





Discover our unique virtual reality medical device designed to work effectively with patients suffering from brain injuries in SSR clinics and rehabilitation centers.

Our virtual reality solutions have been developed to meet the needs of healthcare facilities treating individuals with brain injuries or cognitive disorders. They are aimed at your entire medical team, depending on the medical project's focus for each patient: psychologist, neuropsychologist, occupational therapist, physiotherapist, nutritionist, addiction specialist.

All our software programs are recognized as Class 1 Medical Devices. We also guarantee the highest level of data protection by hosting our solutions with an Accredited Health Data Provider (HADS).





## VIRTUAL REALITY IN SERVICE OF REHABILITATION

For a long time, health was defined as the absence of disease. This concept led to a medical approach focused exclusively on symptom elimination.

Since 1946, the WHO has considered health as «a state of complete physical, mental, and social well-being, and not merely the absence of disease or infirmity.» Based on this principle, medical practice has evolved toward a more holistic patient care, integrating notions of well-being and quality of life.

Brain injuries, regardless of their cause (trauma, strokes, inflammation, tumors, substance abuse, etc.), often result in serious and disabling consequences. Strokes are the leading cause of acquired disability in adults in France, while traumatic brain injuries are the leading cause of severe disability in adults under 45 years old. Furthermore, multiple sclerosis is the leading cause of non-traumatic disability in young adults.

The consequences of brain injuries vary significantly depending on the case, including:

- Physical disorders: motor, praxic, balance, sensory, etc.
- Cognitive disorders: deficits in executive functions, language, memory, attention...
- Behavioral disorders: apathy, disinhibition..
- Psycho-affective disorders: anxiety-depressive symptoms, anhedonia...

Since 2015, C2Care has been dedicated to harnessing the possibilities offered by Virtual Reality for well-being and health. After developing virtual reality therapeutic programs for mental health, particularly for Virtual Reality Exposure Therapy (VRET), we now offer solutions for rehabilitation and readaptation within a comprehensive care framework.



## VIRTUAL REALITY AND REHABILITATION: FEASIBILITY AND EFFECTIVENESS, THE SCIENCE PERSPECTIVE

Rehabilitation professionals often face the lack of ecological validity in the tools available in clinical neuropsychology. Sometimes, patients with everyday life problems show non-pathological results in tests, as neuropsychological examinations are generally conducted in calm, distraction-free environments (Manchester et al., 2004).

This issue also arises in remediation, as although ecological tasks exist, they are costly in terms of time and human resources, and potentially risky for the patient.

The medical application of VR environments offers immersion in situations where it is possible to work on specific cognitive functions or a set of cognitive functions through ecological tasks (Renison et al., 2012). Working in virtual reality allows for

