

Comparing Adult Longitudinal Studies of Productivity for Gifted American from
Different Eras (1954 and 2009)

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ABSTRACT

In the 1950s Terman summarized the results of his longitudinal study of the gifted and compared the “life success” of the 150 most successful men (Group A) with the 150 least successful men (Group C) at the midpoint of their careers (age 30). The objective of this article is to replicate the original Terman work with a modern sample of the most successful (Group A) and least successful (Group C) American Academic Olympians ($N=190$). The most successful adult Olympians were found to have parents that supplied a *Conducive Home Atmosphere* when they were growing up and were not hampered by a lack of motivation. We present implications of this study for today’s schools and for parents of the gifted.

Key Words Cross-cultural, Academic Olympians, competitions, gifted, talent development, career development, adult productivity, motivation, parent involvement

INTRODUCTION

Throughout much of the twentieth century, Terman's longitudinal study collected data from more than 1,000 gifted individuals (Terman, 1926, 1954a, 1954b; Vialle, 1994). In the 1950s Terman (1954b) rated the "life success" of 730 men at the midpoint of their careers. He labeled the 150 most successful Group A and the 150 least successful Group C. After isolating these groups, comparisons were made about the attitudes, values, and developmental experiences that affected their success in life. The criterion of success was the extent to which a subject had made use of his superior intellectual ability. Terman doubted Lange-Eichbaum's theory (1932) that claimed great achievement usually stems from emotional tensions that border on abnormal. Instead, Terman found that success is associated with stability and absence of disturbing conflicts. Other key findings of the Terman study are as follows: average grades between groups A and C were equal until high school; 97% of the As entered college and 90% graduated; 68% of the Cs entered college but only 37% graduated; half of the Group A fathers were college graduates, but only 15% of the Group C fathers had degrees; the estimated number of books in the homes of Group A was nearly 50% greater than in the Group C homes.

PERSPECTIVES

Louis Terman was in the forefront of psychologists that developed the IQ tests in the early part of the 20th century. He believed that these tests could be used to find the next generation of geniuses. This was one of his motivations in conducting the longitudinal

study of gifted individuals that were identified with the Stanford-Binet IQ test. However, Michael Howe is one of the researchers who argues that the exceptional talents of those we call geniuses are the result of a unique set of circumstances and opportunities.

Furthermore, in every case these talents are pursued and exploited with a characteristic drive, determination, and focus that the rest of us rarely show. All the geniuses in his study (Charles Darwin, George Eliot, George Stevenson, the Bronte sisters, Michael Faraday and Albert Einstein) share human qualities that set them apart from other people.

These qualities are ones of temperament and personality rather than being narrowly intellectual ones (Howe, 1999). The finding that assessments of a child's capacity to resist distractions and avoid impulsive actions are better predictors of later success than measures of early intelligence is consistent with this view (Goleman 1995). Terman's finding that individuals who were identified as being unusually intelligent in childhood often went on to have highly successful adult careers. The result seems to confirm the predictive value of intelligence testing. However, Howe argues that it was later demonstrated that had the children been selected on the basis of their family backgrounds and school records, without paying any attention to their intelligence test scores, equally accurate predictions could have been made about their attainments in later life (Howe 1999, 199-200).

The A and C groups in Terman's study shared equal intellectual capacities. The A group, however, accomplished more than the C group in their adulthood. The group that accomplished more shares some personality qualities that are typical of geniuses. These qualities include doggedness, persistence, the capacity for fierce and sustained concentration, as well as intense curiosity. A number of geniuses, including Darwin and

Einstein, disclaimed having superior inherent intelligence, but no genius has ever denied either possessing or relying upon a capacity for diligence or a healthy curiosity. In Howe's, study all the geniuses had reached high standards by frequently and regularly practicing their talents over a period of years. Practice and preparation are shown to be vital in all fields of achievement. For example, around ten years of sustained training are needed for a chess player to reach international levels, and it takes comparable periods of time to reach the highest standards in mathematics and the sciences. In music, it is widely believed that certain gifted individuals can excel without doing the lengthy practicing that ordinary people have to engage in, but the evidence contradicts that view (Howe 1999, 5).

