Central automation disturbances cause problems in learning

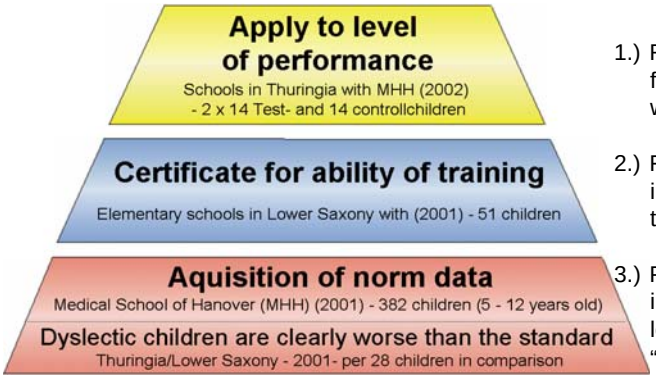
Success rate of the Warnke method scientifically proven and evaluated

This contribution presents a model for the causes of learning problems – mainly in the range of reading and writing - and their remedy. This method was developed about ten years ago. Nowadays more than one thousand therapists of different fields use this method successfully but in spite of this it was still object of discussion until a few months ago mainly by German child and youth psychiatrists and paed-audiologists.

But a change has been brought about recently: Four dissertations and two scientific studies carried out by Prof. Dr. Tewes from the Medical University Hanover proved the effectiveness of the Warnke-method: It was clearly shown that problems in reading and writing skills are caused by so-called low-level-deficits in hearing, seeing and motor skills. The training emerging from the Warnke-method does not only improve central processing of visual and auditory perception but leads to a significant improvement in reading and writing correctly.

Proof of efficiency:

It may be impressive to see how well a certain method works well but this alone won't convince scientists. That is why it is important to prove the efficiency of a method scientifically. To do this it is necessary to follow the fundamental steps described below.



1.) Raising and setting up standard data concerning low-level functions in order to get starting and final values to evaluate tests with children. (see also "Steps of Language Proficiency")

2.) Finding out whether the low-level-functions measured can be improved by training. (see "Training against Low-Level-Deficits" – the results of the scientific studies undertaken)

3.) Proving that the training of the functions mentioned above also improves reading and writing skills. In other words: Is the ability of learning to read and write properly dependent on them ? (see "Transfer to Language Skills)

Before getting (any) further, we would like to present some background information concerning the Warnke-method:

The way a child learns its mother- tongue

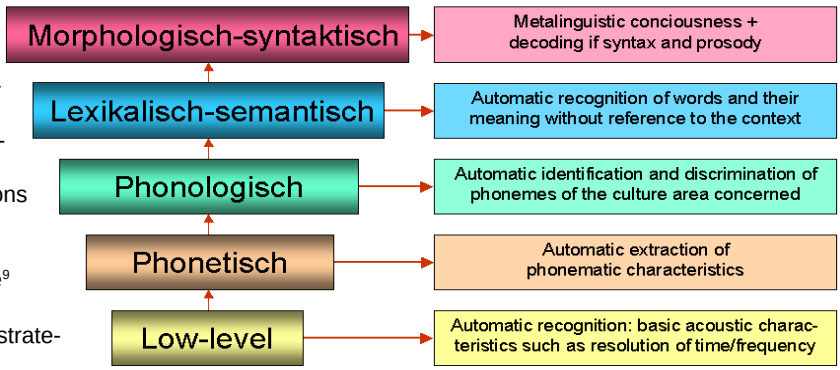
During the last months before a child is born its brain develops more than 500,000 neurons per minute. The ones already existing are producing more than two million new neuronal connections per second at that time[1]. From the 30th week of pregnancy the foetus can already distinguish between certain vowels. This was proved by EEG-measurements with early-born babies[2]. Before it is born the foetus hears everything quietly and dully because all sounds above 1,000 Hz are strongly reduced by the layers of tissue and the fruit water.[3]