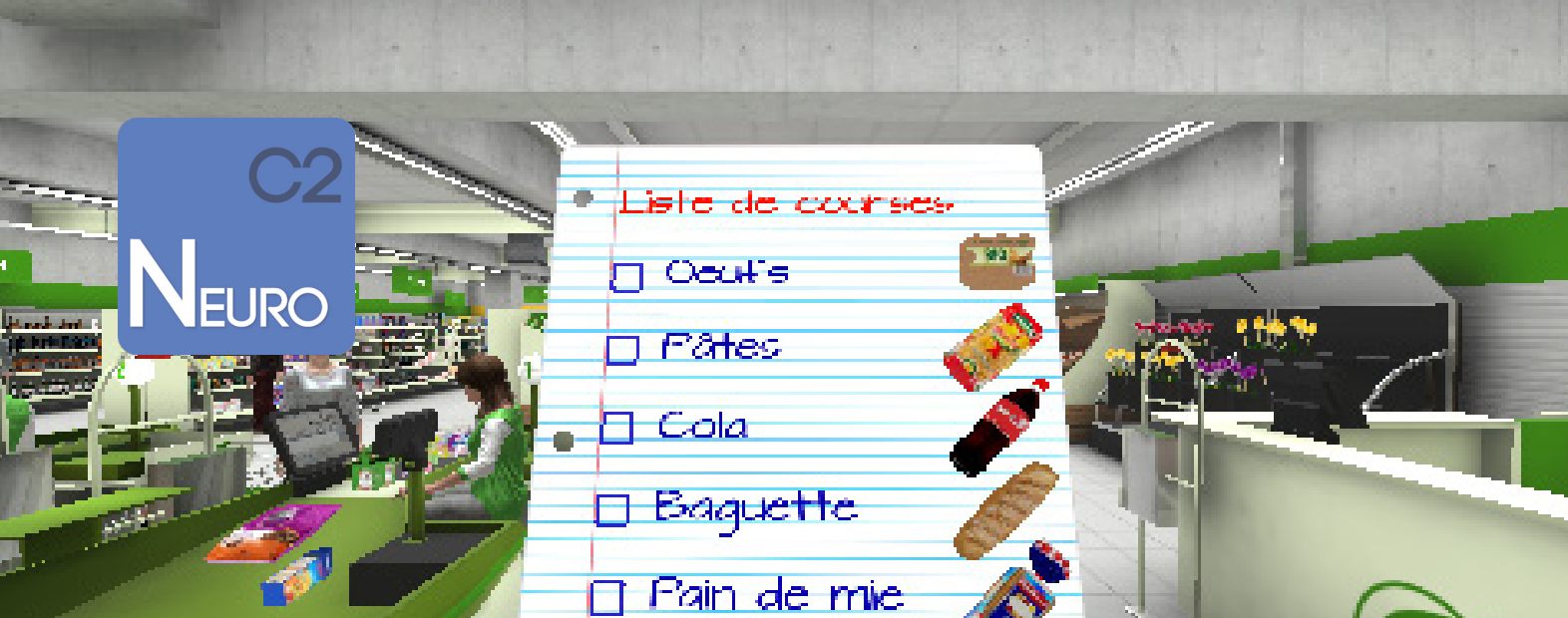
full control of stimuli and responses, enabling the difficulty of exercises to be adapted to the patient's abilities. There is also better skill transfer to everyday life compared to paper-and-pencil exercises (Schultheis & Rizzo, 2001). Additionally, this solution is cost-effective in terms of time and staff, while ensuring the patient's total safety.

Numerous studies have demonstrated the effectiveness of Virtual Reality Remediation in various populations:

- Stroke (Laver et al., 2011, Massetti et al., 2018)
- Traumatic Brain Injury (Alashram et al., 2019, Maggio et al., 2019)
- Mild Cognitive Impairment (Moreno et al., 2019)
- Alzheimer's Disease (Moreno et al., 2019)
- Other Neurological Conditions: Cerebral Palsy, Spinal Cord Injury (Masseti et al., 2018)
- Schizophrenia (Brun et al., 2017)







“ Virtual reality allows for working on the integrated aspects of disorders, as it enables both the evaluation of cognitive and sensory behaviors.

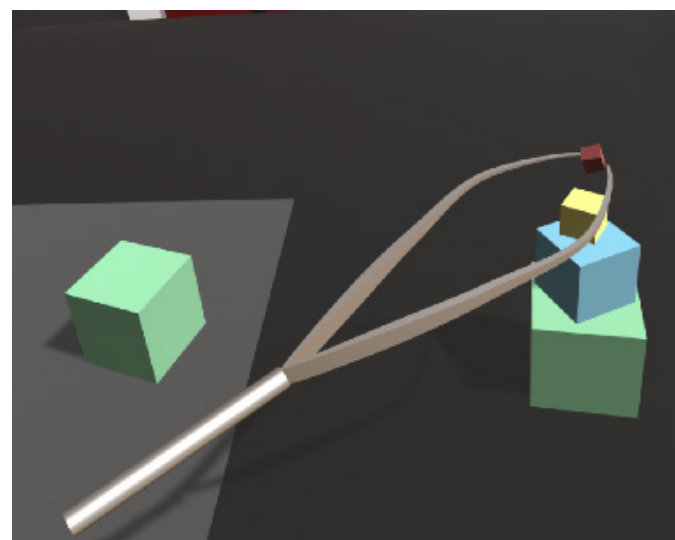
- Viaud-Delmon (2007)

”

C2Neuro is a suite of virtual, ecological, and fully interactive environments, completely adapted and usable at any stage of the rehabilitation process for individuals with brain injuries. It includes various simulations of everyday situations, such as the ability to realistically shop in a virtual supermarket. The evaluation and rehabilitation of instrumental activities of daily living (IADLs) is a crucial element for the reintegration of people with brain injuries.