Later in this article we show that the academic Olympians are more like the geniuses described by Howe than the intellectually gifted that represent the Terman sample. The Olympians are more driven to learn their subject (deliberate practice) by concentrating their efforts. This internal motivation drives them to acquire the expertise that is needed.

Heller's Munich Models (Heller & Perleth, 2004; Ziegler & Heller, 2000) for talent development provide another theoretical underpinning for this study. These models fit the Olympians' need to acquire in-depth knowledge of their subject early in their school careers because the examinations that are used to identify them are steeped in subject matter that is almost never presented in any high school. Howe's finding that sustained practice applied over considerable periods of time fits nicely into this innovative model.

OBJECTIVES

Our study was designed to answer the following research questions:

1. How do the 2006-2007 US adult Olympians compare to the 1954 Terman sample of gifted adults?
2. What factors differentiate between the most productive and underproductive adult academic Olympians?

DATA SOURCES

In each country separate programs have evolved to identify the Mathematics, Physics, and Chemistry Olympians. In some countries these programs are run by governments, while in the US they are conducted by independent professional associations. Our teams have data from 730 Olympians and from many of their parents. We have data from 345 American, 235 European, 165 Scandinavian, and 96 Asian Olympians.

The data utilized for this paper is limited to the 190 US Math, Physics, and Chemistry Olympians who responded in 2006-2007. The subjects in this study represent several age cohorts (1970s, 1980s, 1990s, and 2000s).

METHODS

The international Olympiad studies have been underway for 14 years in six countries. The latest round of data collection now uses web instruments. Olympians are requested to visit a specially designed website (olympiadprojects.com) where instruments are provided. One on-line instrument contains items used to construct the many scales used in most analyses (full survey), while a shorter version was designed for Olympians that participated in previous rounds of data collection (follow-up). Both quantitative and qualitative data were derived in all of these studies (Campbell, 1996).

Most of the data from these Olympiad studies is derived from Principal Component Analyses (PCA). Our approach is to first do PCAs at the national level and later to do Principal Axis Factoring (PFA) with the combined data from all of the countries (Campbell, Tirri, Ruohotie, & Walberg, 2004; Campbell & Verna, 2007).

For the current American Olympian data, the PCAs produced the following latent component/factors: *Conducive Home Atmosphere* during the school years (SA) (Alpha $r=.87$); Olympians' reports of School Shortcomings (C_Short) (Alpha $r=.90$); Olympians' reports of Negative Affect at school (C_AFF) (Alpha $r=.76$); Lack of Motivation (C_FAIL) (Alpha $r=.66$); Individual Effort needed to Perform Well (CC_PE) (Alpha $r=.67$); Global degree of Effort needed for Success (CC_ES) (Alpha $r=.70$). Our analyses also include: Gender (SEX), family structure (one- and two-parent families) (LW), and immigration status. We also developed two composite variables, one that isolates Computer Literacy (COMP), and one that incorporates all of the achievement and standardized test results into an Ability Composite (Ab_final). Finally, we collected data about the Olympians' college/university careers, their degrees, their occupations, and the number of publications (Pubs) they produced. We used the 17 categories currently being

used by the *National Study of Postsecondary Faculty* (NSOPF) to quantify data about the publications produced by the Olympians.

RESULTS

Comparing Terman & Olympian Samples

1. How do the 2006-2007 US adult Olympians compare to the 1954 Terman sample of gifted adults?

Before analyzing the differences between the Terman and the Olympiad samples, some mention of the differences between the instruments and methods employed in these two studies needs to be emphasized. Studies conducted in the 1920s-1950s utilized many univariate variables and some of the earliest developed psychometric instruments. In Terman's case his team collected extensive data over decades. A large body of qualitative data was collected in addition to medical and even dental exams. Terman's sample spent considerable periods of their time supplying information, whereas the Olympiad samples supplied only one hour of their time for any of the rounds of data collection. However, the Olympiad studies were able to use sophisticated methods to produce refined factors/components that are much more reliable and valid than the instrumentation that was possible 75-100 years ago.

