Goodbye Private Lessons?

by Fred Warnke and Hartwig Hanser

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Dyslexia

Goodbye Private Lessons?

New research suggests that children suffering from dyslexia have fundamental deficits concerning their abilities of perception and movement. The good news: They can be successfully trained!

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Fabian's headphones sound »beep - beep - bop« rapidly one after another. Without hesitating, the nine year old boy presses the right button of the device that at first glance looks like a Gameboy. «Great!» praises the device and after a short break another sound sequence appears. Fabian suffers of dyslexia. To come to grips with his problems at school he attends a support group in which researchers test a new aid. With the so-called *Brain*-Boy® Universal the children playfully train various basic functions – here for example the ability of recognising different sound patterns.

»Beep – beep – bop«. Again, Fabian presses the correct button; the device plays a «Super». Thereby the boy by far beats the aim of his support group in the field »auditory pattern discrimination«. Now he takes up one of the other seven games offered by his *Brain*-Boy® Universal for the fields hearing, seeing and motor abilities.

About 100 000 children like Fabian of each age-group in Germany suffer of serious problems in reading and writing abilities. Approximately one third of them – that are about four percent of each age-group – suffer under a congenital, probably genetically conditioned reading and writing disorder. For further seven to ten percent of an age-group the difficulties base on other later acquired causes like temporary hardness of hearing due to frequent otitis media (inflammation of the middle ear) during the infant years.

All affected have one thing in common: their abilities in reading and writing only develop insufficiently. Yet the experts agree that these insufficiencies do not arise from general intelligence problems or inadequate school lessons. What the actual causes are and how appropriate new and specific therapies could look like is still vehemently discussed.

So up to now most of the therapists stick to the measures that seemed to prove in the past. In Germany the traditional private lessons and its numerous variations are still considered to be the first choice against dyslexia. Their main idea is that «reading will be learned by reading, writing by writing»: Besides continuous training of the desired abilities, a complex body of grammatical rules is «hammered» into the heads of the children. That led to the development of a rapidly growing learning industry. Organisations which operate nationwide with hundreds of subsidiaries and annual turnovers in the triple-digits million range live from the learning problems of children.

However, even convinced applicants and advocates of this learning-theoretic private lesson training admit that the kids have to face a long and laborious way which requires a high degree of perseverance. In this connection the child psychiatrists Helmut Remschmidt and Gerd Schulte-Körne from the University of Marburg have proven in a study that the conventional support has to be performed for a period of at least two years to attain a significant learning effect.

In the last years the search for possible causes of those disorders was more successful since a large number of connections between

Well guessed

The more intelligent dyslexic children are the longer they maintain their compensatory strategies. For example a 16 years old boy who, with a very high IQ of 150, showed extreme low-level deficits. The following mutilated sentence was told to him: „The Ørice of the Ørees is in my Øook." The Ø represented an invented sound that helped to reproduce his inadequate sound discrimination. His parents who were standing alongside looked uncomprehending. Yet he answered immediately: „That only can mean „The price of the trees is in my book". Everything else wouldn't make any sense." Everything else – these are 214 possibilities that could be additionally created from this unclear sentence! The student had the ability to compensate for his inadequate automatic sound recognition for years by using the sense of the words and sentences.

THE ACOUSTIC CAROUSEL RIDE The additional lateral training improved the spelling abilities by 42,6 percent.

dyslexia on the one hand and difficulties concerning different basic abilities on the other hand have been revealed.

These children mostly have problems discriminating sounds with different pitches from each other or are unable to precisely perceive the chronological order of sound events – like the time that passes between a consonant and the following vowel in a spoken syllable. The affected persons often search for suitable words and need more time to choose one of the possible alternatives.

FINGER TAPPING INADEQUATE

For purposes of improving the spelling ability according to this, it already could be sufficient to concentrate on one of these impaired functions – so the hope of some researchers. Unfortunately this was a false conclusion. Only recently Dagmar Berwanger from the Ludwig-Maximilians-University of Munich proved that the spelling abilities of dyslexic children won't be improved even for a bit if the recognition of the chronological sound discrimination is trained solely.

The psychologist Roderic Nicolson from the University of Sheffield thus sees the problems in reading and writing as the top of an enormous iceberg of various deficits that are spread over different levels. So for example the competence to understand speech can be differentiated into five steps which build up on each other (see illustration next page). We comprehend sentences by understanding single words which again base on the ability to perceive syllables and sounds. Finally, on the lowest level of this pyramid we subconsciously and absolutely automatically analyse, among other things, the chronological order and pitch of the sounds heard – the so-called Low-Level functions.

