: a unit of analysis that no longer focuses on the subject but on the learning community, as demanded by inclusive education, or on the context, as required by systemic education. Based on new and successful paradigms, both proposals could achieve the results that the currently existing paradigm has not yet managed to attain.

Besides being timely, this proposal is also necessary because, from this perspective, gifted people's results and the trust placed in the people who may one day be the social, scientific, and political leaders of society would not only improve, but the gifted people would also benefit by achieving a more realistic personal self-image and, especially, by developing their whole potential.

However, if the systemic vision is overly emphasized or exaggerated, the context – a central and configurative element of giftedness – may emerge, and the subject may once again be overlooked, as has occurred so often throughout the history of psychology and of education. The context must be underlined, as must the subject's interaction with the context, but not to such an extent that the subject's image and characteristics are weakened. Thus, for example, when, according to systemic

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education, it is stated that giftedness is not a subject's personal characteristic or a person is not gifted or talented, it could be concluded that the subject's world is fading and sinking under the superstructure of the context.

Nobody can be as daring as to emphasize the gifted person's talents and skills to such an extent that their dependence on the setting is disregarded, or to assert excellence divorced from environmental influences. In contrast, if it is stated that excellence is not situated in the individual but instead is a manifestation of the system that exists within an individual and his environment, this is tantamount to voiding the subject because of his marked dependence on the environment and his essential interaction with it. Obviously, the environment conditions people and gifted people's level of adaptation to environmental forces can jeopardize their achievement of many goals because, without adequate adaptation, it is more difficult to achieve the excellence sought. It is true that each individual interacts with the environment in a unique way, and the outcome reflects a process of negotiation with the environment, but it is also true that the gifted have frequently become what they are and do what they do because they rebelled against their environment, for example, like Darwin or Galileo and, more recently, Picasso (Gardner, 1983, 1995; Sternberg, 1985), or Steve Jobs (Isaacson, 2011). All of them achieved the goals they had set when they left the environment in which they had been living. It was precisely the fact of their breaking away from the environment that allowed them to develop their full potential. And, more important, through this distance, in addition to excellence, they also achieved their own personal realization.

It should not be forgotten that, like all human beings, gifted people are systems. But, in contrast to other systems, they are open, intelligent systems and, therefore, as such, they are affected by the environment but they also influence the environment, so they can adapt to it if necessary; they can modify or transform it at will; or they can exchange it for another one if that is more advantageous. Gifted people are a part of the system, part of the whole, but not just *any* part of that whole, they are not the same as the rest of the components, but instead a qualified part that can eventually take over the system.

We admire the clarity with which the author has shown the inefficacy of the method inspired in the mechanistic paradigm, and the more or less implicit assumptions on which it is based. But we should not forget that certain strategies of the currently existing paradigm, such as acceleration or enrichment, have a very important effect size in educational practice, according to the meta-analyses of Hattie (Hattie, 2009; Hattie, Biggs, & Purdie, 1996). Its value, in terms of *d*, is .88, which makes it the fifth variable of impact within the framework of the 25 variables that have the most influence on gifted people's learning.

The author provides a concrete model of the systemic approach, which is original, novel and useful, because it serves as a referent both when designing new approaches to the gifted person's education and to diverse research projects.

Summing up, we believe that the author's proposal is timely, necessary and useful, and could guide and promote excellence in gifted people's education, provided that their autonomy is respected.

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COMMENTARY

A bold and promising model with a few loose ends

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Without a doubt the authors' proposal of viewing gifted education in systemic terms is a promising one. In fact, it is most refreshing to read something eclectic like this with an aim to synthesize a field of research and practice which for too long has lacked consensus in both practice and theory. The result of which is, as the article strongly emphasizes, many a gifted education program's lack of hoped-for success.

I agree with the authors that a mechanistic view of science is partly responsible for such disappointing results in that – to use an old but appropriate cliché – this understanding of science, reinforced by a psychometric worldview, has prevented much of the scientific community from "seeing the forest because of all the trees". A more holistic approach is long overdue (cf. Persson, in press), and perhaps a systemic view as outlined by Ziegler and Phillipson's article is a possible development. Such development, however, is not entirely without problems. It is easy to agree that a systemic view is paramount for any kind of progress if the intention is to be true to the subject of study and practice. It is more difficult to agree on, however, *how* such a system needs to be outlined.

The authors slightly overstate their effort, I think, when arguing that their systemic view represents a paradigm shift. Their theory might certainly be the spark that triggers the onset of one. But it cannot possibly on its own actually represent such a shift, given that I have understood the nature of Kuhnian (1996) revolutions correctly.

A few loose ends in the suggested model

That said, the authors list three main reasons for why gifted education programs tend to fail: (1) fundamental ineffectiveness; (2) application in the wrong context; and (3) incorrect implementation. I would like to add a fourth possible reason for failure; (4) misunderstanding the nature of giftedness, or at the very least not understanding the implication of being gifted more fully.

Decades of psychometric research have certainly provided a degree of insight into gifted minds and their possible needs. Importantly, this research has mainly been a quest into studying gifted *American* minds or the minds of other nationalities

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but usually on the basis of American constructs and cultural values. I argue that we generally lack an insight into giftedness for this reason, but also that we fail to include an evolutionary and socio-biological perspective in understanding who the gifted individuals are and what they do. Being different than a peer group by whatever means automatically triggers unaware behavioral responses from group members resulting in inclusion, exclusion, enforced submission, or, in a worst case scenario, annihilation, depending on the type and grade of difference (cf. Persson, 2009). In this light, the proposed systemic theory of gifted education appears to rely on the tacit premise that giftedness is always a positive, desirable attribute. This is clearly not the case given an international outlook.

