

TWICE-EXCEPTIONAL CHILDREN - MATHEMATICALLY GIFTED CHILDREN IN PRIMARY SCHOOL WITH SPECIAL NEEDS

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Inclusion in Hamburg leads to joint school education of disabled and non-disabled children. The goal is to develop the potentials of all children to the fullest possible extent. Gifted and twice-exceptional children in particular are at risk that their potential is not recognized. In this article, the problem of non-recognition is demonstrated based on four case studies by special talents combined with developmental impairments.

Keywords: gifted children, developmental impairments. inclusion.

INTRODUCTION

Children differ from each other in many respects. They have different interests, show a different attitude towards work and come from different familiar backgrounds and that is why they speak different native languages and have different genetic potentials. Compensatory education, heterogeneity, diversity and inclusion are keywords originating from different times of the German pedagogical discussions. All these terms have in common that they were intended to develop the awareness of these differences. In all times these key-terms were, and they are still today, the foundation for considerations and constructions of learning environments to give all children an adequate access to education. The "CONVENTION on the RIGHTS of PERSONS with DISABILITIES of the UN (2006)" lays a legal basis for people with functional limitations and handicaps. The goals of this convention, which has already been signed by many states, are the following:

- “(a) Full development of human potential and sense of dignity and self-worth, and the strengthening of respect for human rights, fundamental freedoms and human diversity;
- (b) To develop at the fullest extent disabled persons’ personality, talents and creativity, as well as mental and physical abilities.” (Bundestag 21. Dezember 2008), p. 18)

Actually, in Germany, efforts to implement of the idea of inclusion are discussed. Thus for example, the realization of inclusion in Hamburg means that all children with or without disabilities¹ are taught together. Based on special conditions, this is already implemented in various schools under the heading "integration". This concept demands a lot of effort and care. Many teachers do not know whether they

¹ Excluded are blind and deaf children.

have sufficient practical knowledge for being able to teach children with such diverse conditions appropriately.

Particular attention is paid to children with disabilities. But we should not neglect gifted children with special needs, especially because in many cases high intelligence enables such children to compensate limitations and peculiarities. However, this often leads to the fact that special talent is not easily recognized.

Since school year 1999/2000, at the University of Hamburg we foster mathematically talented children of the third and fourth grade in our project called PriMa². Starting with a talent search process, we select and foster around 50 children of grade three until the end of grade four at the University. This project is regularly attended by children with specific performance deficits, diseases or impaired developmental processes.

How many children are affected?

Although we ask the parents to provide us with additional information in case of such impairments, this information we are only given voluntarily. Therefore, until now we do not have accurate data about the whole sample of children participating in our project. This year there are five out of 50 children with special needs we know for sure. Furthermore, the results of a questionnaire, which was answered by 115 parents of the participating children of our project, show that more than 14% of our children are affected by partial performance disturbances or impairments³.

		Frequency	Percentage	Valid percentage	Accumulated percentage
Valid	No	97	84,3	85,1	85,1
	Yes	17	14,8	14,9	100,0
	Total	114	99,1	100,0	
Missing	System	1	,9		
Total		115	100,0		

Table 1: Partial functional-performance disturbance

What do these children need?

² PriMa is a cooperation project of the *Hamburger Behörde für Schule und Berufsbildung* (u.a. *BbB*), and the *William-Stern Society* (Hamburg), the University of Hamburg. (for further information you are invited to visit the website <http://blogs.epb.uni-hamburg.de/nolte/>)

³ The authors of the respective scientific literature about developmental disorders or weaknesses use different terminology for the description of comparable disorders. For instance ‘Partial functional disturbances’, ‘partial performance disturbances’ and ‘impairments’ are used to describe neurofunctional impairments as well as cases of observable performance disturbances (Graichen 1975; Naggl 1994; Nolte 2000).

Method

By analyzing single cases it is possible to learn more about the needs of these children, which has often been practiced in studies about persons with special needs (see f.e. Sacks 1991; Nührig 2008; Busse 2009). In this article, the specific cases of four children are presented. All children were tested as mathematically gifted. For our study, among others, the following results were taken into account:

- a) Individual observations conducted during the fostering lessons
- b) Records of the children, written while solving mathematical problems
- c) Discussions with parents about their children's learning biography
- d) School reports of the second year for getting insight into teachers' observations and assessments concerning children's performance
- e) Results of the children collected during the talent search process (half standardized observations during trial lessons, results of a mathematics test, results of intelligence testing and results of testing verbal competences).