According to Nicolson the weak point of the concerned children is specifically this lowest level, which again affects the upper levels as well. The reason is that a high chronological discrimination is essential for hearing to be able to discriminate a «d» from a «t», a «b» from a «p» or a «q» from a «k». Only if the frequency can be clearly identified, vowels can be correctly distinguished. The British psychologist also sees Low-Level deficits of dyslexic children in the fields seeing and motor skills. The children often react slower if they are asked to press a certain button for a specific sign. And lots of them struggle with difficulties if they shall synchronously tap with their fingers to a clicking sound that alternates from the right to the left hand side. They also face problems with the dynamic vision which they can control less than their age-group *(see Gehirn & Geist 4/2003, p. 72)*.

Frequently such deficits do not become apparent since the children consciously compensate them on another level. For example there is a boy who did not understand some words because he couldn't distinguish certain sounds. He always rapidly measured which words could be possible and which of them best suited to the context (see box on the left). However the price for such individual strategies is high since these children need a major part of their intellectual resources for this process. So it does make much more sense to get to the root of the trouble –as quickly as possible.

The neuroscientists Paula Tallal from the Rutgers University in New Jersey and Michael Merzenich from the University of California in San Francisco agreed to this opinion. They developed a computer program called «Fast ForWord Language» to intercept the retarded development recognised in children in the pre-school age or children attending the first class. It playfully trains all Low-Level abilities while simultaneously integrating the higher levels.

The aim of most of the tasks is to distinguish pitches, sounds or syllables. Further exercises treat the levels of words and sentences. Here the children are asked to discriminate similar sounding words

LEVEL BY LEVEL **Martin Ptok from the institute of phoniatrics and pedaudiology of the Medical University of Hanover divides our competence to understand language into five levels. On the bottom there are the so-called Low-Level-Abilities – the unconscious, automated analysis of the chronological process and the pitch of the heard sounds.**

like »fan« and »van« or find grammatical mistakes. And indeed: after this combination training the children speak and talk remarkably better than before.

Using the functional core-spin tomography (fMRI) it was possible to prove that this training programme changes the brain activity patterns of the dyslexic children, since in some parts their brains work totally different compared to the ones of their unaffected contemporaries. The regions of the left hemisphere that are usually responsible for understanding speech are far less active in dyslexic children if they shall discriminate syllables like «ga» and «ka». The clinical neuro-psychologist Joshua Breier from the University of Texas recently discovered that after a short delay the corresponding regions on the right side react instead. And the Finn Romi Guttorm found out that babies from families with a high percentage of dyslexics, process heard sounds rather with the right than the left side.

SMALL HINT FROM *BRAIN*-BOY® UNIVERSAL

Exactly this is what the Fast-ForWord-Language program changes: after a six-week training with daily units of one hundred minutes the brain normalised its way of working during the language tests, which was found out by the neuroscientist Elise Temple from the Californian Stanford University: The corresponding regions of the left hemisphere that first reacted only little, started reacting almost as fast as in children without dyslexia.

Whenever the improvement of reading is concerned, even a small trigger somewhere in the hierarchic five-level structure of the language competence can have a considerable effect. According to Elizabeth Aylward from the University of Washington in Seattle, reading training for only three weeks with focus on the syllable and word level leads to a normalisation of the brain activities of dyslexic children to a large extent. Similar results were achieved with a computer-aided Low-Level-Training of the recognition of pitch, sound duration and volume which was applied by the Finnish neuroscientist Teija Kujala from the University of Helsinki. Again, besides the improvement of reading abilities, changes in the hearing cortex could also be proven. For these neuronal adaptations it is apparently sufficient merely to train the lowest level of the comprehension of speech. However the spelling does not improve thereby. For this, a multi-track approach seems to be necessary which includes the motor abilities besides hearing and seeing.

A new method that is - especially in Germany - increasingly applied, now takes this into account. First the deficits in the seven most important Low-Level abilities whose development is typically retarded in dyslexic children (see box below) are tested. Then, with the help of the *Brain*-Boy® Universal which offers the eight Low-Level functions as various training games, a systematic training begins. There a non-evaluated training cycle alternates with a test cycle which will be evaluated by the speech output of

THE EIGHT MOST IMPORTANT LOW-LEVEL-FUNCTIONS

▶ The visual order threshold is the period of time between two visual stimuli that is needed to separately perceive the stimuli and put them in order. An ability which e.g. is important for reading.

▶ The auditory order threshold is the smallest chronological distance between two auditory stimuli that could still be put in order. This ability e.g. makes it possible to differentiate between d/t, b/p and g/k as these letter pairs differ from each other above all in the time span before the spoken „e“ can be heard.

▶ The spatial hearing can be assessed best by the distance from an acoustic source to the middle between the ears, where a child still recognises whether an acoustic stimulus comes from the left or rather the right hand side. For being able to recognise an individual voice – e.g. the teacher's voice – within the spatially spread disturbing noises of fellow students, good values are essentially here. Typical noise levels in German classrooms lie between 50 and 60 decibel (A).