Comparing the two samples, Terman's gifted students completed some version of the Stanford-Binet IQ test. This test purports to measure the "g-factor" that includes four cognitive abilities: verbal reasoning, quantitative reasoning, abstract/visual reasoning,

and short-term memory (Freed, Hess & Ryan, 1989). There is no dispute that Terman's young adults were intellectually gifted. We measured the ability of the Olympians by constructing a composite that uses standardized test scores (SAT, PSAT and GRE exams), grade point averages, and the Olympians' high school ranking at graduation. Many of the Olympians also possess high levels of cognitive ability.

The major difference that sets the Olympians apart is the level of subject matter acquired. In order to win an academic Olympiad competition, the student must be able to read the technical literature while still in high school. The required expertise goes far beyond the normal subject matter covered in high school courses (even advanced placement courses). Most high school science and math courses attempt to make the students good consumers of knowledge. The same analysis applies to introductory courses taught at the college level. Even the upper level college courses do not expect the students to be up to date on the advanced literature in the technical journals.

Establishing Productive vs. Underproductive Groups (A vs. C)

2. What factors differentiate between the most productive and underproductive adult academic Olympians?

In the 1950s Terman compared his subjects at age 30. His team wanted to find out how the lives of these gifted individuals were turning out. He wanted to ascertain the nonintellectual factors that were responsible for their productivity. He isolated the 150

most productive men (Group A) and the 150 least productive (Group C). He left no explanation of how he subdivided these two groups.

We searched for ways to subdivide the most and least productive Olympians and do the same type of analysis as Terman did in the 1950s. But how do you separate the most successful Olympians (Group A) from those that do not do as well (Group C)?

We realize that there are many ways that can be used to separate the high performers from the underperformers. One member of our research team suggested separating them in terms of their annual income. In terms of making money, the one Chemistry Olympian that joined Goldman Sacks as an associate has made more money than the many professor Olympians. There are two Talmud scholars and one priest in our samples; certainly these Olympians must be considered successful. There is also one art director, one independent film maker, and a number of career musicians. Aren't they successful?

In exploring ways to subdivide the sample into A and C groups, we used some of the Terman findings to work backwards. For example, Terman found that his Group A had more college graduates than his C Group. In terms of advanced degrees, the Terman sample included 78 PhDs (9.75%); 48 MDs (6%); and 85 Lawyers (11%). But the number of Olympians with undergraduate and advanced degrees is so large that this factor could not be used to subdivide the productive from the underproductive.

We used the same reasoning with several of the Terman findings until we came to publications. Overall, the Terman sample published 67 books (.084/person), 1,400 scientific/technical articles (1.75/person), and 150 patents (.18/person). The number of publications can be used to separate the two extremes among the Olympians. We

separated the A and the C groups by the total number of publications produced, but we struggled to find a cut-off number of publications that would isolate each group. Some of the Olympians have produced more than 300 publications, while some of the younger ones have already turned out more than 100 publications.

Terman's gifted sample was virtually the same age, but the ages of our Olympians range from 16 to 53. How could we find a way to find the Olympians who turned out the most work at any age?

Finally, we realized that the *rate of publications* produced each year would allow us to compare the young and mature Olympians on an equal footing. The cut-off rate we used for including Olympians in Group A was that they have to publish at least one publication per year for their entire life span. Very few Olympians published anything before the age of 20, but as they proceeded into college, some began to publish. The top publication rate was 8 publications/year for a 36-year-old Chemistry Olympian (288 publications). To illustrate further, one Group A Physics Olympian at only 21 years old turned out 32 publications (rate 1.57/year). A 29-year-old lawyer (Physics Olympian) has a rate of 1.28/year (37 publications), and a 39-year-old software engineer (Math Olympian) has a rate of 2.44/year (95 publications).

In assembling the Group C we used three criteria: gender, age and occupation. We started with the 24 highest producers in Group A and also matched each member by gender, age and occupation. For example, we matched a 29-year-old high producing lawyer with a 30-year-old low producing lawyer, and the two Group A females with less producing females with the same ages and occupations. Subsequently, we matched the seven scientists, the two college students, the one engineer, the three software engineers,

the one MD, and the 10 professors/post doctorates. Each group has 24 Olympians including two females and 22 males. Group C is almost like a control group with the one exception being the number of publications produced.