Furthermore, if the presented systemic model serves as a basis for educational program design, I find that it fails to address whether potentially excellent students actually *want* to participate in the resulting system. The authors argue that:

> ... such goals are of a nature which allows them to be happily integrated into the individual's overall system of goals: otherwise the person who is being served by the system of gifted education will, sooner or later, rebel against that system.

I am certain this is a correct observation, especially in regard to intellectually gifted individuals. I, as most likely every other scholar, am fully convinced that gifted children need much more stimulation than the average child in order to develop in a meaningful way. But do they, in fact, need *formal* education? Is a school system, no matter how it is designed and on what basis, really the place in which best to stimulate these children?

I have over the last few years become increasingly aware of the shortcomings of formal education in general for all children, which by no means represents a unique conviction (see Abbot & MacTaggart., 2010; Robinson, 2011). I am even more doubtful that gifted education as part of a formal system of schooling would be appropriate. The reason for this is that education systems are heavily influenced by political will and direction. Education, from a European perspective, is now entirely committed to developing the so-called "Knowledge Economy". There is little room in this emerging education system to excel in anything else than in so-called STEM subjects; that is, science, technology, engineering and mathematics. The idea of knowledge as valuable for its own sake ("Bildung" in Germany and Scandinavia and the foundation for the liberal arts in North America) is in danger of extinction (Persson, 2011). Needless to say, not all intellectually gifted people fit into such a STEM-actiotope.

A third reaction to the target article is more a reflection than a critique as such. As with all systems, complexity is an issue. At what level should description be made for it to be meaningful? If too complicated the system risks being too complex for practical use. If too simple there will be a risk that something essential is missing. I think that the value of the theory must inevitably be proven by actually putting it to the test.

In conclusion

I await a future verdict as to whether the presented systemic theory for gifted education is indeed a cause for a scientific revolution or not. At the very least, the authors should be applauded for trying to impart much-needed new momentum into a research field that has been lacking seminal research and theory for some time.

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COMMENTARY

How novel is the Actiotope Model of Gifted Education?

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In the article "Towards a systemic theory of gifted education", the authors present an interesting approach to gifted education. The actiotope model explains giftedness in light of systems theory where constant interchange occurs between the gifted person, his/her actions, and the environment in which he or she evolves. The approach is refreshing and sheds light on the complex and dynamic process of giftedness as opposed to linear approaches that consider either the individual alone or the environment by itself, but rarely the interaction of both. Without doubt, the approach is significant, but not entirely new, as the authors claim. The paradigm change that they are proposing does include some novelty, but this change is hardly "monumental" as stipulated by the authors.

At first, the authors discuss at great length and expand a great effort to establish that a century long of gifted education was ineffective. They stipulate that all paradigms currently and previously used in gifted education, such as acceleration, enrichment, pull-out programs, and other similar approaches have led to no significant advances in the education of gifted learners. They cite research that showed the ineffectiveness of all these paradigms to the exclusion of other research that has demonstrated undeniably and empirically the validity and effectiveness of some well-established models. For example, the effectiveness of models such as Renzulli's school-wide enrichment model (Renzulli & Reis, 1985), Maker's DISCOVER model (Maker, 1992) and the numerous and various applications of Gardner's theory of multiple intelligences to gifted education (Gardner, 2009) were totally ignored by the authors. Surely, some of the existing models must have had some success otherwise why did their use survive and spread around the globe?

Also, the concept on which the actiotope model is based is hardly new or unique. About a quarter century ago, Albert Bandura proposed an explanation of human behavior similar to that proposed in the model. According to Bandura, human behavior is a function of both the person variables (i.e., self-efficacy beliefs, motivations, and goals) and the environment (the consequences observed or experienced by the person of one's own or other people's actions), a concept that Bandura called reciprocal determinism (Bandura, 1978). The similarity between Bandura's concept of reciprocal determinism and the definition of actiotope proposed by the

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authors cannot be missed: "An actiotope consists of the acting individual and the environment with which he/she interacts in his/her actions" (p. 14). Another similar notion is that of individualized instruction, best exemplified in the concept of aptitude/treatment interaction (ATI). In 1957, Cronbach in his APA presidential address encouraged practitioners to conduct research on examining how personological variables (i.e., intelligence, anxiety, etc.) interact with the best method of instruction to optimize learning (Bracht, 1970). In other words, there should be a synergy between the subsystems operating within the framework of education, some sort of interactionism between all elements in the education system to produce best results. Hence, even though the term is new, the notion of actiotope is built on existing theories and past concepts. Moreover, emphasizing the interaction between person and environment is as old as humanity itself; it is at the heart of the nature/nurture argument that has been debated by Plato, Rousseau, and the famous seventeenth century English philosopher John Locke.

Perhaps the major drawback of this article is that despite its eloquence and use of grandiose terms (or perhaps because of it), the authors fail to relay a distinct message. That is, the reader has to make a great deal of effort to understand the gist of the matter. In other words, it is not clear how the actiotope model would be applied in real life, in real schools, and with real students. The proposed model is too theoretical; even when the authors try to explain how the model differs from current practice in its application the reader still fails to understand this difference. For example, after criticizing the current selection and placement practice of gifted students, the authors propose to replace this practice with creating "highly individualized opportunities, allowing individuals to develop their action repertoires with specific, individually tailored learning environments". How does this translate into action? How is this different from the current practice of developing individualized educational plans (IEP) for students and the notion of ATI previously discussed? Another example is the authors' attempt to redefine the term giftedness (even though they mention being against attaching this label to individuals). People are gifted "when they have demonstrated precocious achievement, reflecting an action repertoire exceeding that of a similarly aged cohort". How different is this definition from the one adopted in current paradigms?

