PANEL #1

NICE
June 2023

ComputationWorld 2023 & DataSys 2023

Theme:

The Brain and the Immersive Environments

Themes

- Virtual vs real environments
- Immersion
- Brain-related activities
- Thinking bias
- Human Perception
- Brain-environments interfaces
- Brain adaptation

Moderator Position

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Ricardo Ron-Angevin

- Virtual environments offer the advantage of unlimited possibilities and the ability to create experiences that are otherwise impossible in the real world.
- It is crucial to consider potential risks and side effects associated with prolonged use of immersive technologies, such as cybersickness, eye strain, or the potential impact on mental health
- Immersive environments have diverse applications, including education, therapy, and entertainment

CONTRIBUTORS

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Moderator

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Panelists

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Panelist Position

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Aurélie Mailloux

Immersive environments benefits applied to healthcare field

Practitioners training => *improving knowledge, skills and behaviors* Strong evidence

Patients care => *reducing pain, anxiety, medication* Strong evidence

Risks for the health [French Agency Report ANSES (June 2021)]

Cyberkinetosis Strong evidence

Sensory-motor coordination Strong evidence

Psychological and psychosocial effects Low-level evidence

Self-representation (through avatars) Low-level evidence

Effects related to physical agents emitted by virtual reality devices Strong evidence

Neurological effects No studies

Brain development No longitudinal studies

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- In the healthcare domain, several devices integrating immersive environments have been developed. Some are dedicated to practitioners training (acquisition of knowledge, mastering of gesture) and others dedicated to patient care (to relax, to reduce pain and to decrease the use of analgesics or anesthesia).

- A collective expert evaluation conducted by the French sanitary security agency in 2021 (https://www.anses.fr/fr/system/files/AP2017SA0076Ra.pdf) considered the adverse effects on general health of immersive environments based, among others,
- on published data (articles, reports, etc.):

- Cyberkinetosis is characterized by nausea, headache, general discomfort, several physiological effects. This phenomenon affects as much as 50% of users, depending on individual parameters, on the content or on visual field. The symptoms increase with the time of exposure but decrease when sessions are repeated to reduce the risks, users should avoid visualization of rapid, multidimensional movements and avoid head-mounted displays. The use of breathing techniques or fragrances in the real environment could also reduce the symptom.

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- Concerning the physical agents :
  First, no health effects have been identified at low level of electromagnetic fields.
  Second, there is strong evidence concerning the negative effects of blue light on the circadian rhythms and on the quality of sleep.
- There is also a strong evidence that the important light modulation leads to epileptic seizures (depending on the typology) the effects on the brain development remains unknown, but the report raised the question of what would be the consequences on the general development when immersive environments are used during childhood

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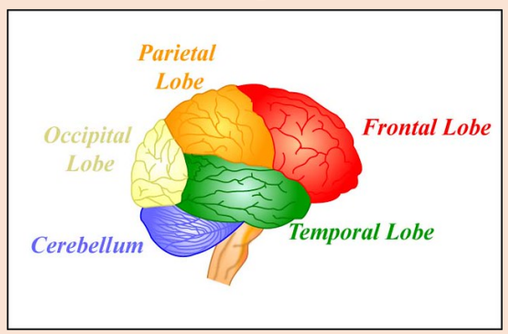
Manuel Caro

Brain

Leveraging the brain's metacognitive processes in immersive environments can enhance the overall learning experience and metacognitive development.

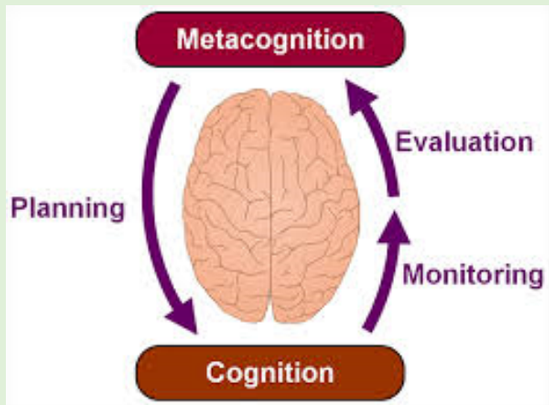
The frontal lobes have been reported to play in important role in metacognition.



Immediate feedback in immersive environments facilitates self-assessment and adjustment in metacognition.

Metacognition

Metacognition involves thinking about and regulating one's own thinking processes.



Through prompting reflection, evaluation, and alternative strategy consideration, immersive environments enhance metacognitive processes.

Immersive Environments

Immersive environments engage the brain's metacognitive functions, promoting self-awareness, self-regulation, and independent learning skills.

The integration of metacognitive instruction and support in immersive environments is crucial for effective outcomes.