▶ Using the pitch discrimination you have to assess the frequency difference between two sounds of almost the same pitch. This ability is necessary for recognising vocals and decoding of intonation.

▶ Deficits in the auditory-motor coordination become apparent when dyslexic children are not able to precisely transform alternating right-left clicks into finger-tapping.

▶ For choice-reaction tasks where you have to recognise sound intervals or letters and then press one of several buttons – dyslexic children need significantly more time.

▶ Auditory pattern recognition: The child hears a fast sequence of three sounds with two of them being identical. He/she now has to specify which of the three sounds is different to the others.

▶ The ability to recognize and name the minimal differences in the length of sounds is particularly important to distinguish certain sounds from others.

FAST REACTION DEMANDED The Brain-Boy enhances the Low-Level-Abilities of dyslexics and thereby also improves their spelling abilities.

the device according to the success of the child with «okay – yes – good – great – super».

The decisive trick is: in each training cycle – while the child comes to a decision – the device offers a hint for the correct answer by indicating the button to press by a light flash. Thereby a second perception channel will be activated which leads to drastic increases of the learning speed – psychologists speak of associative learning. Actually even after only one training cycle the test cycle will be performed remarkably better.

To find out if this program does also have a lasting improvement effect on the spelling abilities, in 2002 psychologist Uwe Tewes from the medical University of Hannover performed a controlled study with 14 dyslexic children each at three schools. First the pupils completed the standardised diagnostic spelling test DRT-3 in which the testee had to write the missing words in lacunas as well as the worldwide spread intelligence test (HAWIK-III), which tests the general attentiveness of children. Also the seven most important Low-Level functions were tested.

ACOUSTIC CAROUSEL RIDE

Then the training phase began. While one of the three groups of 14 attended a conventional support class with an established learning-theoretic approach, the other two groups trained with the *Brain*-Boy®. One of these two groups additionally practised «lateralised synchronous reading»: there the child hears a text through headphones and synchronously reads it along loudly, whereas it perceives its own voice also only via the headphones. The clou is that both the voice reading the text and the child's own voice permanently wander from one ear to the other – inversely. So if the training voice speaks on the left side, the child's voice comes from the right and vice versa.

The reason for this acoustic carousel ride is: the coordination between the two hemispheres shall be improved since it is frequently impaired in dyslexic children. This suspicion was proven, amongst others, in a study from Nathalie Badian from the Harvard University in Cambridge. According to her, children having problems in reading face difficulties to synchronously tap with the left and the right hand to the beats of a metronome. There they resemble the so-called Split-Brain-Patients which have a divided main connection between the two hemispheres – the corpus callosum. So it should not be by accident that specifically this neuronal connection is, on average, developed significantly weaker in children with dyslexia.

After 48 support hours that were spread over four month, all children of the Tewes study passed through the same test like the one at the beginning of the experiment. The result was clear: while the comparison group with the help of the conventional private lessons only improved its result in the spelling test (DRT-3) by 6.8 percent, the group with the sole «Low-Level-Training» with the *Brain*-Boy® increased the performance by 18.9 percent. Finally the third group that additionally underwent the Lateral-Training improved by impressive 42.6 percent! The seven Low-Level abilities tested, as well as the general attentiveness of the children increased by an equal amount.

»We have checked all quality criteria and proved pedagogical and psychological relevance of the procedure now. Thus for the fist time we have evidence that this training improves the performance of central processing and has additional transfer effects on the spelling abilities» summarizes Tewes his study.

The Hanover psychologist currently aims at the Low-Level abilities of adults and therefore researches the way these averagely change in subjects of different ages. Available interim results show that these abilities decrease from the age of approximately 20 years unless they are trained. That means that the central auditory processing of a seventy-year old corresponds to the level of a six-year old.

ALSO FOR ADULTS

If these results will be confirmed in a currently running study, adults maybe should consider to schedule occasional training hours with the *Brain*-Boy®. As thereby they are able to possibly compensate for beginning hardness of hearing in old age by processing sound events more precisely and therefore retard the time a hearing aid becomes necessary. But not only this is a positive effect – there are first hints which indicate that the general flexibility of mind can be improved, too. Who does not dare playing a game for that?

FRED WARNKE is a free science journalist and had important impetus on the new German way of treating dyslexia described here during the last ten years. **HARTWIG HANSER** is editor at the German scientific journal Gehirn&Geist.

Further information

Please do not hesitate to contact Mr. Fred Warnke for further enquiries at: Fred.Warnke@t-online.de. Further information about dyslexia and training of the Low-Level abilities will be found under www.brainboy.de.

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