Despite the very small size of the groups, we calculated the mean differences (t tests) for many variables (see Table 1). For both groups, 23 were reared within two-parent families ($t = -1.00, p = .328$). There were only two one-parent families among the 48 Olympians. One of these families had a deceased parent (Group C), and the parents in the other family were divorced (Group A). We also had immigrant information about the Olympians, but there were no significant differences in terms of immigration status ($t = -.731, p = .468$). Both groups were made up predominantly of third-generation Americans where the Olympian and both parents were born in the US. However, there were two immigrants in Group A, but only one in Group C. There were no significant differences in terms of age between Groups A and C ($t = .816, p = .419$).

Group A produced a mean of 92.88 publications, while the Group C mean was only 6.63 publications ($t = 4.8; p = .000$). These tests revealed only two additional significant differences. One difference concerns a higher SES for Group A ($t = 2.6; p = .014$), and the other difference concerns Groups A Olympians reporting higher levels of a *Conducive Home Atmosphere* ($t = 3.7; p = .004$) during their school years.

The Cs had more motivation problems ($t = -1.1940, p = .059$), and this finding confirms one of Terman's findings (1954a 17). Their lack of motivation was almost significant despite the small size of the sample. The As reported more school problems during their elementary and high school years. Group C had a slightly higher level of

ability and reports greater Negative Affect problems where some teachers and peers were insensitive or showed little respect to these gifted children.

Multivariate Analysis

We performed a Discriminant Function Analysis with these variables. Even with these small samples (see Table 2), the Wilks lambda is significant ($\text{Lambda}=.567$, $\chi^2=22.147$, $p<.014$), which indicates that the model including these 10 variable/factors was able to discriminate between the two groups. The standardized function coefficients show the weights used to separate the groups. The classification results show that this analysis predicted the membership of 91.3% of Group A and 82.6% of Group C.

The resulting discriminant function positions all of the variables together. Those in Group A had a much more *Conducive Home Atmosphere* when they were growing up. Their homes had an abundance of books and magazines that spurred their interests, and both mother and father recognized the Olympian's talent and encouraged him/her to develop it. The SES mean score (Mean=88) indicates that the parents' occupations were professional and technical (see Miller 1991). This function also shows that Group A Olympians were not hampered by a lack of motivation. Their high level of motivation continues into their adulthood.

Group C is characterized by lower SES families (Mean=78) whose occupations can be classified as managers, officials, and proprietors (Miller, 1991). These families were not able to develop such a positive *Conducive Home Atmosphere*. There is less stimulation, less recognition of their talent and encouragement to develop it. This group

had more Negative Affective school experiences. Negative Affect comes about because of insensitive teachers and peers and is especially lethal in the elementary school years where highly gifted children feel isolated and alone. Secondary school for such students is prison-like. However, our qualitative studies with the Olympians show that magnet schools and specialized schools for the gifted alleviate this dilemma (Bittman, 2007).

DISCUSSION

We found the Munich developmental models (Heller & Perleth, 2004; Heller, Perleth & Lim, 2005; Perleth, 2001; Perleth & Heller, 1994; Ziegler & Heller, 2000; Ziegler & Perleth, 1997) to be especially useful in explaining the results of this study. Figure 1 presents the Munich Process Model of Giftedness. We view the triangle on its side as an example of how a student begins to prepare for the Olympiad tests by starting to master material. This student enters the triangle at the narrow top (left side of the tip of the triangle). He/she must then become enmeshed in the subject as time proceeds. As the student becomes more knowledgeable, he/she moves into the middle of the triangle by gaining much more information. As time goes on the student becomes an “expert” of sorts and now occupies the base of the triangle.

Insert Figure 1 about here

The makers of the challenging academic Olympiad tests expect these students to be able to possess the levels of expertise that only the producers of knowledge in that

subject possess. These tests are designed to measure high levels of expertise in the different academic subjects. They expect the students to be knowledgeable in current research trends. What is really required is that these high ability students *must leap frog* not only their high school peers but also many college students.