From the moment of birth the baby's ability of hearing increases dramatically: It can now hear everything expanded by five octaves and a volume more than 30 dB. At the age of two a small child has learnt more than an adult in a four-year-university course of studies. Already two months after its birth it can distinguish between more consonants than an adult.[4] Six months later the child has developed this ability to a well-working discrimination of language-sounds used in its culture area. It is also able to memorize words from stories read to him fourteen days before.[5] This is one month before it had been able to notice differences in simple arithmetical progressions.[6] A two-year-old child possesses an implicit understanding of the syntax in main clause subordinate clause sequences.[7]

What does "implicit understanding" mean? Almost everything a child learns until it starts school is done implicitly. That is to say it learns without becoming aware of the process of learning; it can make use of the things it has learnt but it cannot give an explanation. The child develops its skills to an amazingly high level; this is done by repeating everything frequently until things work automatically. But this can only work if there are no serious disturbances in the child's predispositions or its sensoric input channels. We want to explain this in detail by the example of hearing because this is well investigated and of special importance for learning:

Levels of Language Proficiency

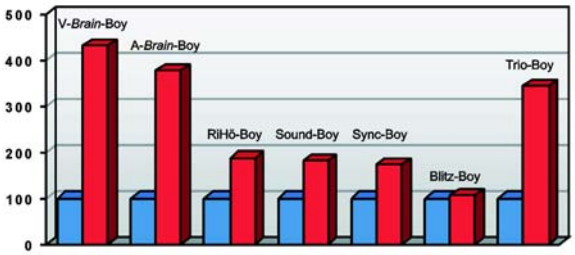
The graphic shown below originates from a concept of M. PTOK[8]. It depicts how all important sensory functions and skills develop hierarchically from the bottom – the so-called "low-level-functions" - to the top. According to this pattern deficits in one or more low-level functions will cause



- ⇨ Clear impairments of the functions above[9]
- ⇨ The need to invent – mostly inefficient – strategies to compensate the deficits[10]

It is assumed that even adults compensate existing low-level deficits to a certain degree, but if there are too many of them compensation strategies are of no help anymore. This leads to the conclusion that problems in reading and writing are mainly caused by disturbances of automatic functions in the low-level area. This is exactly the topic a recent investigation deals with: It is based on four dissertations (submitted to the Medical University of Hanover) on raising and evaluating standard data.[11] Seven low-level functions were the aim of investigation and data concerning hearing, seeing and motor-timing were taken from 382 children aged 5 – 12. Put into a graphic the data show a clearly age-dependent development. After that it had to be clarified whether the corresponding data of dyslexic children deviated significantly.

Study of the Ministry of Education in Thuringia



In a study supported by the Thuringia Ministry of Education and scientifically supervised by Prof. Tewes (Hanover) low-level-data were taken from 28 dyslexic nine-year-old school-children. These data were set against the standard data of 28 children taken from the group tested in Hanover. The results can be found in the picture below. In the graphic the values of the non-dyslexic ("standard") children are all set to a hundred. It is easy to see that there is a dramatic difference between dyslexic children (right column) and non-dyslexic children (left column) in six of the investigated functions.

1. ***Visual order threshold = Visual Brain-Boy®:***
   The person tested sees two brief flashes of light and has to decide which of them appeared first. Controlled by a computer algorithm the time interval between the flashes is shortened if the answer was correct otherwise it is lengthened. Thus the visual order threshold is determined which is the shortest interval of time a person can notice between two optical impressions.

2. ***Auditory order threshold = Auditory Brain-Boy®:***
   The person tested hears two short noises one from the right and one from the left side. He has to decide which of them appeared first. Controlled by a computer algorithm the time interval between the noises is shortened if the answer was correct otherwise it is lengthened. Thus the auditory order threshold is determined which is the shortest interval of time a person can notice between two auditory impressions.

3. ***Spatial Hearing = RiHö-Boy:***
   The person tested hears a click that seems to come from the right or left-hand side. This click actually consists of two electronically created noises the time interval between which is exactly the time the sound needs to move over from one ear to the other. This creates the impression of a single noise coming from a certain direction and the person tested has to indicate the direction he heard the sound from. This allows correct measurement of spatial hearing.

