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A METHOD FOR MAKING CHILDREN WITH LD SUCCESSFUL

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Abstract

Although there are an increasing number of methods treating children with learning and behavioral problems, the provided results are in a lot of cases not self-evident. During my work and research it has gotten clear that all participants, children and parents included, need a feedback on achievements. As most of the times these children suffer a lack of attention during their studies a neurofeedback system was implemented in a movement-development course to provide a more scientific approach in developing their minds. Using this method the gathered data can be used to analyze the growth of participating children and doing so the course can be adjusted if needed. Developing the system also ensures that participants meet various challenges to train their focus while a playful atmosphere is maintained. The question is it worth doing it this way? In today's economical situation various factors must be considered on different levels to answer. On a basic level it must be considered what will a child gain if he/she goes through a developmental course. Will being successful outweigh the cost of training, is it worth for parents or on a higher level for society to invest more resources?

Keywords: learning disability, neurofeedback, success, children, stress, attention

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Introduction

In Hungary if a child is diagnosed with a learning disability parents have numerous options to choose from. In a lot of cases the child will undertake a movement development course where he/she will be doing various tasks that imitate infant movements. This method is used to rewire the participants brain and “repair” or improve cognitive functions (Blythe S.G,2002).

This method though not perfect can be and is used to alleviate the symptoms of learning disabilities (from now on referred as LD-learning disability). Work experience tells that circumstances have changed and the well used method is met with more and more resistance from younger generations of schoolchildren and skepticism from parents. The main cause for concern on the other hand is that children who have already participated in the course came back at a later time. What these children had in common that they had an increasing hard time concentrating on their schoolwork and they were all stressed out about school. As these children had already undergone the normal course a new method was needed to enhance their diminished abilities. Due to their age a new training menu was adapted which concentrates on appropriate conditional and coordinating tasks, but mainly on balance, concentration and movement control. To further strengthen the ability of these children to focus, a personally crafted neurofeedback system in DIY style was integrated in the method. This system serves various purposes. One is monitoring gathered data, which serves as a more scientific base in evaluating performance. As the used system can be adapted into more engaging “games” that challenges participants focus, children are more drawn into their self-improvement. This not only supports their growth it provides a less subjective viewpoint for everyone on their achievements. On the other hand it gives a certain sense of plus to parents as in they feel that their children do not participate in mundane movement development course. The purpose of this additional value though is not marketing but enhancement of growth. Participants of the hybrid and the normal course often leave a certain impression of a troubled mind state which could be defined as one form of stress. This stress is caused by their feeling that whatever they do or achieve is not enough and their hard work is in vain. Moving something with your mind can be very satisfying and relieves some of the feeling of effort in vain symptoms. This effect of the created system is backed by reports that claim that neurofeedback can be used to alleviate the symptoms of stress (Hammond, 2005). Through development children can be taught to have better focus, improved movement skills. Unfortunately, this is not enough if an external support system is not in place which gives children what they need in the right moment. Which system should include family, teachers, trainers and so on.

It should be evident now that to make these children successful addressing one element in the equation is not enough. In the future there are various challenges that will make life harder, be it a consequence or climate, demographic change or the changes in work conditions.

This paper attempts to paint a summary picture of an ongoing research what children can achieve using the developed method. The method is in a continuous developmental status so it has a few drawbacks which will be mentioned as well. As mentioned, the given plus to these children is only part of a bigger equation of their success. Based on work experience and previous available research a theoretical equation will be presented. These individual equations as a sum, depending on results could alter modern societal and economic problems. To raise awareness this bigger picture will be discussed as well.

Material and methods

To summarize previous research and discuss how the development of the neuro-feedback is proceeding various sources will be used. Evaluating progress is based on gathered primary data while conclusions are drawn on secondary elements.

Material

The structure of used data is the following:

Secunder data:

- Various journal or research articles focusing on children with LD and their attention
- Stress related articles, studies
- Articles using neurofeedback systems improving attention
- Work experience

Primer data:

- Gathered data which represents the cognitive behavior of participants during sessions, for analysis raw EEG data and concentration value provided by the used dry EEG instrument are used.

Methods

During sessions children complete various tasks while a Muse headset monitors their brain. The android application of Muse headset can be programmed to provide data about the strength of the different brainwaves. Using these measured beta values, which can be associated with attention, (Linden et al,1996) participants can move through a mobile application for example a toy car. That is if they can mentally perform a mental task and maintain that for long enough for the algorithm to deem enough. When the car starts moving it gives a feedback that they are on the right track, thus participants can learn to control how to regulate the state of their brain. Analyzing over a longer period of time one can observe how the attention of participants have changed despite age or everyday influences. Using these data points and the occasional feedback from parents an equation about the probability of success for children with LD was created. These equations show based on conclusions from other studies and work experience what factors are important to set children on a successful path. This equation also represent the hypothetical additional value and its weight which the developed method provides.