What does it take to acquire such skills at the high school level? It certainly requires a high level of motivation and dedication to learn this technical material when it is really not required at the high school level. Such individuals are more similar to the gifted individuals described by Howe (1999) than those included in the Terman sample. The screening process requires the Olympians to exhibit drive, determination, and the ability to concentrate on their subject at very young ages.

Insert Figure 2 about here

Figure 2 summarizes a more advanced Munich model that depicts the small triangle displayed under the school age label. Notice the larger shaded professional triangles below. The successful high school Olympiad participant must now move to one of the professional triangles to further his/her development. The Olympian is now entering into the technical world of the scientist, engineer, and mathematician. Some US Olympians begin this process in the 9th grade, while others start the process a little later. After more concentrated time acquiring additional technical knowledge, the student expands his/her expertise and begins to move along the triangle (deliberate practice). Once the student has a solid base of expert information, he/she is ready to tackle the Olympiad exam process.

After winning the Olympiad contest, the beginning scientist or mathematician's growth continues at the college/university level where the triangle assumes more professional dimensions. This process continues as the Science, Technology, Engineering, and Mathematics (STEM) career proceeds.

The one key finding from this study is that the learning environment established by parents during the school years was found to have long-lasting consequences years later in the child's career. Once parents make a major effort to recognize the Olympian's innate talents and to organize and develop them, this effort is never forgotten.

IMPLICATIONS

This study carries on the work started a century ago by Louis Terman during the 20th Century. Our focus is on the development of talent. What factors help or hinder its development? By selecting the academic Olympians, we automatically isolate individuals with high levels of talent. Our focus on the Olympians' development well into adulthood has implications for both school and for parents.

Implications for Parents

The one clear implication from this study is that parents need to supply a *Conducive Home Atmosphere* while their children are growing up. In another study (Nokekainen, Tirri, Campbell, & Walberg, 2007) of the International 1998 Olympians, we subdivided

the sample into three A and C cohorts (Young Olympians [ages 15-22]; Early Career Olympians [ages 23-29]; Mature Olympians [ages 30+]). We found that a *Conducive Home Atmosphere* was a significant predictor of productivity for all of the cohorts. Such an atmosphere promotes academic achievement (Campbell & Verna, 2007) and has long-term effects. The fact that this factor emerges again and again in our International and American studies is striking. Consequently, parents that are able to encourage the Olympians to develop functioning attitudes and work habits during the developing years might be surprised to learn that these instilled qualities are still in operation 20 or 30 years later. The implications for every parent are sobering.

Implications for Schools

The long-term effects of insensitive teachers and peers (Negative Affect) when the highly gifted child is growing up is also important to consider. Our qualitative studies of the Olympians show the pain they experience when they feel the sting of being labeled the class “freak.” Our qualitative work also shows that teachers need to become more sensitive to what is happening to such children. When teachers ignore the bullying and taunting, they do not realize the potential long-term negative consequences of these behaviors on the exceptional child. Teachers also need to appreciate the fact that some of these very young Olympians know more in certain areas than their teachers. Rather than be threatened by such a child, teachers need to help the child consolidate his/her advanced knowledge and to spur him/her on to even greater growth.

We must stress that this study illustrates the potential that high ability students have in being able to leap frog ahead of their peers at any grade level in their area of expertise. Many of the Olympians bitterly complain about the lock-step one-size fits-all high school curriculum. They understand the futility of forcing every student to remain with their age mates during the school years when so much more can be accomplished. In effect, we are holding them back while they are capable of zooming ahead at warp-speed. How much talent is lost by applying these academic straight jackets?