4. ***Pitch Discrimination = Sound-Boy:***
   The person tested hears two short sounds which clearly differ in pitch at the beginning and he has to indicate the order of the two. Again a computer algorithm reduces the difference between the two sounds if the answer is correct. This way the best rate of pitch discrimination (which means the ability to tell the smallest difference between two tones) can be measured.

5. ***Auditory Motor-Timing = Sync-Boy:***

   The person tested has to press two buttons alternately and exactly according to clicks he hears from the right and left hand side. The left button must be pressed by the left hand, the right one by the right hand. If the buttons are pressed in time with the sounds heard the time intervals between the clicks are made shorter forcing the person tested to act faster. After a fixed time the final result is shown on the display.

6. *Auditory Choice Reaction Time = Blitz-Boy:*

The person tested hears two different tones each coming from a different direction. A button must be pressed as quickly as possible on that side where the lower-pitched tone was heard. The Brain-Boy measures the time between the end of the lower-pitched tone and the pressing of the correct button. After a fixed number of trials the best result is shown.

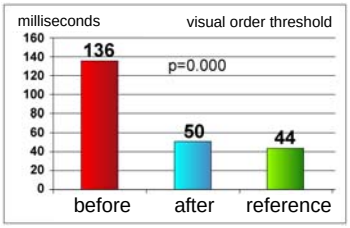
7. *Frequency Pattern Test = Trio-Boy:*

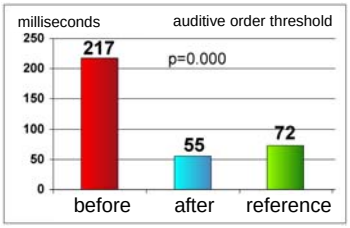
The person tested hears three tones two of which are identical. The position of the deviating tone must be indicated by pressing a corresponding button. A computer algorithm shortens or lengthens the tones as well as the intervals in between in dependence on the answers being correct or not.

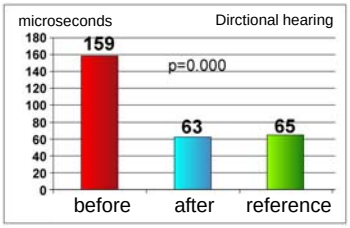
Realizing this significant correlation explained above the question arose whether these low-level functions could be improved by training, especially in children whose poor results seemed to be the cause of their problems in learning. Could it be possible to set up training for functions that had been neglected in the early years of a child? We were given encouragement by a paper from HAIER[12] who proved the ability of improving visual and motor-timing skills to a level of almost perfect automation. The persons tested had to play the computer-game TETRIS. The game made high demands on visual and motor skills they had never done before. After 4-8 weeks of daily practice their results had already improved more than seven times. At the same time the metabolic rate of the motor cortex was found to be reduced in the same way the training results had improved. According to HAIER this can be taken as a significant indication of a process of automation.

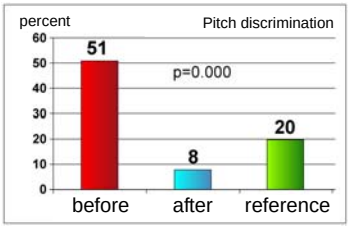
Can low-level deficits be reduced by training?

Yes, they can! This was confirmed by another study undertaken in 2001 with 51 dyslexic children and 41 non-dyslexic children attending an elementary school in Lower Saxony[13]. After raising the low-level data mentioned above the dyslexic group had to undergo a five-week-training. Each of the training-games had to be done only once a day.







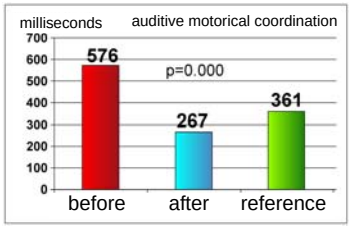


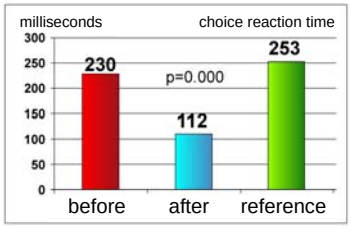
The results of this experiment can be found in the graphics below: The left (red) column always shows the data before the training, the column in the middle (blue) shows the results reached after the training. The additional column on the right (green) shows the data taken from the group of non-dyslexic children. In most cases the children who took part in the training reached even better results than the „normal“ children.