Another limitation of this article is that the authors have failed to explain how implementing the model would change the current state of gifted education. What are the practical advantages of adopting this model? How will the existing policies change? How will the success of the model be verified? What are the limitations of the model and how will they be overcome? Again, the novelty of the model and its revolutionary aspect have yet to be determined.

However, to say that the actiotope model is not entirely new is not the same as saying that it is devoid of value. On the contrary, the model is timely and addresses a dimension that has not been much emphasized in the past in gifted education, that is, the notion of constant change and modifiability, a sort of co-evolution necessary for survival and adaptation, replacing ineffective old actions with new effective ones. Some of the existing models of gifted education are indeed too old and no longer viable and should be replaced with more adaptive ones. The actiotope model is solid and is based on extensive research and a well-thought process. Perhaps the major strength of this article lies in the authors' attempt to demonstrate the importance of considering the dynamic, complex, and multidimensional aspects of giftedness and how these should be applied in the practice of gifted education. A sequel article in which the authors explain more clearly how the actiotope model constitutes a "monumental" change in the current paradigms of gifted education and how it translates into real life is warranted and would add value to the monumental effort the authors have put into constructing this model.

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COMMENTARY

Continuing challenges for a systemic theory of gifted education

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Ziegler and Phillipson make a strong case for the need to reconsider traditional models of gifted education. Although their evidence and argument are compelling, we argue that several additional steps are needed to justify the theoretical foundation of the theory in order to facilitate its evaluation by researchers. First, the authors argue that most intervention studies in the field of gifted education show small effects, if any at all. Moreover, they criticize the field for its lack of control-groups and not following appropriate study designs. However, they then proceed to reject traditional approaches to gifted education even though its relevance or appropriateness has not been adequately evaluated. Although we are not arguing for the validity of traditional models over a new system-based approach, it is too early to reject traditional models without evidence of their inadequacies.

A related-issue relates to measuring success in gifted education settings. This is an issue we have struggled with in our own research examining the concept of talent in sport. For researchers, the concept of effect sizes and probability statistics provide appropriate benchmarks for determining the efficacy of specific relationships; however, these concepts may not have as much relevance to those working in the front lines of gifted education. For example, how does one determine the value of a program in gifted education? What benchmark provides a reasonable criterion for determining whether a program works?

Moreover, determining the rate of success for an individual student is also problematic. There are many different facets of performance that can be evaluated during the learning process and it is clear that some effects only manifest later in development, making them hard to measure. Moreover, the criteria that determine proficiency during early development are often quite different from those determining long-term success in a given field of giftedness. An example comes from our research examining the development of sporting expertise. Although a critical factor predicting an athlete's ultimate level of skill is the total amount of time spent in "deliberate practice", an athlete's capacity to practice day-in and day-out as an adult performer seems to be moderated by the amount of time spent in a less-structured and more enjoyable activity termed "deliberate play" (see Côté, Baker, &

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Abernethy, 2007, for a detailed review). Creativity also seems to be one of the by-products associated with this line of training but is only shown in later years.

A clear definition of success is difficult because there are many exceptions and deviations from the norm. For example, a pupil who underperforms in one program (e.g., a gifted program for mathematics) might simply have decided (either implicitly or explicitly) that their interests are better suited to other areas of endeavor (e.g., in music or artistic pursuits). This distinction would not be reflected in traditional metrics of success but, from another perspective, could be considered a success in and of itself.

Together, these "exceptions to the rule" may represent a significant minority of pupils in gifted programs who are difficult to categorize using traditional measures and definitions of success. On the one hand, this highlights the importance of a systems approach to gifted education where individual differences play a more important role, but on the other it emphasizes one of the obvious problems of introducing a system-based approach to gifted education – the feasibility of its application in the "real world". Although the notion that human behavior in all contexts (including gifted education) is best conceptualized as a dynamic, interactive system of individual and environmental variables, implementation of any interventions to change the status quo will, by necessity, be reductionist. It is simply not feasible to re-boot the system "in one fell swoop". Moreover, it would not be advisable to do so because our understanding of the range of factors affecting development and achievement (e.g., the interaction between practice and the activation of specific genes for learning) is still developing. As a result many of the challenges and limitations of the traditional approach to gifted education identified by the authors will continue to be challenges and limitations to new approaches. All the same, raising awareness of a systemic approach to gifted education provides an important addition in our thinking in this area; the discussion, however, ultimately comes down to "what are the goals of gifted education programs?" and "given our understanding of the myriad factors affecting long-term learning and skill acquisition, how can these goals be best met?"

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COMMENTARY

Paradigm thinking: passionate hopefulness and more than 20 cents of effort

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In their introduction to the idea of a systems approach to understanding talent and giftedness, Ziegler and Phillipson broach the larger issue of the positivistic or mechanistic mindset to knowing and understanding that pervades much of what is called educational research. This worthy tactic brings to light the need to move away from the status quo of accepted research approaches toward something a bit different. No argument from me on this point.

Yet, as interested as I was in seeing what the authors had to say about their developing systemic approach to giftedness; it became readily apparent they were caught in the bind of positivism and began detailing *parts* of their actiotope theory that lead to the whole. Hmm. Isn't this the same Descartian model that Ziegler and Phillipson rail against?

To be sure, the authors strain to explain how their actiotope model is a systems theory – but to no avail in my mind. The article needs a stronger accounting of systems theory and the biologic (rather it should be ecologic) philosophical view (see Bertalanffy, 1969; Bronfenbrenner, 1992).

