

# Experiences with neurofeedback in therapeutic practice

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Neurofeedback is a therapy method to improve the regulatory capacity of the central nervous system. Clinical studies are investigating the effects of neurofeedback in various indications. In addition, practical experience is an important component in the evaluation of the method. 260 neurofeedback therapists – mostly occupational therapists - were interviewed about their experiences in daily practice. The analysis illustrates the variety of applications, positive and undesirable effects, and arrives at a positive risk-benefit ratio.

## 1. What is Neurofeedback?

The task of the brain is to maintain at all times a fine balance between neuronal excitation and inhibition of arousal. Misregulation of this balance often leads to psychological or physical disorders. In neurofeedback, selected parameters of the patients' brain activity (neuro) from the electroencephalogram (EEG), which are not directly perceptible and therefore cannot be consciously controlled, are given as a feedback. Through this feedback, patients can learn to change the feedback signals. The smallest changes are measured immediately and reflected back to the brain. In the sense of operant conditioning, the patient learns to change the signal in the the desired direction. The typical neurofeedback setting can be found in Figure 1.

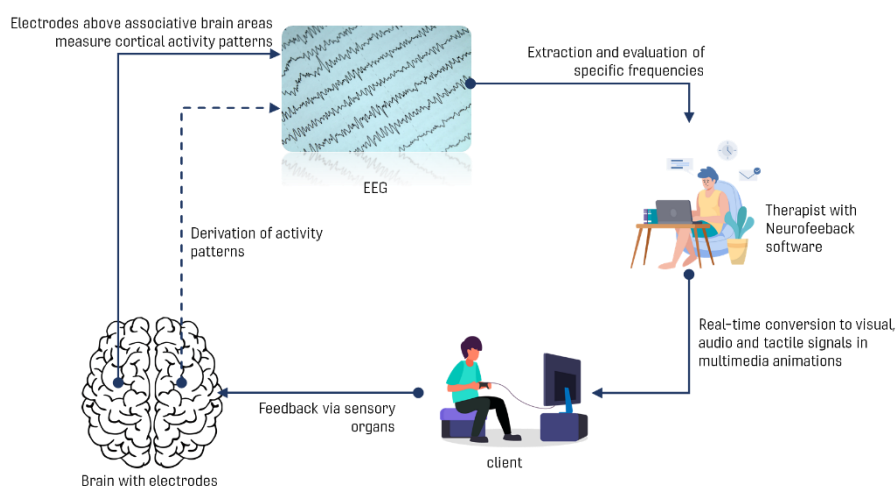


Figure 1: Schematic setup of Neurofeedback therapy

The EEG is recorded via electrodes attached to the scalp. Depending on the treatment method, determined parameters are extracted from the EEG and these signals are given as a feedback via visual animations, which patients can follow on the screen in front of them. Also auditory and tactile feedback nearly can be provided real time. These feedback signals are perceived via the respective sensory organs; the brain recognizes the correlation of the feedback signals with its own activity states and begins to respond to both the signal itself and to embedded cues. This leads to a modulation of the brain's internal control systems and a learned change in the brain's ability to self-regulate. With neurofeedback, patients can thus learn to improve the regulation of cerebral activity. This is a valuable therapeutic component especially for patients with dysregulations of the central nervous system, which are present in a variety of physical and mental dysfunctions. The neurofeedback methods differ

in the parts of the EEG signal that are fed back and positively amplified and in the exact positioning of the electrodes. Electrodes are placed depending on the indication.

In classical frequency band training, a certain desirable frequency range is defined in advance, which is "rewarded". In this way, reaching the desired target frequency can be positively reinforced. By means of operant conditioning, patients learn to increase or decrease certain frequencies.

SCP (Slow Cortical Potential) neurofeedback works with very small shifts in brain activity (less than 0.1 Hertz). These are much slower than the usual frequencies and do not so much reflect the current excitation level of the brain but rather an aspect of the general excitability: the willingness to respond appropriately to a stimulus. In studies, SCP neurofeedback particularly shows an contribution to improved attention in AD(H)D [1].