To show how children with LD are more endangered to stress and how this is related to a lack of focus previous studies were used. Based on this thought train and using statistics which connect a cost to stress an economic cost of LD can presented. These costs include various sources, medical bills, missed opportunities and loss of quality of life. If we presume that making children more successful through development the cost of these courses are investment which aim to lessen their stress and related cost during their lifetime. Using this method a comparison can be made between investment and gain or in other way avoided cost.

If we progress based on previous assumptions made on individual level an estimation can be made by relying on secunder data on how society would benefit a certain number of children with LD would be successful.

Results

To show the effects of the neurofeedback two data sets will be presented. One was acquired during an intense training camp where the developed system was used everyday. The other data is measured during sessions from an another group of children who are currently weekly partaking in the new program.

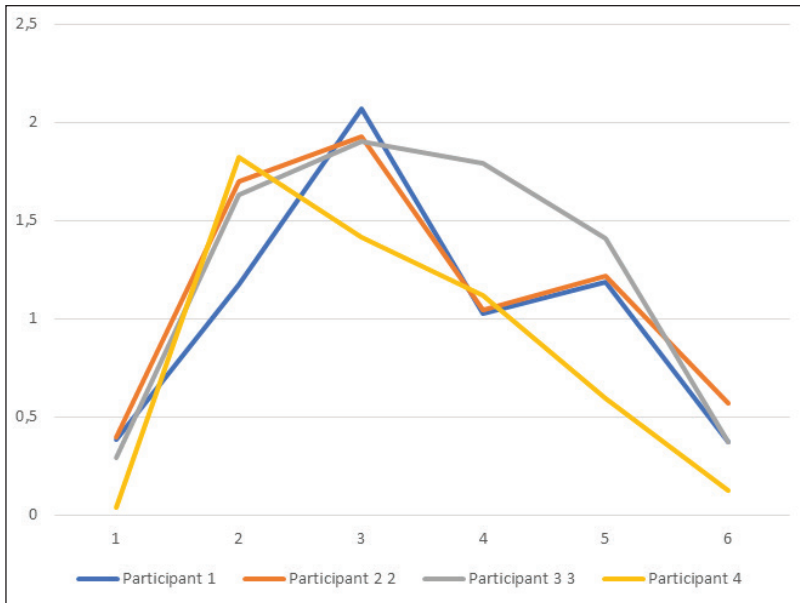


Chart 1: Average concentration score during training camp
 Source: Own construction based on gathered data

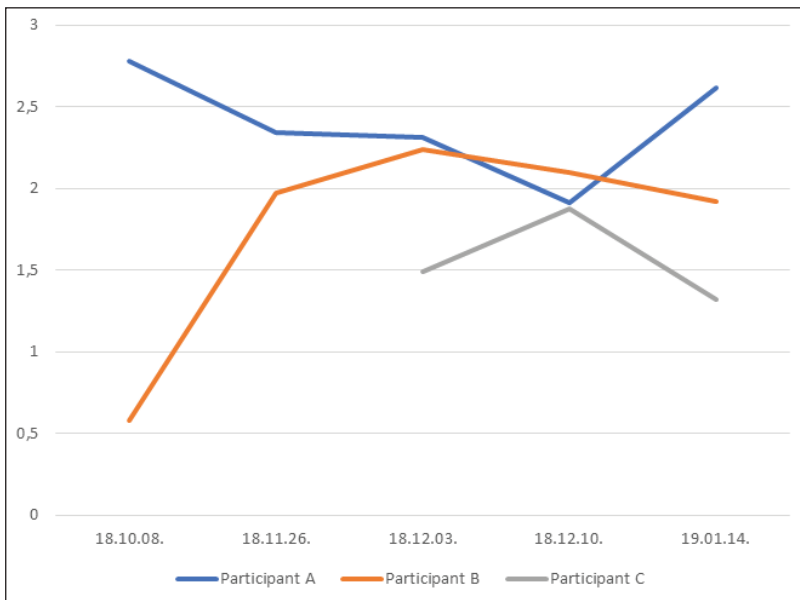


Chart 2: Another look on concentration scores
 Source: Own construction based on gathered data

