An individually adaptable, BNCI-based, remote controlled COgnitive eNhancement TRAining for successful rehabilitation after STroke including home support and monitoring

CONTRAST will deliver a comprehensive cognitive rehabilitation tool, **COALA**, which can be used in the sub-acute rehabilitation phase as well as at the patients' home. The resulting end product will be highly innovative by making use of neurofeedback and allowing for remote controlled data processing and monitoring of important health parameters.

Objectives of the Project

Millions of people live with the consequences of stroke, which often include cognitive impairments. Unfortunately, there is a considerable gap between clinical and home care after stroke.

CONTRAST will bridge this gap between clinical rehabilitation and care, and patient monitoring and support at home by developing an easy-to-use auto-adaptive rehabilitation tool. The overall goal is to deliver a comprehensive product, called COALA, which can be used in the sub-acute rehabilitation phase as well as at the patients' home, thereby supporting the patients to achieve an independent, socially integrated living.

> Bridge the gap between clinical and home care for patients after stroke

CONTRAST addresses this challenge by employing a battery of established and novel methods to engage not just scientific and industrial professionals but also end users, carers, relevant professionals, and the public at large. In detail, CONTRAST will:

- Include a **standardised neuropsychological diagnosis** on which shared decision making between doctors and patients can be built.
- Develop highly **engaging training modules** for the improvement of general and specific cognitive functions using neurofeedback.
- Address **mood disturbances** and alertness with HRV (heart rate variability) biofeedback training;
- Provide **home support** and **tele-monitoring** of important health and performance parameters.
- Accompany the developmental process of the product with thorough **evaluation** and broad **dissemination**.

Clinical Picture

Depending on the extent of neuroanatomical lesions and functional loss, post-stroke patients often experience severe cognitive deficits and motor impairments. Both aspects may increase dependence on others, promoting feelings of lost autonomy and helplessness, which often accelerate the development of depression. It is thus evident that improving daily functioning after stroke, which includes the improvement of cognitive function and monitoring health and social parameters, is a timely and critical challenge.
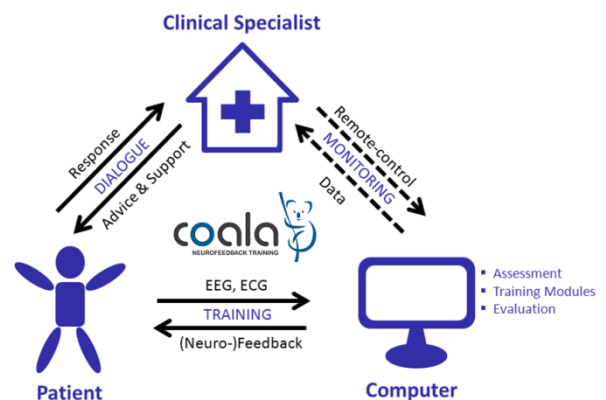
Project Description

The major objectives of the CONTRAST project are as follows:

Diagnosis. CONTRAST will provide an algorithm that helps the expert and patient to make sound decisions on which training modules should be used. The individually tailored interventions will be based on neuropsychological, psychological and medical assessments.

Neurofeedback-Based Training Modules. Embedded in a highly attractive and user-friendly virtual environment the patient will receive feedback about the activity in distinct brain areas measured via EEG. By making use of neurofeedback the cognitive function of interest is targeted directly in the brain. Developing an easy to use semi-dry EEG headset (comparable to headphones) will also be an objective within the CONTRAST project.

> Cognitive functioning is targeted directly in the brain

Mood Disturbances. In addition to the improvement of cognitive functions, affective states are also important targets of the training modules. The reasoning behind is that depression is frequent in post-stroke patients and hampers executive functions, and functioning in daily life. By integrating HRV biofeedback this challenge will be addressed.

Home Support and Monitoring. In order to create a product suitable for home use CONTRAST will provide remote-control and tele-monitoring of important health and performance parameters. These features will be embedded in a HCI (human-computer interface / interaction) architecture that processes and integrates data acquired at the patient's home from multiple sources.

Evaluation and Dissemination. The development of the product will be based on interactive feedback loops between patients, professionals and developers to ensure the best practical outcome. Also a test battery for measuring outcome at the behavioural (neuropsychological tests, activity measures, quality of life) and physiological level (heart rate variability, EEG parameters) will be composed. Additional dissemination efforts, including hosting two workshops and dissemination through publications and major events, will ensure participation of key stakeholders.

> Feedback loops to ensure the best practical outcome

Additional challenge: As an additional challenge CONTRAST will explore the benefits of using virtual realities within the rehabilitation field.

Expected Results & Impacts

From a clinical point of view: CONTRAST's approach to rehabilitation considers the patient as partner and fosters empowerment. The deficiency in current approaches, e.g. the huge gap between clinical and home rehabilitation, will be addressed by CONTRAST. The shared doctor-patient support system will synergize with the well-designed and user-friendly new HCI to motivate patients to remain compliant and engage with doctors, caregivers, and other key people. CONTRAST targets to increase autonomy in daily living of a person after stroke thereby improving quality of life.

> Reduce in-patient rehabilitation time and lead to a better outcome

From a social point of view: Europe's aging societies lead to an increasing social and financial burden for young generations. Highly effective and economical approaches in rehabilitation are therefore mandatory. By potentially reducing the in-patient rehabilitation time and leading to a better cognitive and emotional outcome for the patient and the social environment CONTRAST will reduce life time costs for people after stroke. At the same time, CONTRAST will make an effort to motivate and socially include people affected by stroke.

> Increase autonomy in daily life

From a business perspective: COALA clearly has the potential to surpass existing systems for neuropsychological rehabilitation. The resulting product will be unique for combining neurofeedback with tele-monitoring, and being highly adaptable to the individual. It will be portable and positioned in the low-cost sector, therefore perfect for home use. In addition, CONTRAST will make an effort to ensure broad dissemination and exploitation of COALA. For being highly attractive to a broad and even growing market the resulting product will presumably be easy to market.

> Highly attractive to a broad and growing market

From a scientific point of view: CONTRAST's numerous multimodal research efforts will gain important insights in the brain mechanisms and benefits of diverse training modules (embedding EEG-signals and HRV), remote-controlled systems, and virtual realities in the context of stroke rehabilitation. The CONTRAST project might turn out to make a significant contribution to Europe's quest for a leadership position in the rapidly growing field of BNCI (Brain/Neuronal Computer Interaction).

> Gain important insights in the benefits of BNCI in stroke rehabilitation

CONTRAST

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Project co-ordinator:
Julius-Maximilians-Universität Würzburg (Germany)

Contact person:
Prof. Dr. Andrea Kübler
Tel: + 49 931 31-80179
Fax: +49 931 31-87059
Email: andrea.kuebler@uni-wuerzburg.de
Website: www.i1.psychologie.uni-wuerzburg.de/int/home/

Partners:
- Julius-Maximilians-Universität Würzburg (Germany)
- University of Graz (Austria)
- Fondazione Santa Lucia IRCCS (Italy)
- Université du Luxembourg (Luxemburg)
- T-Systems ITC Iberia SA (Spain)
- Mind Media BV(Netherlands)
- Hasomed GmbH (Germany)

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Adaptive BNCI, Neurofeedback, Cognitive function, Monitoring of health parameters, Remote control and supervision, Shared decision making