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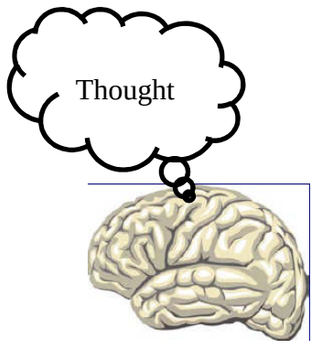
- Use of virtual reality techniques in Brain-Computer Interface

"A Brain-Computer Interface is a communication system that does not depend on the brain´s normal output pathways of peripheral nerves and muscles "

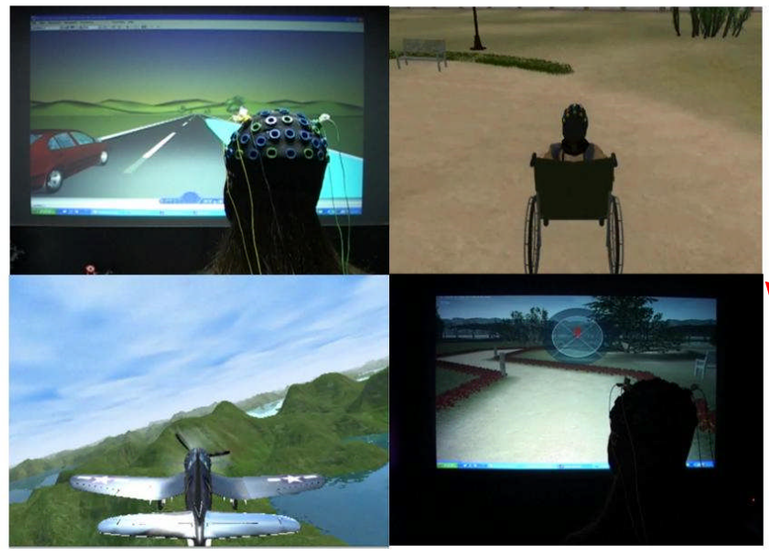


Brain Signal (EEG)

BCI

Contro Signal

Training techniques



Virtual games

Training in safe environments

Ricardo Ron-Angevin

A BCI system translates brain activities into output commands without carring out any movements.

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Reflection #1

What about alteration of senses when repeatably using immersion environments.

Are there recommended limitations of abusive usage, to avoid unintended side effects, short-long term or permanent-temporary health side effects on feelings/cognition?

Reflection #2

As immersion means extra devices, electric fields, wireless, are there studies on how the immersive technologies affect the brain?

Disclaimer: I have this Q and no answers from ~ 1999, when there was a lot of wireless-related Canadian research I was involved in.

By that time, there were a lot of controversies, conflicting measurements, but... wireless business prevailed.

Is metaverse on the same path?

With home automation and immersive environments is the silence around the issue assuming (i) *a tacit acceptance*, (ii) a *certitude that there are 'no bad side-effects*', or (iii) *simply there are others major things to deal with*?

Petre Dini
IARIA

Reflection #3 (Case study)

Is Bluetooth better than wireless in terms of brain damage?

Some websites still claim that Bluetooth can be dangerous and lead to disastrous consequences to human health.

? Bluetooth waves do not travel very far. In fact, most Bluetooth devices typically have a maximum connectivity range of only 30 feet. Bluetooth waves typically switch frequencies to combat interference and fading (changes: amplitude and/or phase over time and space) . However, it operates within a frequency range of 2.402 to 2.480 gigahertz. This occurs in the same wavelength as the frequencies used by microwaves, Wi-Fi, and mobile phones.

https://www.headphonesty.com/2021/06/is-bluetooth-safe/

On the electromagnetic spectrum

Waves of the electromagnetic field carry electromagnetic radiant energy: radio waves, microwaves, infrared, visible light, ultraviolet light, X-rays, and gamma rays.

EMR can be classified as ionizing EMR or non-ionizing EMR, depending on the strength of the emitted radiation

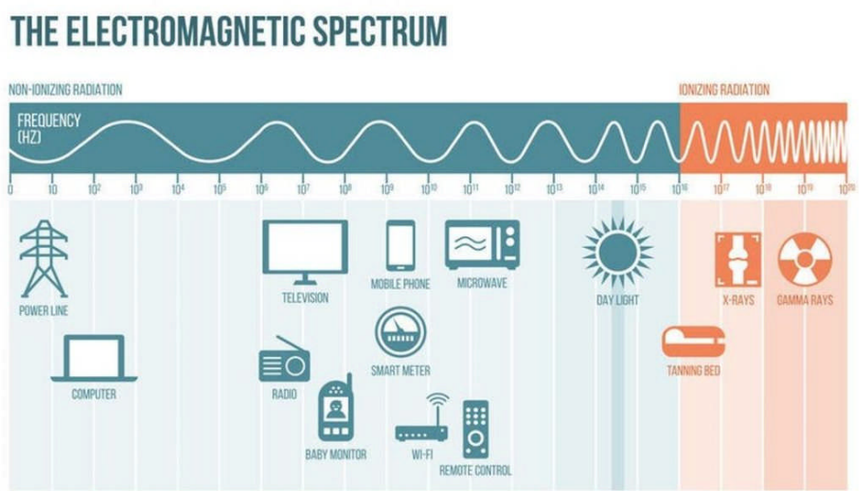
Ionizing EMR

'Ionizing EMR' refers to high-energy radiation which have shorter wavelengths and higher frequency waves. These can be found at the far-right of the electromagnetic spectrum, which includes X rays and gamma rays.