In fact, shopping in a supermarket involves many functions, such as executive functions, working memory, orientation, and spatial navigation. It is an essential skill for living independently. Unfortunately, it is often difficult to evaluate and train. The use of C2Neuro allows for a method of cognitive assessment and remediation in an ecological environment, cost-effective in terms of personal time, while guaranteeing the patient's total safety (Schulteiss & Rizzo, 2001).

C2Neuro can also be used to work on motor and praxic functions. This is the case in the supermarket when the patient needs to pick up items or place them in their cart. These are, again, everyday activities that cannot be avoided. Two other environments are also available. The “Thumb-Index Grasp” environment focuses on fine motor skills, a central element in rehabilitation. The “Learning” environment is a tutorial to ensure proper software handling. Additionally, it serves as an interesting exercise that can be done independently or semi-independently to evaluate the patient's progress.



“ Virtual reality was quickly adopted in the field of motor rehabilitation, providing participants with repetitive practice, performance feedback, and enhanced motivation.

- Holden (2005) ; Weiss et al. (2004)

”

C2Motion addresses motor and praxic disorders that can arise as a result of brain injuries. The use of virtual reality increases patients' motivation and involvement in rehabilitation. With real-time feedback, patients can correct their movements at any time to reach their goals, optimizing their rehabilitation.

C2Motion can be used for the evaluation and rehabilitation of functional mobility. The software allows for a fast and accurate quantitative assessment of joint range of motion.

The proposed exercises focus on increasing joint mobility, tracking and precision of movements to improve fine motor control, and maintaining positions to increase patients' strength and endurance. In orthopedics, it is possible to start the rehabilitation of an immobilized limb as early as possible or alleviate phantom limb pain.

Brain injuries often cause body schema and proprioception disorders. C2Motion allows for the evaluation of the patient's sense of position through a quick and precise quantification of positional error.







“ Participants perceived a clear improvement in their symptoms in daily life.

– Navarro-Haro et al. (2019) ”

For many people, the use of a car is a symbol of autonomy, freedom, and quality of life. However, driving is a complex activity that involves many cognitive and sensorimotor functions. Therefore, driving abilities are often affected after a brain injury (Lundqvist et al., 1997, 2000). However, many patients resume driving without being tested, which can endanger not only the patient but also other road users (Fisk et al., 1998). It is the responsibility of health and rehabilitation professionals to assess the level of risk and the ability to drive safely. Nonetheless, this task is particularly challenging, as neuropsychological tests do not satisfactorily assess driving skills (Gagnon, 2010). Ortoleva and collaborators showed in 2012 that in the absence of a valid neuropsychological predictor, evaluation in a driving simulator was useful. Used with a steering wheel and pedals, C2Drive allows for realistic driving simulation, enabling an ecological assessment of the ability to resume driving.

For patients suffering from post-traumatic stress disorder (PTSD) following a car accident, it can also be used for exposure therapy or bilateral alternating stimulation. In 2010, a meta-analysis by Wiederhold and collaborators showed that virtual reality exposure helped reduce symptoms in patients with PTSD following a car accident.