Chart 1 represents how growth can manifest itself as a result of the used hybrid method in a weekly course. It can be observed that all participants start strongly from day two, when they had to control a toy-car with their mind. After that participant four got very tired and could not maintain a performance. The exhausting effects of training got the other participants as well, but they had the mental strength to reduce the fall down. But how is that chart connected to growth? As an example, Participant B should be taken a look at on Chart 2. Participant B has only started using the system in that time frame. In my experience children with LD in general who have a problem focusing when they start using the system, they can only produce low measured concentration values. A typically encountered numerical average for beta value would be around 0.5 just as Participant B had in the start. In this case Participant B shows remarkable control and shortly gets the hang of the system on the easy settings. Current personal hypothesis is that the aforementioned low beta value is connected how children with LD have a different wiring in their brain and that must effect their ability to efficiently think or concentrate. Interestingly most of the participants of the training camp started as children who had already partaken in the traditional course, but later in school could not keep up the required attention level. Observation tells that these children were quite stressful about school and it is possible that some reverse change happened in the wiring of their brain which influenced their ability to focus. This reverse change was reflected in their movement skills as well. Balance, coordination was not on the level which they could attain during their earlier days of the course. While 75 percent the early participants started with a 0.5 beta value as a crystallization of their effort in the camp, they could maintain an average around 1. Their maximum value was in the range of 3-4. This is no mean feat as they produced these values after rigorous cardio and various coordination skill developing training. While some of the participants of the training camp showed recognizable improvement outside the sessions as well, on the other chart participant A is a clear sign that the system needs improvement. Participant A can generate from a data point of view very good concentration value but cannot make use of this increased brain power in other areas of life. This leads us to the other question what defines success and what factors are needed to make it useful in everyday struggles.

Equation of success:

The closest factors which correlate with work experience from the available studies are found in the work of Raskind et al (1999). In their long term study, which tries to pinpoint attributes that make children with LD successful they listed the following variables in table 1.

Variable	Correlation with succes
perseverance	0.88
proactivity	0.9
goal setting	0.75
self-awareness	0.69
emotional stability	0.55
lack of support system	-0.84
Emotional instability	-0.78
reactivity	-0.77
lack of goal setting	-0.7
lack of self-awareness	-0.58

Table 1: Success related attributes

Source: own edition, based on Raskind, 1999

While these resonate with personal experience based upon the last 4 years another approach should be taken. In this approach variables are classified into three big parts. One cluster could be defined as internal environment and closes external environment. Genetics, family teachings, situation, the child's psychology are all here. Second group of influencing factors could describe best as simply as school. The third batch consists of everything that can be defined as extra activities and are aimed on the improvement on the child. In this approach the variables of success or at least a probability for success could described as in table 2.

Genetics	Quality of school	Effects of extra activities on development
Family situation	Friends	Extra energy required to complete these activities
Psychology of the child	Positive or negative stress due to school life	Provided additional value
Performance of the child		Multiplier which influences additional value depending on the quality
Σ =Success		

Table 2: Variables of success

Source: own edition

But why is success and attention such a key point? Based on various studies, conducted by Mark and colleagues (2008), Hoel et al (2001) on work related stress the following hypothetical process can be made.