Infra-Low Frequency (ILF) neurofeedback also works with very low frequencies below 0.1 Hertz. The training frequency and the electrode positions are adjusted according to the individual needs and symptoms of the patient. Research results indicate that these low potentials affect the brain at the level of networks - such as the default mode network or the Salience Network [2].

In principle, every neurofeedback training belong in the hands of experienced therapists who have a close clinical observation of the short-term physiological state changes. Those changes can occur for example as a result of a change in the neurofeedback training frequency. The training protocol then can be adjusted accordingly.

Furthermore, effective neurofeedback also depends on the correct application and a sound training of the users. Occupational therapists have the right prerequisites for neurofeedback qualification: They are trained to observe patients clinically and pay attention to the physiology of a patient to recognize signs of tension and relaxation.

## 2. State of the Art and Research Question

The first clinical neurofeedback studies from the 1960s showed positive effects of the method as a complementary treatment for patients with resistant epilepsy [3]. Epilepsy even today is still an area of application for neurofeedback. Recent studies have been able to document that even after almost ten years of follow up, the benefit in terms of reduction of seizure frequency is maintained [4]. With further development of neurofeedback, the variety of indications for the use grew rapidly. The most important clinical indication for the use of neurofeedback is currently AD(H)D. Extensive studies with good methodological background show that the effects of neurofeedback therapy are comparable to medication with stimulants [5]–[7] or even superior to other methods [8]. The positive effects of neurofeedback therapy are usually long-term. A recent meta-analysis shows that the main symptoms of AD(H)D continue to decrease even six months after the end of therapy [9]. This scientific evidence has to the implication of Neurofeedback therapy in the current guidelines of the AWMF (Association of the Scientific Medical Societies) for the treatment of AD(H)D in children, adolescents and adults [10].

In addition, there is a large number of studies and case reports on the application of neurofeedback for other disorders: Anxiety Disorders and tics [11], [12], substance abuse / addiction and post-traumatic stress disorder [13], [14], Migraine [15], [16] and autism spectrum disorders [17], [18].

Clinical studies are an important contribution to the evidence of therapeutic procedures, but they often take place under conditions that cannot be transferred to the day-to-day treatment of patients. It is therefore of great interest to collect data that refers to the experiences in the application of

neurofeedback in everyday therapy routines. Neurofeedback as a method forms the link between therapist and patient and must be investigated more than just in standardized efficacy studies.

### 3. Implementation and Methodology

The research questions were derived from a qualitative pre-survey with a focused user group and are methodically reflected in a specially developed questionnaire:

- Who constitutes the primary patient group for neurofeedback?
- For which indications is neurofeedback mainly used in everyday practice?
- Which positive symptom changes can be achieved through neurofeedback in practical application?
- What are the undesirable side effects and how often do they occur?
- How is the risk/benefit ratio of neurofeedback therapy evaluated?

The questionnaire was distributed to 475 therapists between September 2017 and November 2019. To ensure that the therapists have sufficient practical neurofeedback experience, the questionnaires were distributed as a follow-up to advanced EEG Info training events, where the participants had already attended a basic course - five-day introductory course on the technical and practical aspects of neurofeedback - and gained at least one year of practical experience in the application of neurofeedback in daily therapeutic practice. Participation in the survey was voluntary, and participants did not receive anything in return. The response rate of the questionnaires was around 71%. Due to incomplete or multiple participation of a therapist in different courses, 260 valid questionnaires remained.

### 4. Results

All respondents have a medical or therapeutic background and are active in outpatient or in-patient patient care; the largest professional group represented are occupational therapists (48%), another 30% are physicians, psychotherapists and psychologists, while 22% of the respondents belong to other healing and therapeutic professions (e.g. curative teachers, non-medical practitioners, physiotherapists, etc.).

Figure 2 shows the distribution of patients within the categories children (1 - 10 y), adolescents (11 - 18 yrs), adults (18 - 65 yrs), and elderly people (65 yrs and older), with multiple responses possible. Adult patients form the largest group.