I do feel Ziegler and Phillipson begin a complicated conversation (Rorty, 1979) that might lead to a more ecologic view of giftedness and talent development; but, the approach is not paradigmatic in any of the myriad ways Kuhn (1970) defined the term. For instance, the discussion about the subjective action space of the actiotope model honors the choices individuals have in their development (both witting and unwitting). I feel this construct makes space for discussion and focus on the developing Self of the individual as a contributing factor to development (Csikszentmihalyi, 1994; Roeper, 1990, 1995, 2007; Schultz & Delisle, 1997). This is hardly paradigmatic in scope, yet important to gaining broader awareness about development, motivation, wisdom and the like.

As a curricularist and philosopher of (worrier about) education, my professional life is constant interrogation of what is and what should (or could) be. I share the frustration that Ziegler and Phillipson have about the contradictions evident in gifted child education. We (as a field) focus too much on identification and not enough on the needs of the gifted. We argue to "hold the line" on funding, services

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offered or rendered, and recognition that our work is valuable. We cannot even holistically define giftedness and/or talent within our ranks, let alone make distinctions to those outside our field.

From a systems approach, we exist in a family, sharing all the (dis)function evident in any of our personal lives. Yet, the parade of learners needing something "more than", or "different than" the standard marches on.

I do agree that a paradigm shift needs to occur – but am at a loss for what that might be, or how it might look. This is standard fare for paradigms, though. Those within one cannot see beyond the borders of the existing mindset.

However, I do have a sense of passionate hopefulness bubbling in my soul. We live in a time of unprecedented change causing major perturbations in the status quo (Kegan, 1994). Kuhn (1970) points out tumultuous times forbear paradigm shifts. In systems theory, this chaos leads to redistribution of networks and spontaneous formations of nodes of activity (Prigogine & Stengers, 1984).

Let's think big as a paradigm shift approaches. Keeping the conversation going is one approach; yet, not quite enough from my perspective. Ziegler and Phillipson leave out an important component of the entire system – the gifted themselves. They need a voice in the conversation, too (Schultz, 2002, 2005).

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COMMENTARY

Paradigmatic shift or tinkering at the edges?

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In their target paper, Ziegler and Phillipson present a long awaited call for a paradigmatic shift in thinking within the field of gifted education. This paper considers how educators and researchers within the field could bring about such a change. They challenge the prevailing conceptualization of gifted and talented education and rightly call into question the hitherto accepted methodology for selecting students who are already, or have the potential to, demonstrate high ability. The opening sections of the paper thus set the scene for the possibility of some radically different thinking.

The hypothesis presented within the paper is one which I would generally support. However, for me, an overriding shortfall throughout the article is the lack of reference to how the issues raised articulate with wider discussions within general education. Issues and possible ways to address them are looked at only through the lens of gifted education. There is no cognizance, within this paper, that these issues pertain to the effective learning and teaching of all children or to education systems as a whole. Rather, the paper concentrates on those considered to be highly able or in need of an "individualized learning pathway" (Ziegler & Phillipson, p. 27). While I accept the paper is looking specifically at issues within gifted education the danger is that unless we look beyond such narrow fields of research the ideas put forward will languish in the academic arena, being debated and discussed at gifted and talented conferences while practice remains firmly rooted in the old paradigm.

In defense of Ziegler and Phillipson, trawling through the literature related to special, gifted or inclusive education reveals that educators in all camps are questioning how they can best meet the needs of specific groups (Ainscow, 1999; Balchin, Hymer, & Matthews, 2008; Lewis & Norwich, 2005) and, generally, this occurs within their own field with little horizon scanning taking place. However common issues seem to emerge from the literatures and from this paper:

- Identification.
- Whether to educate together or separately.
- The importance of parental involvement/environment.
- Appropriate curriculum opportunities for all pupils.

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Thus it would seem timely that common solutions are sought through greater engagement between the fields.

As pointed out in the paper gifted education is rooted in the reductionist approach of categorization and often separation of pupils in the belief that this is the way in which their needs can best be addressed. Thus giftedness becomes a phenomenon in itself, responsibility for giftedness is placed within the pupil and theories and models developed are based on diagnoses which form the basis for intervention. This argument resonates with Poplin's (1988) work where she considers the conceptualization of learning difficulties and suggests that we need to shed reductionist assumptions based on: measurement; instructional methodologies; and organizational structures if we are to enter a new paradigm. The call for a paradigmatic shift in thinking within education and the arguments presented within this paper, while welcome, are not new.

Some thorny issues are skirted around within the paper and while there may be other fora for discussing them they will nonetheless impact on development of the actiotope model. These would include:

(1) Changing the establishment.
(2) Global and cultural understandings.
(3) Education and economy.
(4) The research, policy, practice nexus.

(1) Changing the establishment

When considering special education Tomlinson (1982) spoke of gatekeepers who she argued had a vested interest in perpetuating the existing systems. I see parallels here with Ziegler and Phillipson's work. Statements such as "well established strategies" (p. 5) or "trait models of giftedness" (p. 6) acknowledge that an industry has been created to meet a perceived demand. Tomlinson suggests that reasons for not changing practice often had little to do with the child and much more to do with maintaining the status quo for the sake of the adults involved. Ziegler and Phillipson acknowledge that any change "should not be made lightly" (p. 6) but radical change would require seismic changes to the life work of many researchers, educators and consultants.

(2) Global and cultural understandings

Social, cultural and political factors all impinge on attitudes and beliefs and calling for a paradigmatic shift is likely to require some fundamental shifts in thinking across all spheres. However attitudes and beliefs change at different rates, in different ways and at different times across societies (Bruner, 1996). Global and cultural differences will be brought to bear on models and theories.

