

EEG monitoring and training as a new option to improve focus during tasks and performances in a competitive VUCA-World*

**VUCA is an acronym for “volatility” “uncertainty” “complexity” and “ambiguity”*

The world has never been more competitive and using new technologies and every trick in the book has never been more important. Drivers like digitization, globalization and the “new work” trend have put every individual on this planet in a more complex world like ever before. Some will have many aspects of their lives influenced by that, others only a few. Athletes, especially in digital fields like e-sports, compete with the rest of the world. Companies have competitors from all other countries, with quickly emerging disruptive start-ups shaking the foundations of the businesses they have been running for the last decades. Information is faster, margins are smaller, production cycles are shorter.

Another trend coming with this development: more and more work and daily tasks become cognitive with the success and quality being mainly influenced by the “brain performance” of the workers. The ability to focus and stay focused over longer periods of time is a crucial factor in this scenario. On a literal level, talking about the actual brain of a person, and on a figurative level, meaning the project management or the general strategy of a company.

Real Time Monitoring of Focus using EEG

The EEG (electro-encephalo-graphy) is a very reliable medical technology, measuring the electrical activity generated by brain cells while sending information to other brain cells. This is often also referred to as “brain waves”. The German physiologist and psychiatrist Hans Berger (1873–1941) recorded the first human EEG in 1924. Since then the electrical signature of the brain has been used mainly by neurologists to detect major interferences, for example caused by epilepsy, heavy intoxications or injuries. An EEG recording represents the functional image of the brain’s activity, so with more detailed algorithms to analyze these patterns, the received information exceeds the ability to diagnose only severe medical conditions.

Especially the level of focus, stress, relaxation and the presence of fatigue can be analyzed and monitored. The necessary hardware can vary from high-end medical devices to easy-to-use wearables. Electrodes are applied on the head in a pain free procedure and the data can be processed and either saved or visualized for an observer.

Neurofeedback - using EEG measurements combined with intuitive live feedback

A few decades ago, psychologists and doctors started to study the idea of turning the real time EEG data into a training tool for patients, trying to create a live feedback loop. The trainee is receiving the processed EEG data in an intuitive auditory or visual feedback, often gamified, for example displaying the current level of focus.

Learning theories like operant and classical conditioning, as well as sport science theories such as the supercompensation model can explain why this is efficient and can help people to

improve their levels of focus or attention and decrease stress and rumination. While the training effects, similar to physical training, will take several sessions to occur, the effect is considered to be persistent and linked to long term adaptations in the brain. The required number of sessions to achieve effects vary between individuals, based on prior mental training and the kind of training as well. A general range to identify the first significant effects for an average trainee seems to be around 5-10 hours of training spread over four to six weeks.

Application of neurofeedback

Since the first experiments, neurofeedback has become more popular, especially in the medical treatment of, amongst others, ADD/ADHD, depression, epilepsy and sleeping disorders. Several studies have shown, that neurofeedback training involving the so-called theta and beta brain waves can improve focus and attention, while reducing fatigue and stress. Hence, next to the medical field, athletes and executives have started to use neurofeedback trainings to improve their ability to focus, with no prior medical condition.

The neurofeedback solutions and trainings in this peak performance fields have different requirements compared to the medical field. Since the trainees are not medical patients in a doctors office, trying to solve a severe impairment of their health, the neurofeedback should be easily accessible, linked to a training program and, to put it simple, “more fun”. People might need more motivation to stay engaged, and since they don’t have a doctor reporting their progression, easy to understand dashboards and tracking of their training seems useful.

Building a turnkey neurofeedback concept is a challenge

The entire neurofeedback loop consists of different components, requiring interdisciplinary knowledge and collaboration. Recording of data, processing, analysis, visualization, gamification, training and tracking of progress link disciplines like engineering, data science, sport science and medical knowledge. Several EEG solutions trying to enter the market seem to be failing because they only deliver one link of this chain.

To generate customers, who at this point are mainly early adopters, and keep them engaged, a solution needs to be easy to use, appealing to younger people and finding the balance between gamification and self-optimization.

Current trends involving mental fitness

Looking at mental fitness and health, and neurofeedback as one significant tool in that field, the trend point clearly to the integration of this technology in daily live, indicating a growing market in the future. Some medical systems, for example Germany, have adopted

neurofeedback as a recommended treatment for ADD/ADHD, making it accessible in a curative way for people with medical conditions.

Furthermore, students with mild cases or just suspected ADD/ADHD often prefer neurofeedback to medication due to the non-existing negative side effects and the longterm improvements. Many parents are intrigued by the playful EEG-based skill training and try to avoid having to give daily medication to their children.


There even is a growing number of parents who send their kids to neurofeedback training to improve focus and reduce anxiety before tests without any existing medical diagnosis. This relates to the peak performance trainings involving neurofeedback applied by athletes to increase their levels of focus and motivation. Students with increased attention are also received positively by schools, which is why private schools seek cooperations with neurofeedback providers.

Another trend, which has also already started a few years ago, is the integration in preventive corporate health programs, often supported by health insurances. This means, that people who are possibly at risk, but not yet affected by mental health issues, will have access to neurofeedback. Subsequently, since used in a preventive way, people and companies currently try to adopt neurofeedback for performance enhancement, with the clear objective to improve, for example, the ability to focus of themselves or their employees.

In summary, these examples show the ongoing trend of neurofeedback entering the field of non-medical applications to improve the general mental performance and well-being.

Conclusion

Having this trend in mind, the aforementioned requirements of a neurofeedback system outline a concept with a high product market fit in a growing market, B2B as well as B2C. Since user experience and engagement paired with a well working technical solution are key features, companies with prior experience in the field of neurofeedback will most likely have the advantage in conquering this market. The most extensive research has been done trying to improve the level of focus and the ability to relax and reduce stress. These should be the first “non-medical” applications to offer neurofeedback to a healthy target group. A tailored solution with a clearly defined narrow target group will most likely be the right way to enter the market.



Philipp Heiler, M.D.

About the author

Philipp Heiler is a Munich (Germany) based medical doctor running a practice specialized in bio- and neurofeedback as well as CEO and co-founder of the company brainboost which is focused on neuroscientific leadership trainings, neurofeedback classes for practitioners and software development, especially therapeutic games and data analytics.

Philipp is guest author for online and offline publishers, writing about neurofeedback, mental fitness and mental health, always working closely with several universities in Germany (TU Munich, LMU in Munich, Universities of Würzburg and Heilbronn). In 2019, he joined the Interactive Producline IP AB advisory board after learning about the overlapping mission to make neurofeedback accessible for more people in the non-medical field.

Sources

Cheng, M. Y., Wang, K. P., Hung, C. L., Tu, Y. L., Huang, C. J., Koester, D., ... & Hung, T. M. (2017). Higher power of sensorimotor rhythm is associated with better performance in skilled air-pistol shooters. *Psychology of Sport and Exercise*, 32, 47-53.

Elvebredd, P. M. S. (2014). *Optimizing Performance in Psychology Students-Neurofeedback as a performance enhancing tool* (Master's thesis, NTNU).

Mikicin, M. (2015). The autotelic involvement of attention induced by EEG neurofeedback training improves the performance of an athlete's mind. *Biomedical Human Kinetics*, 7(1).

Pacheco, N. C. (2016). Neurofeedback for peak performance training. *Journal of Mental Health Counseling*, 38(2), 116-123.

Pop-Jordanova, N., & Demerdzieva, A. (2010). Biofeedback training for peak performance in sport-case study. *Macedonian journal of medical sciences*, 3(2), 113-118.