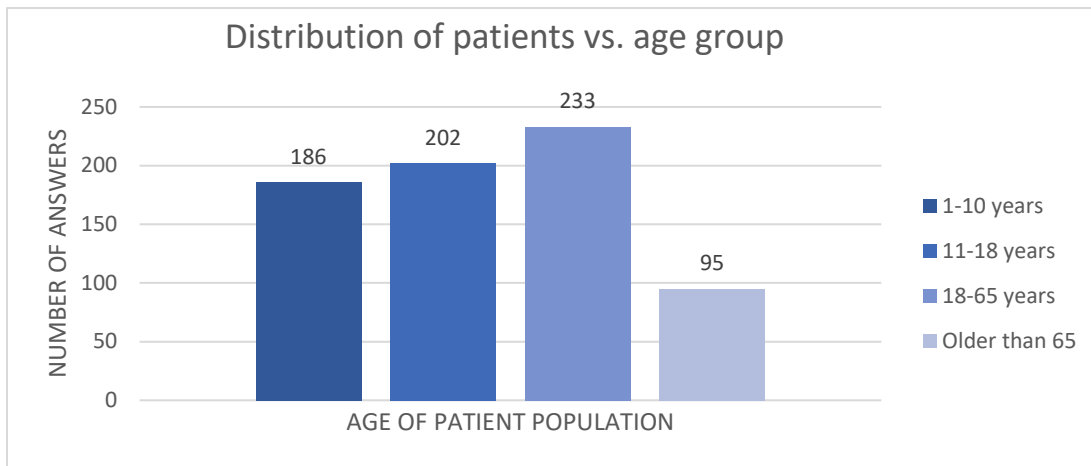


Figure 2: Distribution of patients to age groups

Figure 3 illustrates the variety of indications for which neurofeedback is used in therapeutic practice. Most frequently mentioned is the treatment of AD(H)D with neurofeedback, as well as sleep and anxiety disorders, depression and pain. Rather rarely neurofeedback finds application in the treatment of indications like bipolar disorder, eating disorders and psychoses.