(3) Education and economy

The current economic crisis is leading many countries to examine the role of education and how they might best develop citizens for the twenty-first century. Countries that are strong in economic terms, for example China and India, have very different

cultural perspectives on education and ability which will impact on how they develop the curriculum. In times of economic restraint I wonder if countries will be brave enough to adopt the kind of paradigmatic shift discussed within the paper.

(4) The research, policy, practice nexus

Educators, policy-makers and researchers all work in contexts that are informed and shaped by research and yet often there is little meaningful dialogue between the groups. This raises questions about the role of researchers and the purpose of research. The article helpfully illustrates how aspects of the model might be implemented in school, although I'm not sure I agree that maintaining the labels "talented" and "gifted" (p. 24) will "facilitate the communication between research and practice" (p. 24) given the wide variation in understandings that teachers typically demonstrate. However the examples are helpful to readers who constantly seek to actualize models and theories in a way that might make learning more effective, in spite of the danger that some of the suggestions fall back into the paradigm the authors are trying to shift away from. Yet again, many of the examples pertain to all learners, not just those deemed to be gifted or talented.

In conclusion, the article challenges some long held assumptions within the field and indeed within education. For any such challenges to result in the paradigmatic shift the writers call for these changes cannot simply take place within the field of gifted education but must occur across education and herein lies the difficulty. If these changes occur only within gifted education then surely we have merely tinkered at the edges. Is education ready for such a change? I'm not sure. "A real danger of the paradigmatic shift is the overwhelming sense of inertia and apathy that we may feel as we discover the vast quantity of definitions and methodologies that must be rethought" (Poplin, 1988, p. 401).

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COMMENTARY

A systemic approach: the ultimate choice for gifted education

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In this new article, Ziegler and Phillipson have proposed a systemic approach to gifted education. For this approach, they built a model that they call an "actiotope" model. As the authors explained in the article, an actiotope consists of the acting individual and the environment with which he or she interacts. The model includes four necessary elements: action repertoire, goals, environment, and subjective action space. These elements are interdependent with each other, co-evolving to reach a dynamic equilibrium. Here, the actiotope model describes all the factors a perfect system needs to work well.

In current studies of giftedness, it has heretofore been difficult to find a theory that takes all these factors into account and builds up a perfect framework for developing giftedness. Most researchers focus on either cognitive (Duan, Wei, Wang, & Shi, 2010) or non-cognitive abilities (Shi, Li, & Zhang, 2008). After many years of research and education experiments, however, researchers and educators realize the great necessity of reconsidering human nature in its entirety.

We agree with the systemic view that excellence is the product of a system. The idea of system theory has appeared in various fields and has a relatively long history. In education, for example, Confucius, the great ancient Chinese educationist, proposed that educators should teach students in accordance with their aptitudes (Zhang, 2006). In thus saying, he was actually expressing the message that educators need to treat every student as an entirety, which would include each student's own biological characteristics, distinctive psychological traits, and social network. Thus, educators must have profound insight into these distinguishing features. Only in this way can educators appropriately deal with each unique individual.

Bronfenbrenner's ecological systems theory is another example of a previously presented system that considers the way individuals and the environment interact with each other (Bronfenbrenner, 1977). In this process, the system reaches a dynamic equilibrium. Another psychologist, Shi, proposed a biological–social–psychological model in which he portrayed individuals as possessing three different dimensions: biological, social, and psychological (Shi, 1999, 2006). According to

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Shi, individual development is the product of the interaction of these three dimensions.

Theoretically, the systemic approach is acceptable to most researchers and educators, they do view individuals as a whole. In practice, however, researchers often decompose the individual system into different parts, such as memory, language, reasoning, creativity, and emotion; it is practically very difficult for educators to maintain a holistic approach to individuals' aptitudes. Because researchers themselves are limited by research methods, they can investigate only limited variables and cannot promise that even these variables will always, or even commonly, work in real systems as they performed in the studies. Perhaps the mere fact that Ziegler and Phillipson's approach considers so many factors, compiling them into a system, makes their approach difficult to put into practice. This is the biggest objection to the actiotope model: it's good – but too good to implement.

However, with the demonstrated improvement in methodology, the appearance of the structural equation model enables researchers to consider many factors simultaneously in order to test whether their systems (theories) are right or not (Anderson & Gerbing, 1988; Muthén, 1984). At the same time, the structural equation model can separate the effect of one factor from the whole. Nowadays, a number of researchers apply a similar method to their research (de Jonge et al., 2001; Golden, Conroy, & Lawlor, 2009). The actiotope model gives us an excellent example of the systemic approach. I find that the most substantial contribution of the actiotope model is its new perspective on gifted education, and we believe that the systemic approach will be the ultimate choice in gifted education and research.

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COMMENTARY

Everything is connected: giftedness within a broad framework for cognition

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Introduction

Ziegler and Phillipson (Z&P) have provided a valuable discussion of the identification and development of giftedness under a systemic umbrella, including issues of differing theoretical approaches and efficacy. This commentary considers their discussion within a novel systemic framework that links also individuals and environment, but in terms of interacting information processing systems. Gifted education, in this framework, involves developing interacting systems that give rise to culturally-valuable performances (actions).

A novel framework for cognition

In this framework, information is all of the matter and energy that makes up the universe (*sensu* Gribbin, 1994). All discrete entities are information processing systems, with processing referring to changes in information. In such systems, memory refers to the overarching range of possible interactions, for example chemical pathways, and learning is any change in information through input or output. Learning and memory, therefore, may be generalized as concepts applying to both organismal and non-organismal structures, acknowledging the relevance of emergence and biological context. Within this framework, the mechanism that Z&P attribute to Descartes can be utilized in examining component systems and their interactions, with no separation of structure and system (p. 11), or separation of biological and social interactions. Learning and memory in human individuals and their component systems can be described in terms of connectivity with environment, inclusive of connectivity within the nervous system and the brain, an holistic view with support from neuroscience (Squire & Kandel, 2008) and applied in educational theory (Sweller, 2007).