For measuring IQ we used CFT 20 R in combination with a vocabulary test and a number sequence test. As an academic achievement test in mathematics we used DeMat 2+. The stumbling words test is based on finding useless words. The reading test proves the degree of understanding of a short story. For observing the performance in the trial lessons (MTR) we developed special lists which contain cognitive components of problem solving and patterns of action which are important in solving mathematical problems (Nolte 2006; Nolte 2012). We constructed the maths test based on complex problems which enabled us also to show cognitive components of problem solving and patterns of action.

Justin, 8 years old

Justin participated in the project during our third year. Because we were still in the process of developing the talent search process further, about him we do not have as many information as we have about others. Additionally, Justin did not participate in the intelligence test.

Sometime, after starting with our fostering program, Justin's motivation went down. He was no longer in the mood to come to the university and did not feel well. The tutors reported that he had difficulties in understanding our problems and that he did not start working on his own. Justin did not like explaining his solving process through writing. But this occurs often with many other children. After talking to his mother, we supposed that perhaps his reading capabilities were not as good as that of other gifted children. Therefore we conducted further diagnostics and tested his reading skills, from which we found out that his reading skills were below average.

In Justin's school report it is stated that Justin is a high-performing student in all subjects. His capabilities concerning acquisition of writing and reading are just as

good as those shown in mathematics. He is described as an inquisitive, thoughtful and socially well-integrated boy. Advice is given to speak more clearly and to write stories more detailed, which might be taken as a hint. He is also learning Italian at his school. Taken together, this indicates that he needs more practical exercises for learning new words.

Why is Justin unhappy and unmotivated?

Our tasks for mathematically gifted children are presented by avoiding much redundancy. The language is demanding due to this fact that we pay special attention to mathematical correctness. Although the problems are presented orally and by examples, for working on these tasks the understanding of the texts on the worksheets is needed. These kinds of phrasings differ from those normally used at school. The mixture between everyday language and special mathematical language is called “Bildungssprache” (‘academic discourse’ or ‘academic language’ (Gogolin 2009; Gogolin and Lange 2011). Understanding our phrasings is even more difficult due to the complexity of the mathematical content, the low redundancy and the high level of mathematical correctness. Reading and understanding the text in our problems is significantly harder for Justin than it is for other children.

In contrast, in school, Justin is able to participate in reading contests. He gets the feeling that he is not intelligent enough to understand the mathematical contents. Therefore, he feels unsafe and withdraws. His tutors get the impression that he is no longer interested in solving mathematical problems. His mother notices that he does not feel well. She thinks his performance in reading is not as high as expected. However, as according to the school report, his performances in school are above average, and therefore his teacher thinks, his mother is much too ambitious.

Reading Test	Trial lessons (MTR)	Math-Test
ca. PR 35	One of the best	34 th of 135

Table 2: Justin Test Results

The test clearly shows discrepancies between his mathematical capabilities and his reading capabilities. Justin felt this discrepancy between his superior mathematical skills and his less than average performance in reading, but could not cope with this. We talked to him about his weakness and then developed together with him specific mechanisms to compensate them. The tutors were informed and Justin’s mother took care for additional support concerning his weaknesses in reading.

Justin is a child with a dissociated performance profile, which results from a partial impairment of performance.

Justin needs:

- Understanding of his behavior by others

- Understanding of his situation and the development of methods to compensate his weakness
- Strategic support in the current situation to compensate his weakness
- Long-term professional support in the field of reading acquisition

Lars, 9 years old

Lars is a shy and cautious boy. At the beginning of our lessons Lars was highly motivated, but then, over the time, his interest went down. First, interaction and communication with others was difficult, which might be caused by the circumstance, that the way he arranged his workplace and the way he solves problems were quite chaotic. Two meetings ago, he changed his place to join another group of children. At the beginning, the children got into contact to him and showed only a weak interest in working. Obviously Lars enjoyed working in a new group. During the last sessions he worked excellent. He seemed very motivated and very attentive even during the plenary discussion.