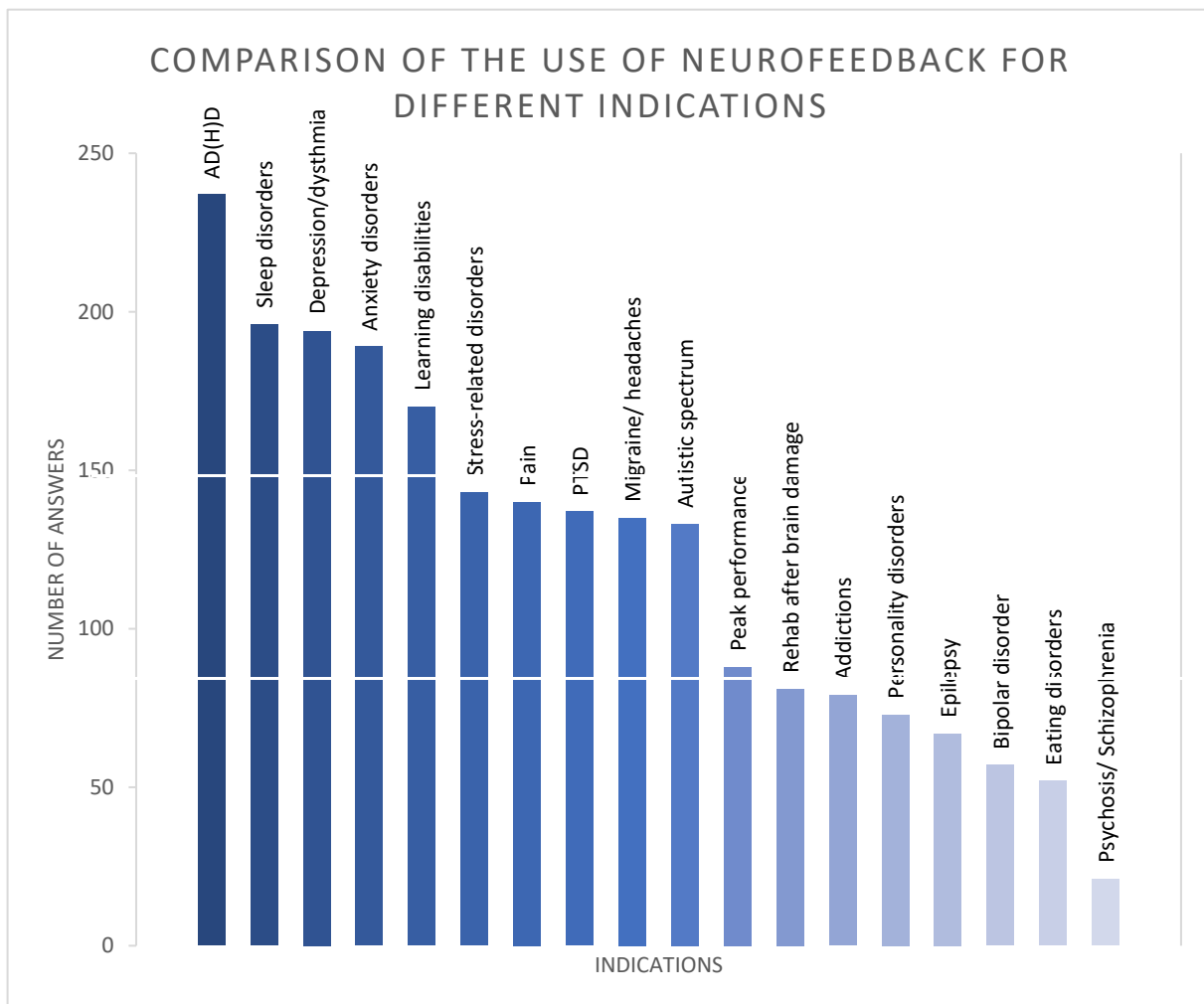


Figure 3: Variety of indications for neurofeedback

Figure 4 shows a listing of positive effects that can be induced by neurofeedback treatment. From their clinical experience, therapists cite as positive effects: improved sleep, better attention, improvement of mood, relief in dealing with stressful events, improved emotion regulation, and impulse control.