High levels of ionizing EMR passing through the body can alter our cell structure well enough to eventually cause cancer.

Non-Ionizing EMR

These are radiation with longer wavelengths and lower frequencies, normally found at the left side of the spectrum. Unlike ionizing EMR, non-ionizing EMR do not have enough energy to ionize an atom and change its charge.



Since it is a kind of non-ionizing EMR, Bluetooth is generally safe for humans, and will not affect our health.

Bluetooth has relatively low specific absorption rate (SAR) levels, further proving that it is not dangerous to humans.

> SAR refers to the rate at which the human body absorbs energy per unit mass, upon exposure to radiofrequency (RF) electromagnetic field. In different areas of the world, manufacturers of devices that emit radiation are required to comply with specific SAR levels. This ensures they are safe for human use.

> In the United States, the Federal Communication Commission (FCC) requires a SAR level of 1.6 watts per kilogram (W/kg) or lower for phones. In the European Union, meanwhile, phones and handheld devices have a SAR limit of 2 W/kg.

> These are levels deemed safe for humans. However, with Bluetooth devices, SAR levels can be much lower.

> FACTs: Bluetooth devices have a power density 10 to 400 times lower than those of mobile phones.

https://www.headphonesty.com/2021/06/is-bluetooth-safe/

Reflection #4: How is the implicit elasticity on interpreting the relative sense of notions altered by immersive environments, e.g., 'far' with respect to the distance?

(+)

Immersive environments might enhance depth perception cues (stereoscopic vision, motion parallax, and convergence)

Immersive environments might enhance cognitive engagement and attention, which can influence our perception of distance; a virtual environment might help building spatial relationships and an accurate interpretation of distance.

Useful applications in training (pilots, drivers, etc.) and patient treatments (inducing well-being status)

(-)

Simulate realistic visuals, sounds, and haptic feedback, might create a stronger sense of presence (fake presence; see dreams!)

Immersive environments can manipulate the perceived scale of time/distance; this might alter human implicit elasticity on the preconceived notions of what constitutes a certain distance/time

Physical health risks: motion sickness, dizziness, eyestrain, or nausea

Dependency and addiction: unhealthy attachment, detrimental for uncontrolled waste of time

Ethical aspects: privacy, consent, and data security; potential misuse of personal information

Troubled reality: neglecting real-life obligations, relationships, family tasks

Psychological effects: intense or distressing experiences; emotional reactions or psychological discomfort: anxiety, fear, or stress.

Responsible use of immersive technologies is advised!

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Lodewijk Arntzen

- Humans should be most of their time in interaction with the real world
- Digital Immersive Environments helpfull while training interaction with real-world
- Digital Immersive Environments Support Development of New Creative Tools
- Lots of Opportunities in Applications for Learning Environments (Education)
- Helpful in Maintaining and Establishing Social Connections (learning)
- Digital Immersive Environments could aid in several other ways, such as
- Training Medical Operations at a distance
- Training (fast response training) making use of games
- Removing Unwanted Stimuli (Adaptations for Autism Compatible Applications)

Output highlights

- Further studies should be conducted on this subject
- Designers should be aware of these risks to adapt immersive environments
- End-users should be informed on the potential and identified risks for their health
- A Citizen Awareness and Protection Center might be useful
- Virtual environments can provide highly immersive experiences that engage multiple senses, leading to a sense of presence and suspension of disbelief.
- Immersive technologies like VR and AR can create a strong sense of presence by stimulating the brain's visual, auditory, and sometimes haptic systems.
- The future of immersive technologies holds exciting possibilities.
- Advancements in areas like haptic feedback, eye-tracking, and brain-computer interfaces could further enhance the realism and interactivity of immersive experiences.
- Immersive environments provide highly engaging and realistic learning experiences, capturing learners' attention and promoting active participation in metacognitive processes.
- The interactive nature of immersive environments prompts learners to reflect on their thought processes, evaluate their understanding, and consider alternative strategies, fostering metacognitive awareness.
- Immersive environments, with their high level of engagement, can sometimes lead to learners getting absorbed in the immersive experience itself, diverting attention away from metacognitive reflection and self-regulations.