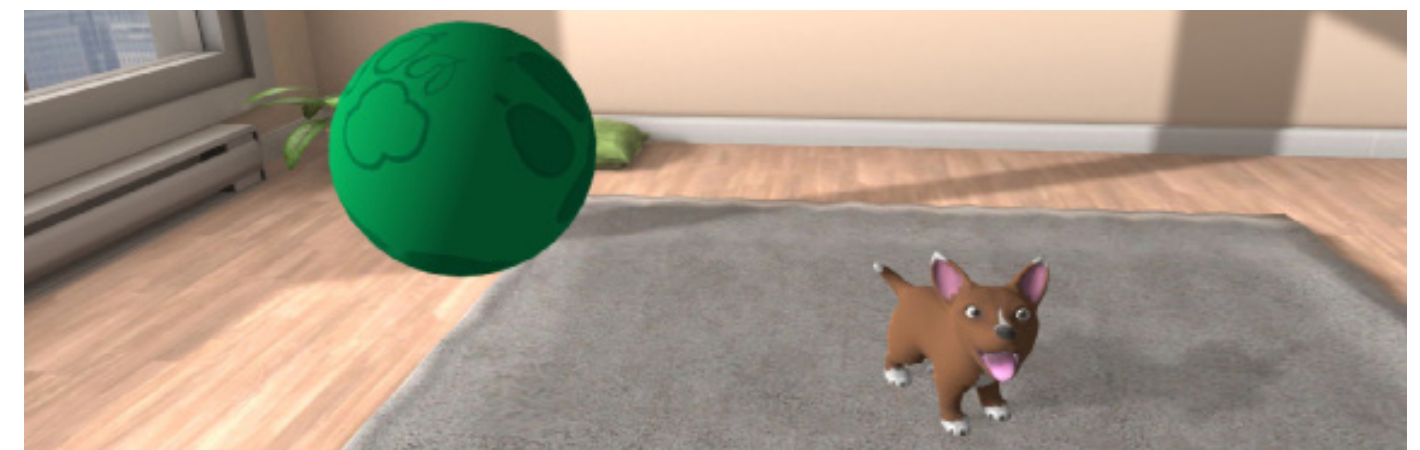


“ Intermittent interaction with puppies reduces depressive symptoms in patients.

– Barker SB, Dawson KS ”

C2Companion allows patients to care for a small virtual dog. Animal-assisted therapy improves the recovery process and quality of life in patients (Yeh, 2005). Libin and Cohen-Mansfield demonstrated in 2004 that the use of robotic and plush cats generated interest and pleasure among nursing home residents. When the presence of a real animal is not possible, C2Companion helps manage anxiety-depressive symptoms through the benefits of animal-assisted therapy.