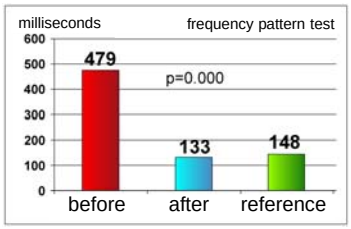
There is another reason why these results are surprising: A study done by the Hörzentrum Würzburg[14] in the year 2000 stated that the auditory order threshold alone was supposed not to be improvable by training. To clarify this contradiction it must be mentioned that in the training described in the study a certain method of training was not allowed.[15] This is the method of giving an additional hint (*Reinforcement)* in the latency time. This small but important detail is a further development of the learning concept set up by SKINNER: According to SKINNER the typical process of learning in human beings works like this:

1.)	Task	person tested hears to two sounds
2.)	Latency	person indicates order (sequence)
3.)	Answer	person presses button
4.)	Confirmation	display shows „correct“

As described in the German Patent N° DE 196 03 001 („Vorrichtung zum unterstützten Trainieren und Lernen“) an additional (visual) hint is given during the latency time between task and answer: A red light-emitting diode (LED) shows the right answer while the person tested is still thinking. This method (patent granted to MediTECH exclusively) is the secret of the Warnke-method´s success.







Results of a study with 51 dyslectic children and 41 non-dyslectic children in an elementary school in Lower Saxony

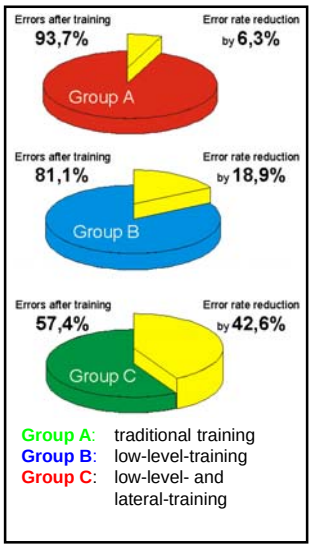
Transfer to Language Skills - is the training really effective?

This is certainly the most important question. Does the training of low-level functions really improve the reading and writing skills? The following results can answer this question easily: A study by HESSE[16] provides interesting results of an intensive in-patient treatment done with 34 children all of which were tested with poor low-level functions. After the training there was a significant improvement on the auditory level as well as on higher levels such as attentiveness and spelling.

Another proof was contributed by a group of scientists from Finland:[17] A Computer-training that combined several low-level functions concerning frequency patterns, pitch discrimination and time resolution was offered to 24 seven-year-old children. All 24 children who took part in the training could not only improve their low-level functions (found out by MMN-tests) but showed better skills in reading afterwards. This is a surprising result as - in contrast to HESSE - no special reading lessons or similar training had taken place.

The study in Thuringia - already mentioned above was designed as followed: All children taking part were divided into three groups all of which got exactly the same time for training. The first group (A) was given additional lessons in reading and writing specially designed and planned for dyslexic children. The second group (B) took part in daily low-level training and was offered only a minimum of additional lessons. The third group (C) did low-level training and was given the chance of transfer exercises - that means an additional training on the syntactic and semantic level. This special training was done with the help of another technical device: the lateral-training[18]

The lateral-training is based on the facts that „..memorizing words means the development of inter-hemispherical networks held together by the corpus callosum...“[19]. It is the corpus callosum that is often impaired in case of dyslexia mostly in size[20] as well as in function[21]. This is the reason why it cannot fulfil its tasks to coordinate and synchronize the functions of both hemispheres properly. During the lateral-training the child hears a voice (reading a story or singing a song from CD) periodically changing from one ear to the other. At the same time the child hears his own voice on the opposite ear. Thus the child must always compare the two impressions which force the corpus callosum to coordinate the perceptions coming from the left and the right ear.[22]



Before the training started the writing skills of all children were measured with the spelling-test DRT-3. After the training-courses the test was set again. The graphic below shows the results:

> Group A (normal school-lessons) was able to reduce the number of mistakes by 1.77 mistake (or from 100% to 93.7 %) Group B (low-level training only) could reduce their mistakes by 6.63 mistakes (or from 100% to 81.1%) Group C (low-level and lateral-training) reduced their mistakes by 15.07 mistakes (or from 100% to 57.4%)

This is the first time that it has been proved that this way of training (Warnke-method) can not only improve the central processing of perceptions but causes a significant transfer to reading and writing skills, too.