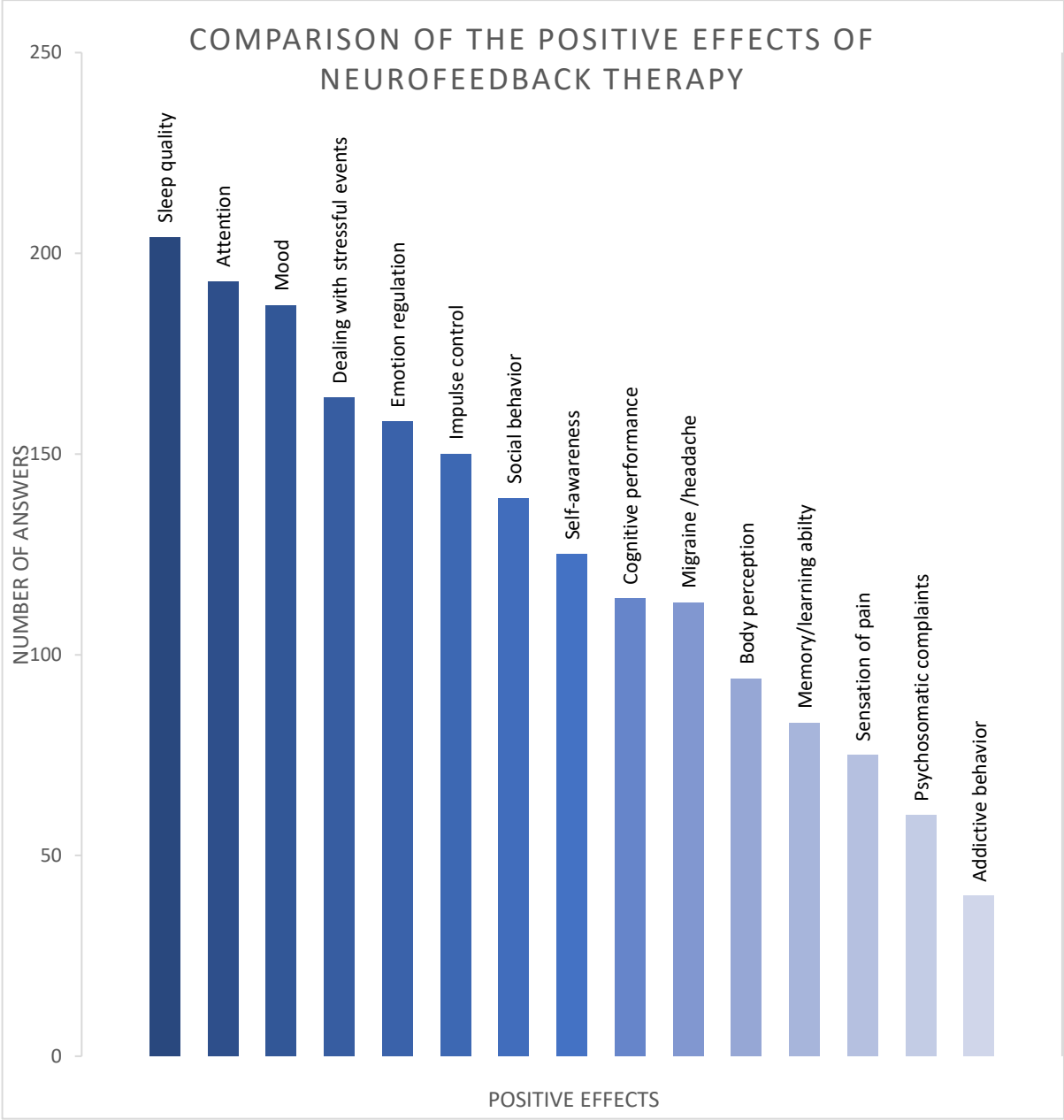


Figure 4: Positive Effects of neurofeedback therapy

The neurofeedback therapists also mention a number of possible undesired effects. Most frequently fatigue and headaches are pointed out, followed by restlessness, dizziness, nausea, drowsiness and sleep problems (see Fig. 5). Severe side effects such as post-traumatic complaints are rarely reported. As the Neurofeedback training is carried out by a trained therapist, there can be an immediate reaction on side effects during the training by changing the training parameters. This helps to avoid possible unwanted effects in the future.