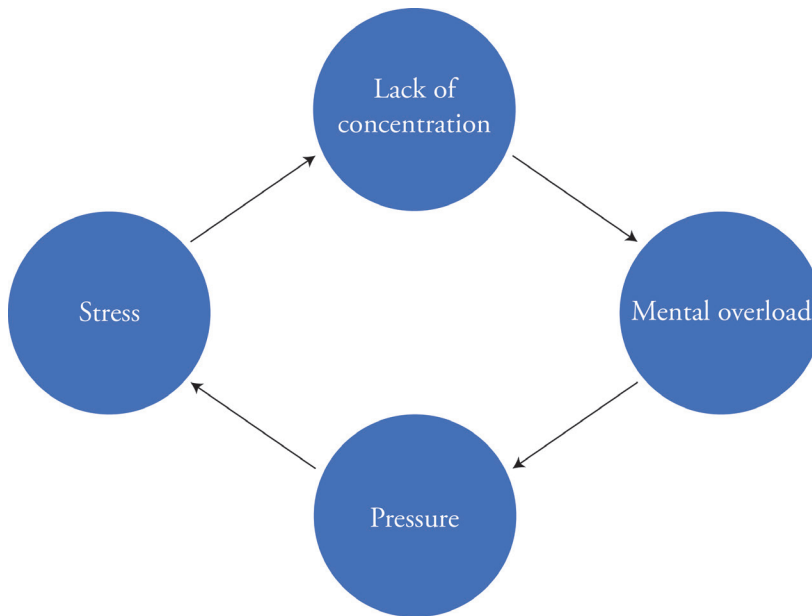


Figure 1: Devil's circle

Source Own editing based on Mark et al, 2008, and Hoel, 2001

Now previous studies using EEG agree that children with LD have a similar brain pattern. In frontal lobes they have excess theta waves while beta waves are less strongly present as in normal children. Due to this cognitive peculiarity children with LD have a hard time focusing their attention as their brain process is disturbed or overloaded with theta waves (Wang, 2013). This brain pattern was confirmed during early recordings and is showcased on Chart 3, where theta and beta waves of an early adapter is shown who had partaken in the traditional course.

But if this is case then children with LD are more endangered to stress as their brain work in such a way that mental overload is almost certain. At least one could say that if nothing is done to alleviate this pattern, if mental overload is given what follows is a stressed state. Now stress is a well discussed and researched topic. In this paper it is significant because we can link a cost to stress using various statistics thus an indirect cost to LD can be given. This would of course include variables like loss of productivity, health problems, loss in quality of life. The Roeher institute made a similar estimation which they calculated as cost of LD over an individual's lifetime. This cost amounted to 1.982 million dollar. If we calculate for example with ten percent of each generation who has LD one can draw the conclusion how badly this cost of life like symptom effects the success of generations. Including the different neural structure of people with LD, (Butterworth, 2013), its effects on concentration and other aspects of life it is evident these people face hardships in their life. To improve

their overall quality of life hard work is required on their part and parents to create the required environment where they can thrive and be a successful member of their community.

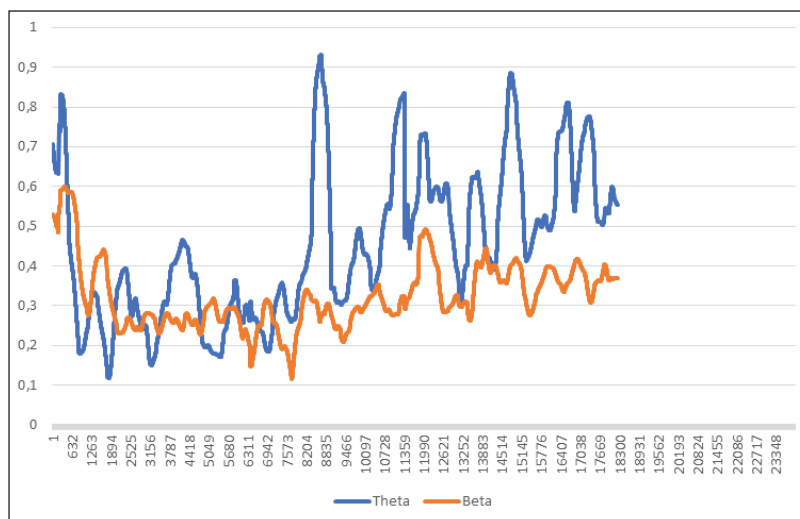


Chart 3: Beta/theta brainwave ratio

Source: own edition

Influence of society

Following the previous thought of train to make an estimation on society's cost three points must be considered.

1. The number of people or children with LD. Literature mainly agrees on 10 percent of current population (University College London, 2013) Available studies also state that in some cases these numbers are growing which are supported by workplace experience in a Hungarian foundation as well.
2. The cost of average stress per person. This can be deducted by starting with the following study on how much the EU has spent annually on stress. (Hassard et al, 2014) Using estimated population, the cost work related depression from the study's time cost can be calculated.
3. Average amount of investment for a child with LD to reduce symptoms through movement-development. Cost will be estimated based on gained work experience in mentioned foundation. This cost which would be around 100 euro is not the maximum amount, but should represent an average starting for extra activities. Depending on location and the child's problem cost can greatly vary.

Using these data for simple calculations and a 5 percent rate balancing time various estimations can be made of cost of stress and the development of a child. These estimations are represented in table 3.

Name	Estimated value (Eur)
Cost of LD/stress for a person per year	2975
Cost in a 15 years period	6185
Cost in a 40 years period	477 776
One year of movement development	4024
5 year of movement development	18 203

Table 3: Estimated costs of LD

Source: own edition

Up till this point these costs burden an individual who has LD or their parents when they pay for “extra curriculum” in hope to fix their children. These numbers should be treated as only as an artificial design, to show the loss of quality on life for these individuals. As mentioned before lack of focus, stress and LD cause can cause different indirect costs. This can be money spent on gas bringing a child when bringing him/her to movement development. Or a dyslexic person makes a mistake at work because his/her brain is overloaded and cannot properly process information anymore. These “costs” over a lifetime add up and not only affect certain specified individuals but their environment as well. This could be considered as a cost to society as their members have excess burden which they must pay. Question is what is the efficiency of different method that aim to treat people with LD. In other words when is it when the developmental course provides enough additional value to push the child over a certain threshold of success. On the other hand, it would worth to invest more into people with more LD so that they can be successful and what method should be chosen?