This broad framework allows a formal partitioning of cognitive structures and interactions, as is common in modern science, but supports the view that learned concepts are not anatomically isolated or uniquely subject-dependent (Dehaene,

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2009). Differing component systems operate within a larger dynamic system that acts with dedicated flexibility, for example, through feedback, muscular action and conscious control (Cotterill, 2001), in adapting individuals to a range of environmental interactions. The framework accommodates arguments that only a small fraction of this dynamism operates in conscious learning (Raichle, 2010), a fraction Z&P seem primarily concerned with in their emphasis on individual goals and self-regulation. This dynamism operates, however, both consciously and unconsciously, during formation of long-term memory and spatiotemporal sequencing (Edelman, 1989), including during the linkage of the cognitive aspects of emotion and chemical reward with learning and memory processes (Damasio, 1994). Some of these issues are discussed by Z&P, who recognize that intervention affects the entire system (p. 13), but some aspects are not considered cognitive.

Giftedness within a broad framework for cognition

In considering a human individual as an information processing system, there may be differing component systems that process information in different ways, but which contribute to an assessable human performance, as proposed in complexity arguments (Davis, Sumara, & Luce-Kapler, 2008). The contribution of components that function in motivation and emotion (Cotterill, 2001; Geake, 2009) and creativity (Haier, 2009; Haier & Jung, 2008), has been a consideration in examining giftedness, where components of the cognitive system are treated effectively as components of an integrated system. Such consideration may avoid the problem of correlating performance with ability or probability (p. 6). The framework also supports temporal considerations in giftedness as seen, for example, in differential development trajectories (Perleth & Wilde, 2009), and offers advantages in examining the rates at which individuals learn, an overlooked aspect of giftedness. The framework suggests also that connectivity of internal component systems needs consideration, as indicated in studies that relate neuronal hyper-connectivity and hyper-plasticity to the development or lack of expertise (Casanova, 2010), such as in individuals with differing cognitive connectivity with expertise in specialised domains (Grandin, 2006; Mottron, Dawson, & Soulières, 2009), but this is not the focus of the Z&P paper.

This framework may allow comparison of differing approaches to cognition and, as a result to giftedness, through consideration of differing theories, at least where these can be paraphrased in terms of matter and energy interactions, or related emergent properties, and it may be useful for Z&P to consider how their systemic view can be applied to cognition more generally and then to specific results of cognition, such as seen in giftedness. The broad framework here, however, suggests an emphasis on the identification and improvement of culturally-valuable performance, rather than trying to identify giftedness *per se* (see Borland, 2005). For a teacher, this includes aligning societies goals with those of the gifted student so that these individuals feel that their school life is of benefit to them, and it may be valuable for Z&P to consider their view of goals in more general cognitive terms, before applying them to gifted education. Further testing of this systemic approach, such as seen in Zeigler and Stoeger (2008), in teaching practice may need to consider such generalist approaches.

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COMMENTARY

Connectedness and life skills development for all children

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Ziegler and Phillipson draw upon the Actiotope Model of Giftedness (AMG) to give an overview of a systemic approach to gifted education. They argue the value of such a systemic approach for understanding the development of exceptionality. We certainly agree that the achievement of excellent performance is not only the result of individual abilities and efforts but also the collective support from interactive components within the system. In our field, the AMG has provided us with a conceptual framework that helps us interpret our data on connectedness and life skills development among children in Hong Kong.

In Western countries, efforts have been made to identify components of exceptionality (such as intelligence, creativity and personality) that may contribute to excellence. However, consideration of how these attributes interact with sociocultural factors within the total system is often neglected. In the Asian context, the emphasis on "the system" is consistent with beliefs and practices focusing on "whole person" education, with each child having opportunities that will bring out his or her full potential (Hong Kong Education Commission, 2000; Yuen, 2010). In this context, promoting connectedness and life skills through whole-school approaches goes beyond implementing specific programs. The key is in collaboration among teachers, parents, administrators and guidance personnel, with a focus on nurturing students' healthy social–emotional development (Yuen, Chan, Lau, Gysbers, & Shea, 2007; Yuen, 2011).

Ziegler and Phillipson also point out weaknesses in key models and strategies established so far in gifted education. They certainly challenge the fundamentals of the current mode of nurturing giftedness. They hold that the development of exceptional achievement requires attention to students' needs *at an individual level*, rather than group or class level. Given that gifted education should construct individualized learning pathways that focus on optimizing interactions between students and their environment, it seems to follow that the mode of educating gifted students should be reconceptualized. It may be that gifted students are not able to benefit fully from acceleration, enrichment and pull-out programs due to their often asynchronous development.

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Under a systemic approach, the focus needs to be on providing individualized learning opportunities for *all* children, rather than selection and placement of a few high ability children. *All* children need to develop their action repertoire through positive interactions with variables in their socio-cultural environment. Indeed, the expansion of action repertoire involves a matrix of interactions among environments in different domains. This view is consistent with research findings in Hong Kong that show children's development of life skills in academic, personal–social and talent domains are positively associated with their connectedness to parents, teachers and peers (Yuen, Chan, Chan et al., 2010). In addition, data from high-ability adolescents in Hong Kong show that their involvement in talent development opportunities can enhance their life skills and foster better relationships with their peers, teachers and parents (Yuen, Chan, Gysbers et al., 2010).