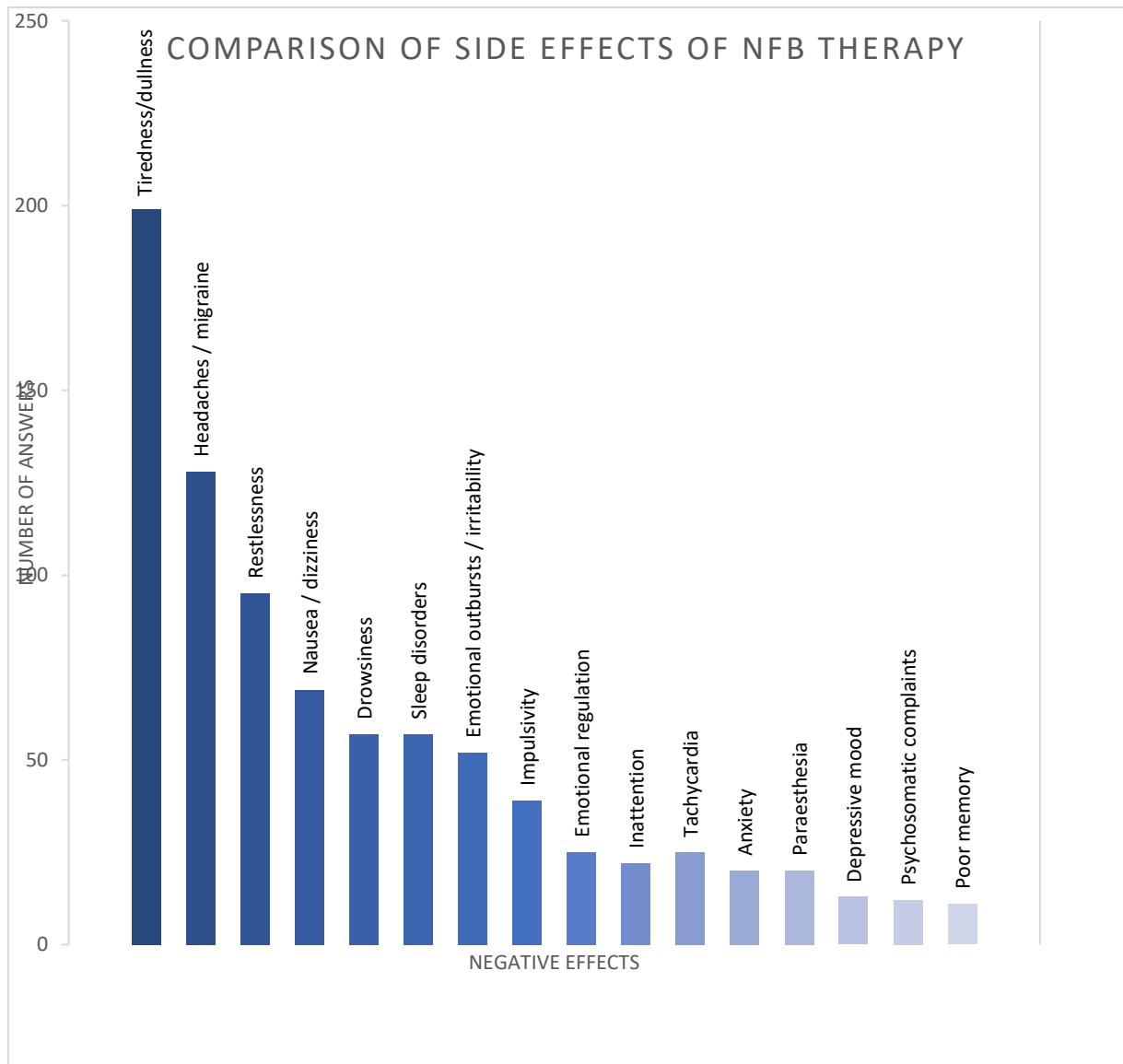


Figure 5: Side Effects of neurofeedback therapy

In conclusion, the therapists were asked for their assessment whether they consider neurofeedback to be an essential tool for the effective treatment of their patients. 85% of the 260 respondents agreed with this statement, 12% could not come to a conclusion. 3% (7 questionnaires) disagreed with the statement that neurofeedback is an effective treatment method. The therapists were also asked to subjectively assess the risk-benefit ratio of neurofeedback. 96% rated it as very good or good; no one rated it as critical; eleven participants rated it as average (see Fig. 6).