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Table 1
Comparison of Groups A and C Olympians on selected factor/components (N=24 Group A and N=24 Group C)

Variable	<i>M</i>	<i>SD</i>	<i>t</i>	<i>df</i>	<i>p</i>
Conductive Home Atmosphere					
A	3.0417	.63377	3.069	46	.004
C	2.3083	.98419			
SES					
A	88.2708	12.29968	2.559	46	.014
C	78.2396	14.75018			
Lack of Motivation					
A	2.7609	.83271	-1.940	45	.059
C	3.2250	.80717			
School Hindrances					
A	1.5446	.90763	.763	46	.450
C	1.3452	.90375			
Negative Affect at School					
A	.8229	.79905	-.484	46	.631
C	.9271	.68951			
Effort Attribution Individual					
A	3.6174	.47064	.137	45	.891
C	3.5917	.77005			
Effort Attribution Global					
A	3.1739	.54582	-1.007	45	.319
C	3.3750	.79400			
Publications					
A	92.88	87.527	4.804	46	.000
C	6.63	8.591			

Table 2
Standardized Function and Correlation Coefficients

Variables Factor/Components Composites Function	Standardized Function Coefficients	Correlations between Variables and Discriminant
SES (Socio-Economic Status)	.488	.448
LW (Family Structure One-Parent/Two-Parent Families)	-.173	-.172
SA (Conducive Home Atmosphere)	.650	.580
C_Sho (School Shortcomings)	.456	.174
C_Aff (Negative School Affect)	-.460	-.077
CC_PE (Individual's Effort needed to Perform Well)	.021	.039
C_Fail (Lack of Motivation)	-.440	-.328
CC_ES (Global Degree of Effort needed for Success)	-.261	-.195
COMP (Computer Literacy)	.094	.066
Ability	-.296	-.197