Controlled by head movements, the environment is accessible to patients with motor or praxic disorders and can be used as entertainment or an activity during care. The social aspect of animal care makes this application an ideal tool to create a bond between patient and caregiver, or for group mediation (Siriaraaya et al., 2014).







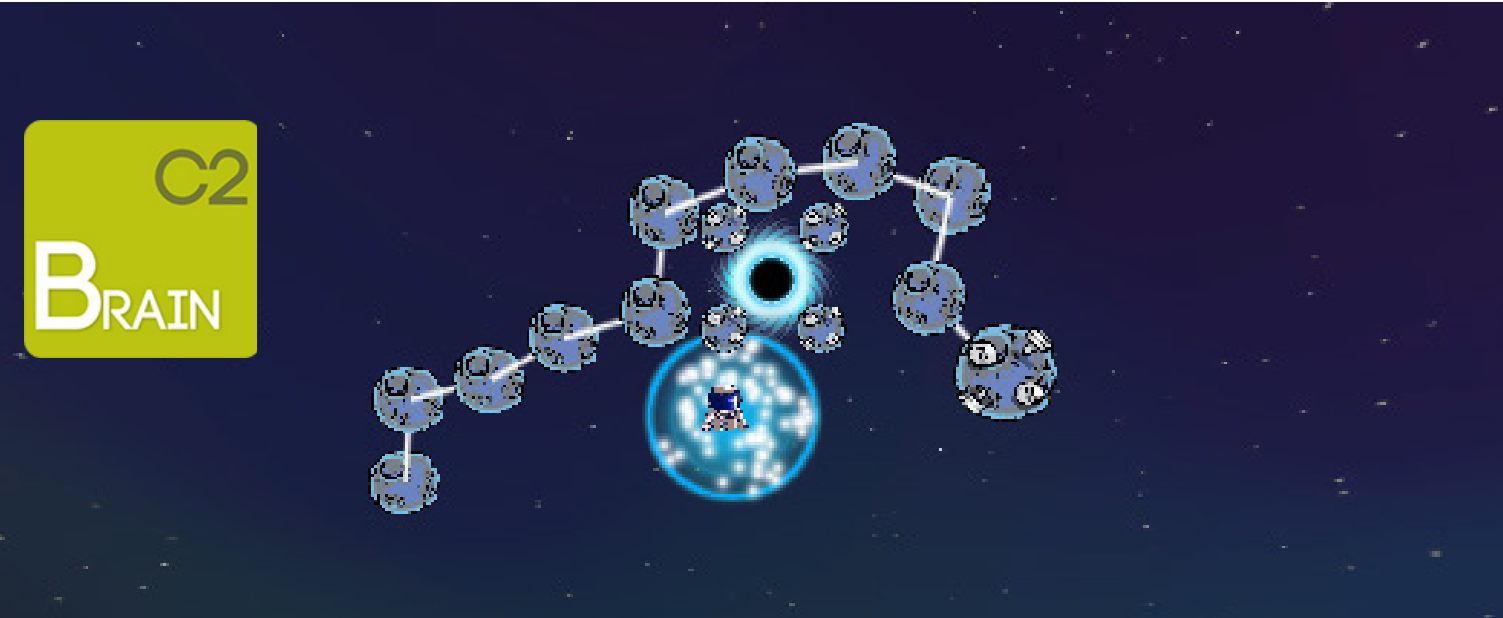
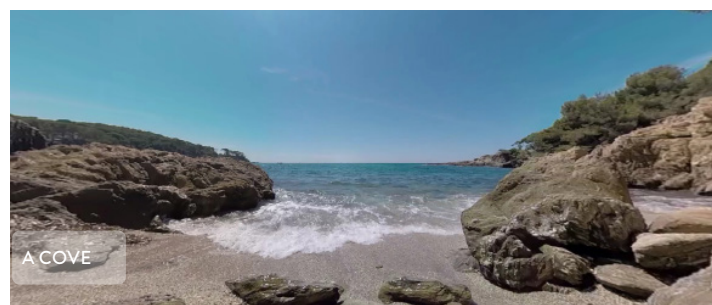
“ The use of virtual reality in mindfulness groups offers better therapeutic engagement. ”