Ziegler (in press) suggests that external resources (e.g., wealth, cultural values) and internal resources (e.g., bodily fitness, learning goals, personality traits) need to be considered in the process of talent development. Data from high- and average-ability children in Hong Kong reflect that internal learning resources – in this case adaptive perfectionist traits – strengthen connectedness to family and school, which in turn promotes competence in applying academic skills (Fong & Yuen, 2011). We agree with Ziegler and Phillipson that educators need to recognize themselves as part of a gifted individual's developing actiotope. Educators need to commit themselves fully to helping individuals use their internal and educational resources effectively on the path toward excellent performance. The paper leads us to reflect on how we might engineer students' learning environments more effectively to ensure development of exceptional achievement.

As suggested by Ziegler and Phillipson, one of the few strategies implemented at the moment that can cater to students' individual needs is *mentorship* (Grassinger, Porath, & Ziegler, 2010). Indeed, Wood (2010) found that gifted students regard interaction with experienced people from their field of interest as the most valued and helpful means for their development. Similarly, our study of high ability adolescents in Hong Kong has shown that many students benefit from peer mentoring and counseling in school (Yuen, Lau, Lee et al., 2011). The model can serve as a base from which to individualize educational pathways; but more research is warranted on how to maximize educational benefits of mentorship.

The theory underpinning AMG reminds educators to attend to students' all-round social-emotional development, not merely the cognitive and academic. To optimize students' achievement, students need to perceive connectedness to a network of sub-systems that stimulate and support them toward exceptional performance and talent development. The systemic approach contends that exceptionality grows where persons and their sub-systems interact and adapt continuously until equilibrium is reached. The application of the theory is not limited to academic pursuits only, and it is essential to expand students' subjective action space continuously in many domains. The ideal is obviously to provide students with individualized learning opportunities and to give them continual feedback. But the problem is how this ideal can be achieved for gifted students within the typical school context.

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COMMENTARY

An action-oriented approach to gifted education: evidence from the field of scientific creativity

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Eight years ago, we carried out a study on scientific creativity (Zhang & Jin, 2007; Zhang, Jin, & Lin, 2008). Thirty-four eminent scientists, who had gained great creative scientific achievements in five fields – mathematics, physics, chemistry, geography and life science – were chosen and interviewed. In the study, we tried to find out what made a person demonstrate outstanding scientific creativity. The result showed that eminent scientists had a variety of essential traits, such as intrinsic motivation, eruditeness, autonomy, and initiative. However, we also know that these traits are also possessed by many ordinary people to some extent. So these traits are necessary but not sufficient for preeminence. More importantly, along the pathway the interaction and the co-evolution are the keys to transcendence. It is lucky that we have a chance to read Ziegler and Phillipson's systemic theory of gifted education, which can shed more light on our findings. Here, we will first comment on the theory that inspires us, then reinterpret our findings in the light of it, and put forward some tentative suggestions in the end.

Redefinition of excellence

For a long time, giftedness has been viewed as the properties of an individual (Schneider, 2000). According to this theory, the development of preeminence is considered autocatalytic. This means that if the environment does not stand in the way of the natural unfolding of talent, excellence will somehow find a way to develop. Guided by this autocatalytic approach, researchers focused on identifying a list of such traits as interests, creativity and attributions that could support the development of excellence. Based on this kind of understanding of excellence, a variety of educational supports, such as acceleration, enrichment, ability grouping, and financial support, were provided to "potential" people. However, contrary to expectation, these supports didn't work all the time (Ziegler, 2005; Ziegler & Stoeger, 2007). Therefore a new comprehension of excellence is needed.

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In contrast to traditional trait-oriented conceptions, Ziegler and Phillipson redefine excellence from the perspective of an action-oriented approach. In the Actiotope Model of Giftedness, which has been elegantly crafted over the years, excellence refers to a specific quality of actions (Ziegler, 2005). According to this model, a gifted individual has access to an action repertoire that can make him or her successfully adapt to a progression of environments. Therefore excellence is not the potential for exceptional accomplishments in one or more domains, but a term that refers innately to performances, a system of actions, or exactly an actiotope which is made up of four interacting components: the goals, the action repertoire, the environment, and subjective action space. In this way, Ziegler and Phillipson greatly expand the understanding of giftedness. Excellence is not only a series of traits or an individual's quality, but also a system which includes the environment in which an individual lives. System is the origin of excellence and of its potential to develop excellence (Ziegler, 2005).

The interactive and dynamic–interactive perspective

From the above model, manifold interactions are involved among the four components mentioned. First, the goals must be constantly adapted to an ever-changing action repertoire; in addition, expansions of the subjective action space should keep pace with the expansions of the action repertoire. In order to keep enough flexibility to enable change of system components, and to maintain enough stability to be in the position to successfully implement the modifications and transformations in the meantime, the components in the system are also dynamic–interactive. When the environment changes, such as skipping a grade in school, the movement from university to workplace, or the change of tutor of a graduate student, co-evolutions of all the other components are needed for the development of excellence. So stability or equilibrium means that the four components are complementary in nature and co-adapted in time.

A reinterpretation of our findings on the basis of the model

Based on main developmental tasks and dominant activities during a specific period, we concluded a five-phase developmental path including the period of self-exploration, talent exposure and professional orientation, concentrated vocational training, excellent work creation, and a later period of creation. In each phase, critical factors, such as early promoting experience, study guidance and support from teachers, and guidance in key stages, have an important impact on development (Zhang et al., 2008). After reviewing the systemic and dynamic–interactive theory, we came up with different interpretations about our findings. The term "activities" we employed to divide developmental stage is just similar to "actions" in the model, and thus all the dominant activities in every phase constitute the action repertoire. Furthermore, those critical factors at different phases represent and embody the interactions among actions, environment, goals, and expectations of individuals. For example, the goals are similar to the main developmental tasks, and they change during the process of individual development. It is also true with other components. So we put forward different critical factors in correspondence with different developmental stages. Therefore, our findings in the field of scientific creativity can be regarded as perfect proofs to the model.