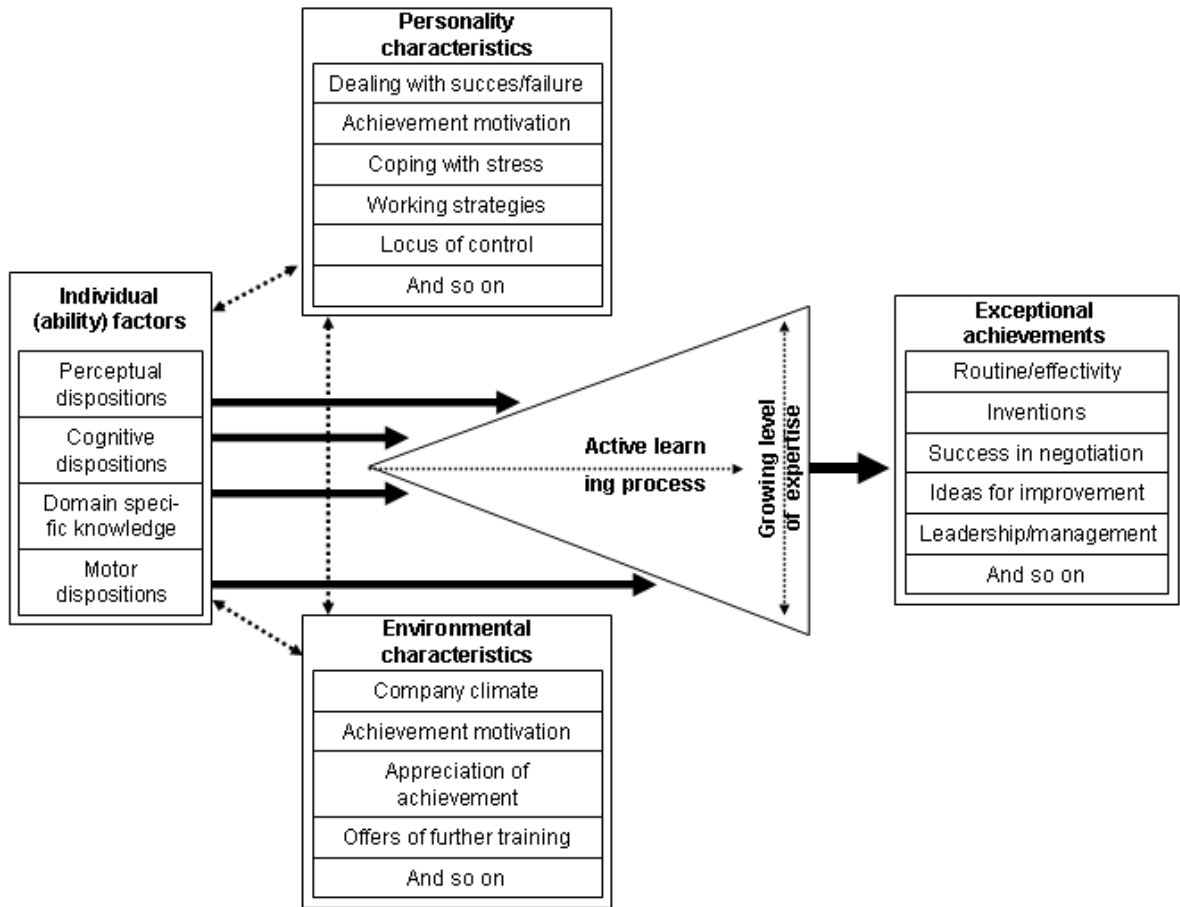


Figure 1 The Munich Process Model of Giftedness by Ziegler and Perleth (1997), Heller, Perleth & Lim (2005, 150).

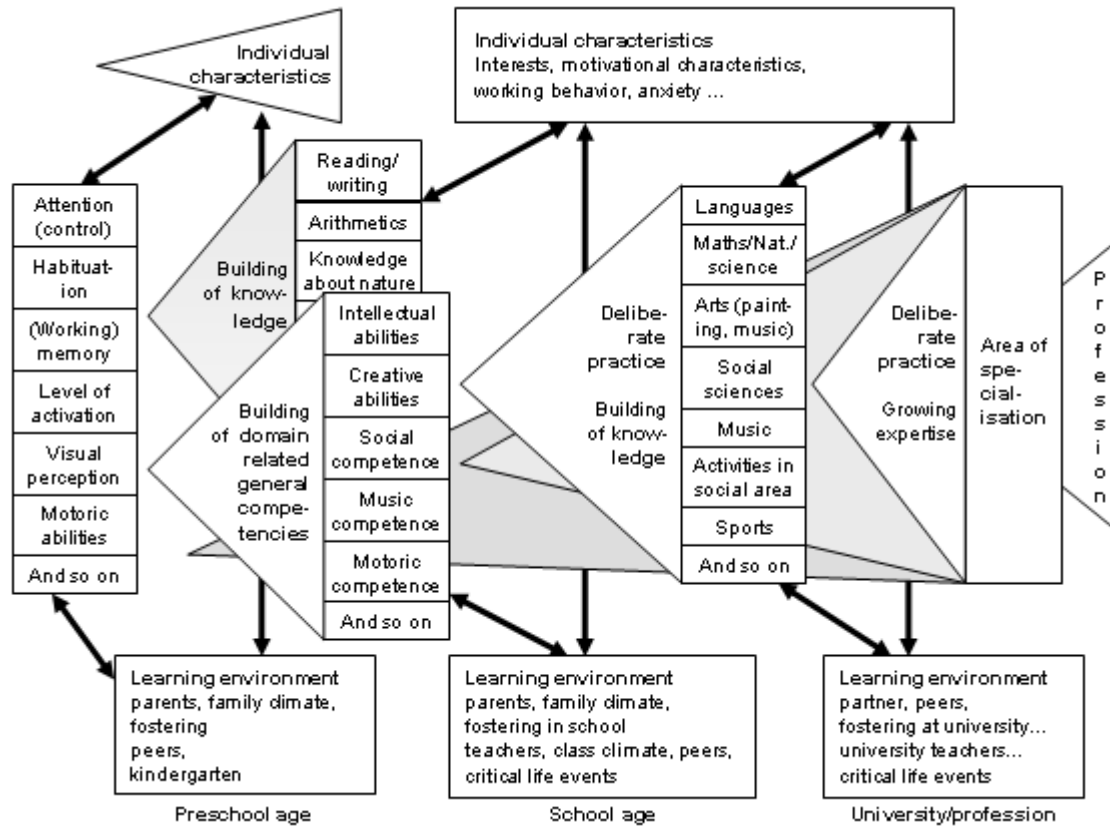


Figure 2: The Munich Dynamic Ability-Achievement Model according to Perleth (2001, p.367).