- Navarro-Haro et al. (2019)

Designed in collaboration with specialists in relaxation and hypnosis (psychologists, hypnotherapists, sophrologists), C2Hypno enables the management of anxiety-depressive symptoms as well as pain. The different environments adapt to all relaxation techniques (cardiac coherence, autogenic training, Jacobson's technique, mindfulness, hypnosis...) and can also be complemented with other methods such as aromatherapy or massage therapy.

A literature review by Zeng and collaborators, published in 2018, showed that virtual reality has beneficial effects on depressive and anxiety symptoms without negative effects. In 2007, a study by Hoffman and collaborators demonstrated that the use of virtual reality significantly reduced pain (both physiological and subjective pain markers).

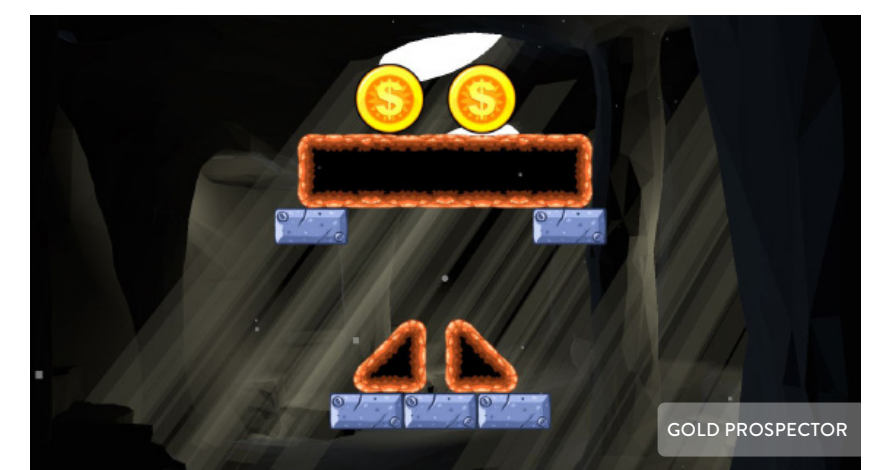
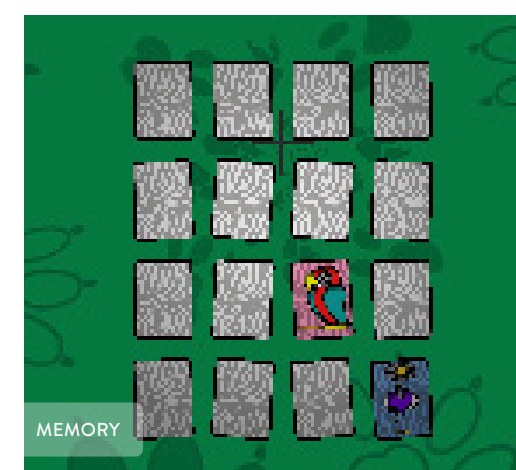
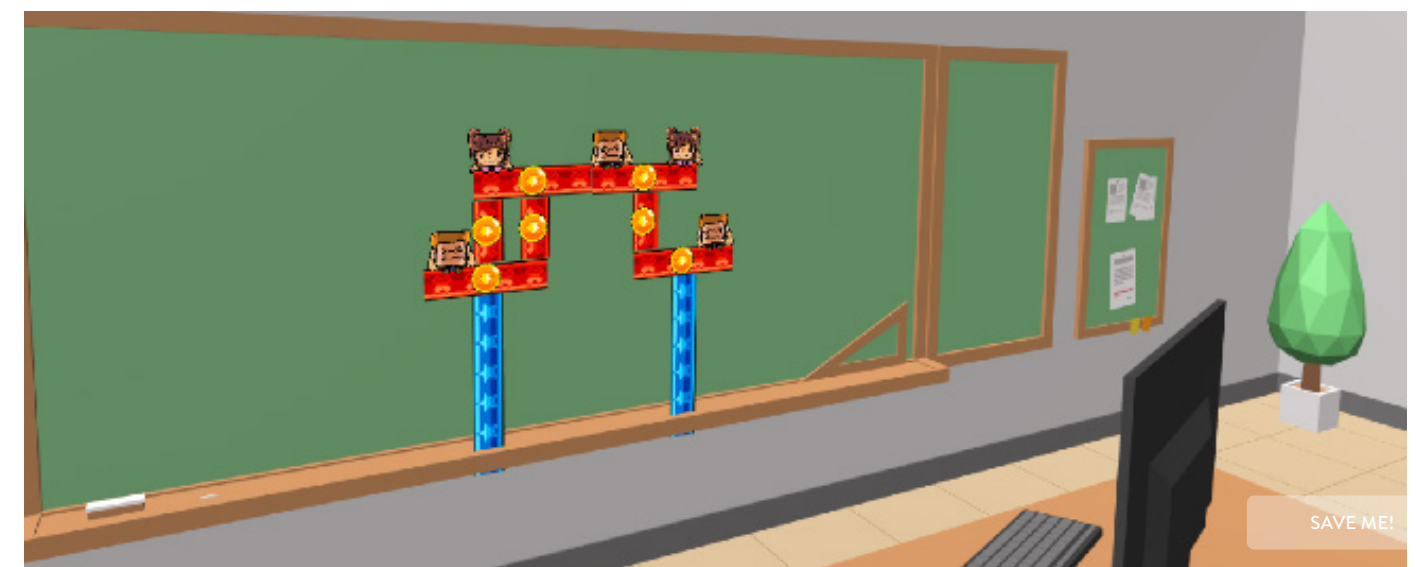
C2Hypno can be used occasionally for painful treatments or as a long-term therapy for managing chronic pain. For patients who are no longer able to travel, it also offers opportunities for escape...



“ Virtual reality technologies offer new ways to assess and rehabilitate cognitive functions. ”

- Kinger (2006)

C2Brain is a software designed for cognitive training, intended to be used in a simple and playful manner in virtual reality. Several of its cognitive training modules, conceptualized as stimulating games, are available. We developed this application with sensory and motor difficulties in mind. The C2Brain software, accessible and easy to use, provides the opportunity to stimulate patients' cognitive functioning through an innovative and motivating tool. Immersion will become a key asset for your cognitive stimulation workshops and sessions.





C2Care

Ilôt Les Picôtières  
101 Avenue Desmazes  
83110, Sanary-Sur-Mer

[www.c2.care](http://www.c2.care)

+33 (0)4 83 57 51 58