His school report states that Lars is a high-performing student in all subjects. Also his capabilities in the acquisition of writing and reading are nearly as high as those he shows in mathematics. Only his spelling is described being good instead of very good. The report gives advice to put more efforts on keeping his working place in order. Further, it is described, that he is well integrated into class community and that he likes to support his class mates, but seems not always to be able to control anger.

IQ	Vocabulary	Number sequences	Academic achievement test	Stumbling words test	Reading test	Trial lessons (MTR)	Maths-Test
151	118	136	PR 97	PR 58	41 of 50 points	Place 95 of 370	Place 76 of 226

Table 3: Lars' Test results

Also with Lars discrepancies between his high intelligence and his verbal capabilities can be observed. Comparing the IQ with his verbal capabilities, there was a difference of about more than two standard deviations. His performance in a mathematical school test was very high (PR 97). Nevertheless the observer during the trial lessons did not propose him for participation in the project. His writing is not appropriate for a third grade child, especially of his intelligence.

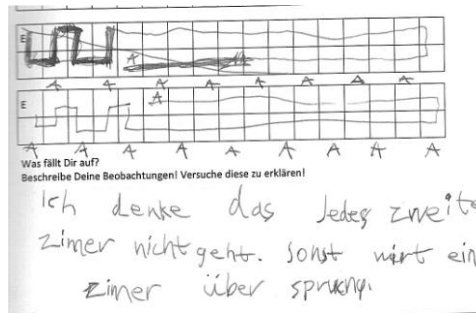


Table 4: Lars' writing

How to explain these discrepancies between his school reports and his performance in our tests?

Lars attends a school with a high population of pupils with migration backgrounds. In such a situation, his weak writing and reading skills are not as easily noticeable as within a population with a lower percentage of children with migration background, because many of his classmates show low performance in reading and writing.

Lars felt unhappy and shy, and we got the impression that he needs further support. His parents told us, that Lars shows weaknesses in auditory perception. This partial impairment of performance has a strong influence on his capabilities of understanding auditory information. It has also an impact on the development of reading and writing skills. This might be the reason for misunderstandings in communication processes and calls for more effort and causes more stress in attending lessons at school (Nolte 2004). We confirmed the parents' observation that their son has very high potentials but needs additional support concerning his impairments. Obviously, Lars is able to take care for himself and we hope that he will keep his motivation and continue working.

Lars needs

- people who insure that communication and interactions are clearly in the current situation
- support to develop metacognitive competences for organizing his work
- long term intervention for the development of his auditory perception and his written language skills.

Karen, 9 years old

Karen is a quiet and reserved student. She works very carefully and strongly tries to make no mistake. After getting used to the situation at the university she is actively involved in the plenary discussions. She writes only sophisticated solutions, which show excellent considerations. She seems not to be under pressure. Her meticulous way of working can be regarded as the reason for sometimes working very slowly. Also Karen's reading capabilities did not match with her mathematical performance. In the stumbling words test she reached a percentile rank of 58. Due to her slowness she could not finish the whole test. The results of other tests did not match with her

remarkable performance during the trial lessons and the maths test. The results show a discrepancy of nearly two standard deviations between the total IQ and the result of the vocabulary test. The good results in the reading tests can be explained by the possibility to get the necessary information from the context.

IQ	Vocabulary	Number sequences	Trial lessons (MTR)	Math-Test	Academic achievement test; Mathematics	Stumbling words test	Reading test
120	91	112	Place 12 of 370	Place 36 of 226	PR 97	PR 58	46 of 50 points

Table 5: Karen's test results

After analysing her worksheets, it is striking that she works very carefully. She expresses herself well and seems to have a remarkable memory.

Karen shows a discrepancy between the test results concerning IQ, verbal capabilities, and the mathematical achievements in the teaching process. A spelling mistake gave us the crucial evidence. This was an error typical for children with impairment of phonological processing. In the meetings with parents, we learned that Karen needed several surgeries between the age of one and seven years because of problems with her ears. This affects the auditory development as well as her phonological consciousness. Her very good results in our fostering program show that she is able to compensate her weaknesses by very carefully and reflected approaches. But this is the reason why she works very slowly which does not allow a limitation of time for her. Therefore, we assume that her test results do not show her real capabilities.

Karen's needs

- more time than other children
- no more pressure

Dissociated performance profile

All three children can be regarded as an example for children with specific performance deficits. Their test profiles show significant variations. In all cases, these discrepancies are not identified in school. All children need additional support to develop their abilities.