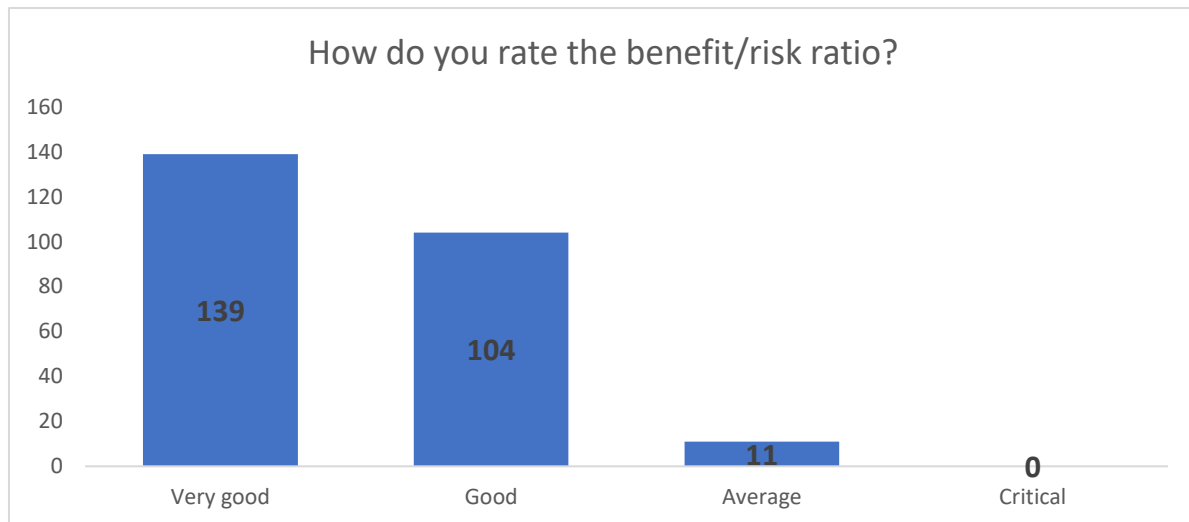


Figure 6: Depiction of the risk/benefit ratio through the eyes of the therapists

## 5. Discussion

Even if neurofeedback for ADHD is particularly well investigated and is also the most commonly treated indication, it seems that the use of neurofeedback in practice does not seem to be limited to children. The results rather show that adults from 18 to 65 are an important target group as well. Experienced neurofeedback therapists - in the majority occupational therapists - evaluate neurofeedback as an useful and effective tool. They also report positive effects, which outweigh the less frequently reported adverse effects as can be seen in the benefit-risk assessment.

Based on these results, adverse effects of therapy are an acceptable risk. Adverse effects should be typically resolve within minutes or at most subside over the course of minutes or, at most, hours when training parameters are adjusted. Typically, at least twenty sessions are necessary to achieve long-lasting effects [19]. 85% of the users rate Neurofeedback as an essential tool for an effective treatment of their patients. It shows that neurofeedback can contribute to a number of positive changes in the general condition of the patient. It should also be mentioned here that neurofeedback easily can be offered nonverbally and to patients with difficult introspection.

The applicability of neurofeedback as a therapeutic instrument was positively assessed by 91 %, which is remarkable considering the great variety of psychic diseases for which neurofeedback can be used with good effects. Among users, there seems to be a high subjective satisfaction with the efficacy of neurofeedback.

In the future, it would be important to compare neurofeedback with other commonly used therapy methods in order to be able to work out differences accurately. First results on this aspect in the treatment of AD(H)D indicate that the effects of neurofeedback are comparable to those of pharmacotherapy [5], [20]. In addition, more detailed studies are needed on indications for which neurofeedback is already frequently used, but the mechanisms of action are not yet fully understood, such as sleep- and anxiety disorders, depression, and migraine. There are already some studies on these disorders [12], [16], [21]. However, more data are needed to be able to make specific statements.

This work can only be seen as a first small step in order to raise awareness of the need for practical results to gain a broader understanding of neurofeedback and use this to enable a translation of

separated research results into a holistic patient care. The costs of brain diseases have a major impact on the health care system [22], so finding alternative ways to treat patients effectively should be a key aspect. Similarly, in the current societal discourse, there is an increasing call for non-medicinal treatment options is becoming increasingly louder. There is also the demand to treat the cause of the disease and not just its symptoms. According to the independent neurofeedback network, occupational therapists are the largest user group of neurofeedback in Germany. Occupational therapy is a discipline in which neurofeedback can even be billed in the frame of the available remedies that can be used as a treatment.

## 6. Summary

The aim of this non-interventional study was to collect practical data on the use of neurofeedback. In summary it can be said that - based on the results – neurofeedback seems to offer promising effects for practical therapeutic work. Based on a model of central dysregulation, neurofeedback can be used for a variety of indications and may be of interest as an alternative to standard (drug) treatments. Up to now, it have been a complementary treatment option – positively evaluated by therapists. Further research is needed to integrate neurofeedback even better. Occupational therapy as the largest application group to date, can play a play a major role.

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