Efficiency is a key point because it matters that how much of the supposed cost of two million dollar can be reduced? For example, if with numerous development types during three years the child with LD improves overall 5 percent for their life the “investment” and “return” is not enough. If the parents during these years spend a fictional amount of 40 thousand dollars in return they would get with 5 percent efficiency 100 thousand dollars. It looks like worthwhile but we must consider that this cost represents life quality over a lifetime. In this approximation it is obviously

better to aim for efficiency in the higher numbers. This way maybe the child will be focused enough to save money, as opposed spending it on for example stress, to buy maybe a summer house.

One method can be individual movement development, but it's efficiency can be doubtful in a mot of times. Based on the effects and gathered data from the training camp intensive movement development and daily biofeedback sessions should be more efficient. To do so unfortunately one would need a specialized school with equipment and proper staff. Without going in much detail but accounting for neurofeedback equipment and a properly skilled staff for a reduced class with changed curriculum the price would be around 570 000 Euro. This would be a four year project for fifteen children with LD to bring them up to speed then integrate them back into the normal school process. Using this method as a plus option society's cost, investment is summarized in table 4.

LD incidence	Children who need movement development	Cost of three years movement development	Cost of proposed school
	Million	Million Euro	Million Euro
10 %	7.9	257	561

Table 4: Cost of LD from a broader view

Source: own edition

On the other hand, the possible gain in quality of life and for estimation purposes 40 percent of the related 1.97 million dollar would be **13*10¹² Euro**. As a comparison according to the World Bank's data in 2017 the GDP of the EU was around 16*10¹².

Conclusion

A traditional movement development is adapted to suit the needs of school aged children with LD who have trouble concentrating due to experienced stress. To monitor progress, to give a playful element and evaluate cognitive changes a neurofeedback system is integrated into the sessions. Early results of this hybrid method show promise as participant children's beta waves have gone through a significant growth which in some cases reaches four times the original starting values. During neurofeedback sessions children have to reach a beta threshold to move a toy car. The first batch of participants mostly showed better outside recognition in their skills and self-confidence. These included better behavior, diligence and improved ability to study. We could say that these children have gotten more successful or successful enough to

better adapt to their school life. Unfortunately, further testing shows the system has flaws and limitations. One flaw lies with hardware part of the system. The used dry sensor EEG devices can provide too much noise or invalid data. Partly due because of the behavior of the children partly because these systems were not designed for this audience. If there is not a strong enough support system around the child, and the cooperation of the child is just for show the additional value provided by the method is not enough to push over a certain threshold to achieve success. Different traits and factors of life must be provided for and by the child so that this threshold can translated into a criteria for success. To solve this on an individual level the system is currently under development to be more engaging and trustworthy. This also includes to make it more diversified in the hope to provide more of a challenge while strengthening various cognitive attributes that are required for success.

If the requisite psychological traits and ability to concentrate are not met than these children with LD are more endangered to various stress factors. As a result, they will have approximately a 2 million dollar cost over their lifetime which is spent on coping with their health, abilities. Given that at least around 10 percent of current younger generations have LD this poses a serious question to aging societies. As climate and demographic changes become more pressing it is more and more important that coming generations are prepared to meet the challenge. This can be done on an individual level which depending on the efficiency of the method can be a good investment for the child. This has the downside that parents can be overburdened by logistic and cost. Other pressing point is efficiency. As data shows gathered during sessions (Chart 2) a child's focus can greatly vary and in some cases cannot use what he/she learned. Using the neurofeedback system in a training camp showed that everyday usage greatly enhanced participants ability to rev up their brain and maintain that working state for more time. Thus in term of efficiency a daily session would the best. Work experiences tell that more and more children have some developmental issues. Unfortunately, not everyone can afford the different developmental courses needed on a personal level. As the occurrence of this problem grows a solution should be made on grater levels. For this to happen though greater investment should happen on state levels, changing and developing a developmental system with guaranteed efficiency to use in schools or a specialized school system. While the cost to do to this would be enormous in the range of trillions but in terms of quality of life or reduced economic cost spent stress related matters it would be a worthy investment.

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