Leon

At the beginning of our fostering program the parents informed us that Leon is autistic.

“In addition, gifted individuals and those with autism are also similar in that they may have a compulsive preoccupation with words, ideas, numbers and foods; perfectionist personalities; a rigid fascination with an interest; a need for precision; intellectual rigidity; a lack of social skills; the need to monopolize conversations and situations; the ability to concretely visualize models and systems; an intense need for stimulation; difficulties in

conforming to the thinking of others; and a tendency toward introversion” (Cash 1999, p. 23).

IQ	Vocabulary	Number sequences	Trial lessons (MTR)	Math-Test	Academic achievement test; Mathematics	Stumbling words test	Reading test
151	118	136	Place 9 of 370	Place 25 von 226	PR 97	PR 58	42 of 50 points

Table 7: Leons’ Test results

Leon feels completely comfortable when working with us at the university. He is fascinated by doing mathematics. His achievements are impressive. Most of his considerations he does on mind using an almost unlimited number space. He prefers to work alone and can be distracted by anything when it comes to mathematics. When talking to others he explains very precisely his ideas at a very high level of language. But due to his need for precision, the participation in discussions with others is difficult for him and likewise plenary phases are a challenge for him, especially if other contributions are not as exact and completely as his considerations. It is hard for him to endure that others are not as fast as him and also not as capable as him in understanding mathematical content deeply.

For the tutors working with him it is a pleasure and a challenge at the same time. He takes everything what is said literally. Therefore, the tutors check their communication with him constantly. Furthermore, his brilliance in mathematics requires emotional support for other children. His rigidity in conversations is a challenge to cope with and they are confronted with the fact that their contributions are often of lower level of mathematical insight. Due to this experience, some of the other children got the impression of being less able as they are.

Dissociated development

With Leon the cognitive skills and the social-emotional skills differ strikingly. He gets therapeutic support and continuously develops his skills to behave in a group.

Discussion

At the university we are used to children who are exceptional in different ways. We are well aware of the requirements arising from the fact that some children do experience the first time, not to be the best. Rather, they must learn to work in a group with similar interested and talented children. It is very important to us to support the children in developing their social and emotional skills as well as their mathematical competencies.

The cases lead to the question whether high abilities allow hiding developmental disorders and impairments during regular classroom lessons, and also vice-versa whether developmental disorders and impairments may hide high cognitive abilities. Apart from Leon where a clear diagnosis was present, our observations were not always consistent with school reports.

We assume that the children voluntarily come to us because they are interested in mathematics. Thus, it is an important signal for us if they lose motivation. Also discrepancies of test results may indicate problems concerning development. Both Justin and Lars showed by their awareness of something is wrong by behaving not appropriate. This was different with Karen. She behaves very well, works very hard, but she stresses herself. Perhaps there are different ways to compensate such irritations of boys and girls. Because we have some experience with giftedness and developmental disorders, we are cautious in judging behaviour and performance.

“To reach their full potential, twice-exceptional students need a balanced educational program that nurtures their gifts and talents while providing intervention for their disabilities.” (Schultz 2012 p. 120) and later “Many school programs seem designed to either remediate weaknesses or develop gifts and talents but are unable to address both simultaneously (Schultz 2012 p. 120).

Intervention as well as the development of challenging learning environments is based on the information of teachers about normal and abnormal development. Interpretations of behaviour or performance are as broad and good as the knowledge of the observer. For working with children with developmental disabilities the knowledge about the nature of the problem is essential. Knowledge about developmental disorders as possible causes of unclear or even contradictory observations in the classroom is a prerequisite for the development of appropriate methods. For this we need to balance between searching for impairments and overlooking them. Not every problematic child is ill or disturbed. The first step in analysing a child's problem should start with looking for rational reasons for the shown behaviour. A lower motivation to work on mathematical problems can also be caused by the situation in the classroom or by the fact that a child would rather play football. With the next step, however, questions should be asked concerning the learning preconditions of the child in connection with a particular task. After this the responsibility of the teachers lies in the construction of appropriate methods to match as well as possible the strengths and the weaknesses of the child. To meet the high demand of working with impaired and / or twice-exceptional children, additional support for teachers is necessary.

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