Suggestions and prospects

As stated earlier, the model can well interpret the findings in scientific creativity. Still, we would like to put forward some suggestions for further application of the systemic theory in gifted education. First, the model offers good predictive power to retrospective study. But on the other hand, if it goes further to a prospective study or design of an instruction program for a group of children, what can we get from the model? It is certain that for a man with tremendous achievements in a field, there must be a perfect match among all the components of his/her actiotope, but there are many uncontrollable factors in the process of an individual's development in the prospective view, and therefore it is difficult to design specific programs unless more specific sub-models are provided. Second, as far as the empirical research is concerned, many concepts in the model, such as action, co-evolution and good fit, cannot be assessed and thus the model cannot be testified.

The model provides a comprehensive new vision for gifted education, and can help researchers understand giftedness more profoundly and broadly. What we are looking forward to is its widespread application in gifted education in China.

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COMMENTARY

Excellence is a wisdom tree grown up under a proper environment

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Theoretical research on or scientific study of giftedness has made huge advances compared to Sir Francis Galton's era. The practice of gifted education seems to be in an awkward position, which is very discouraging. In fact, no matter how successful a given special program for gifted and talented children is, public opinion tends to attribute successes attained by individuals not to the program but rather to the giftedness of the children. However when (or if) gifted individuals do not grow up to meet the public's expectations, then it is the program's fault. The gifted education program fell into such a discouraging situation simply because of the lack of comprehensive theories underlying the appropriate evaluation of gifted education programs. The Actiotope Model of Giftedness (Ziegler, 2005) and the systemic theory of gifted education (Ziegler and Phillipson) shed light on the difficulties faced by gifted education in practice all over the world. The Actiotope Model emphasizes the importance of actions of gifted individuals and the interactions between individuals and their environment. If the excellence, exceptionality, or creativity of an individual can be understood as a result of one's action repertoire in a given environment, then the evaluation of a gifted education program should focus on not only the outcome or achievement of the individual but also the whole system, especially the actions of the individual, the interactions between the individual and his or her action space, and the support from his or her environment.

In order to discuss gifted education from an ecological perspective, we would like to employ the Wisdom Tree (WT) Model (Shi & Xu, 1993) and describe how it grows up in its environment as an echo to Ziegler and Phillipson's systemic theory of gifted education. Like the Actiotope Model (Ziegler, 2005) and the systemic perspective (Ziegler and Phillipson) on giftedness, the WT Model also emphasizes the importance of environment and of the interaction between the intelligent individual and the environment he or she lives in. Creativity or excellence is a result of the accumulation of one's intelligence on a specific task within a certain period of time under a given condition or in a given environment (Shi, 2004). Without con-

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sidering the importance of conditions or environment people cannot compare whether Kepler (1571–1630), who lived around 400 years ago, or a university student living nowadays is more excellent, as Ziegler exemplified in his article on Actiotope Model of Giftedness (Ziegler, 2005). It is obvious that Kepler is recognized and remembered because of his laws of planetary motion but the university sophomore students investigated by Qin and Simon (cf. Ziegler, 2005, p. 415) will only be mentioned in an article arguing on the effects of condition or environment on gifted education.

According to the WT Model, an individual with a genetic heritage of intelligence or potential obtains information through seeing, hearing, touching, feeling and so forth, and responds to his or her environment by speaking, doing, acting, or behaving in general. The individual acquires knowledge, gathers experience, is socialized, and grows up through interaction with his or her environment within a certain cultural background. Through interaction (learning from, responding to, and getting feedback from, etc.) with the outside world an individual's intelligence or giftedness becomes socialized and grows up into excellence, manifests itself in different areas of expertise, and is respected as high achievement in specific domains. As the Actiotope Model of Giftedness emphasizes, excellence or creativity is not solely a personal attribute but rather a result of the interaction between an individual's innate potential or capability and his or her environment including collaboration with other individuals. A series of interactions between an individual and his or her environment consists in a system called interactiotope. The interactiotope of excellence development of an individual can be exemplified by an individual with his or her innate potential or giftedness starting to develop in a given environment at an initial stage. He or she gathers experiences (including knowledge, skills, impressions, and relationships, etc.) from his or her surroundings (including family, schools, communities, peers, and other people, directly or indirectly) and is influenced by his or her environment; and his or her activities and achievements can influence the environment in return. There are two series of development or changes in the interaction system or interactiotope: the individual development series and the environment development series. The two series interact and make the manifestation of excellence or high achievement in a specific domain possible.

In order to reach an objective goal (in the real world there are different goals set up and evaluated by contemporary common values of the world) in a specific direction, or more specifically, on a certain task, many individuals or groups of individuals work on such a task. These individuals may have different potentials or intelligences and different non-intellectual personalities, exist under different environments featured with different cultural backgrounds, providing different strengths of support. When the first one who reaches the goal is evaluated as creative by the world it becomes a competition (consciously or unconsciously). The first one may not necessarily be the best one or the most highly intelligent.

In summary, the Actiotope Model of Giftedness and the systemic theory of gifted education remind people of focus on constructing a proper system for gifted individuals. It is also very important for people to realize that learning procedures and interactions of gifted individuals with their family, school, peers, and society are just as important as their final achievements when people try to evaluate a special program for gifted children or students.

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