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1 HENRY, J. „The Secret Life of the Brain, National Academy Press, Washington (2001)
2 CHEOUR-LUHTANEN, M. „The ontogenetically earliest discriminative response of the human brain” , Psychophysiology 1996, July 33(4), pp 478-481
3 QUERLEU, D. „Fetal Hearing“, European Journal of Obstetrics & Gynecology & Reproductive Biology, 29 (1988), pp 191-212
4 BERTONCINI ,P. „Perceptual Representations of Young Infants“ Journal of Applied Psychology 1988, Vol 117, No. 1 pp 21-33
5 JUSZYK, P.W. „Infants Memory for Spoken Words“, Science, Vol. 277, September 1997
6 MARCUS, G.F. „Rule Learning by Seven-Month-Old Infants“ Science, Vol. 283, January 1999
7 WEISSENBORN, J. „Children´s Sensitivity to Word-Order Violations in German: Evidence for Very Early Parameter Setting”, 22nd Annual Boston University Conference on Language Development (1998)
8 PTOK, M. „Auditive Verarbeitungs- und Wahrnehmungsstörungen und Legasthenie“ Hess. Ärzteblatt 2/2000 pp. 52-54
9 BULLER,N.; PTOK, M. „Basale auditive Verarbeitungsfähigkeiten und phonologische Bewusstheit im Vorschulalter“, paper read at the 1st Annual Conference of the *Gesellschaft für Aphasieforschung und -behandlung* (Association of Treatment and Investigation of Speech Impediment)
10 FAWCETT, A.; NICHOLSON, R „Dyslexia in Children“ Harvester Wheatsheaf (1995) ISBN 0-7450-1636-7
11 STEFFEN, S.; TEWES, U. „Normierung und Training von sechs basalen auditiven Zentralfunktionen“ Annual Conference DGA in 2002
12 HAIER, R.J. „Regional glucose metabolic changes after learning a complex visuospatial/motor task: a positron emission tomographic study”, Brain Res. 1992 Jan 20 570(1-2) pp 134-143
13 MICHALSKI, S.; TEWES, U. „Zentrale Hörstörungen nachweislich trainierbar ?“ Hörakustik 10-2001 pp. 98-106
14 KÜHN-INACKER et al; „Training der Ordnungsschwelle“ in: Stimme-Sprache-Gehör, 3/2000 pp 119-125
15 WARNKE, F. Deutsche Patentschrift DE 196 03 001 „Vorrichtung zum unterstützten Trainieren und Lernen“ patent granted 23.11.2000
16 HESSE, G. „Die stationäre Intensivtherapie bei auditiven Verarbeitungs- und Wahrnehmungsstörungen im Kindesalter“ HNO 8/2001
17 KUJALA et al „Plastic neural changes and reading improvement caused by audiovisual training im reading impaired children“ Proceedings of the National Academy of Sciences, August 2001 Vol. 98 Nr 18, pp 10509-514
18 WARNKE, F. „Vorrichtung zur Verbesserung der Hirm-Hemisphären Koordination“ Deutsche Patentschrift DE 39 39 401, patent granted 25.04.1991
19 PULVERMÜLLER, F. „Neurobiologische Wortverarbeitung“ Naturwissenschaften 82 (1995) pp. 279-287
20 HYND, G.W. et al „Dyslexia and Corpus Callosum Morphology“, Arch Neurol 1995 Jan (52) pp 32-38
21 SUMMERFIELD, B. „Processing of Tactile Stimuli and Implications for the Reading Disabled“ Neuropsychologia 1993 Sep (31)/9 pp 965-976
22 Samples for Lateral-Training can be found on the CD: „Einsicht in das Warnke-Verfahren“ (Insight into the Warnke-Method) MediTECH-Verlag ISBN 3-932659-15-5

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