OPPORTUNITY 44

SCOPE VISIONARY

UNCERTAINTIES

Technology, Values

MEGATRENDS

Advanced Health and Nutrition

TRENDS

Brain–Computer interfaces (BCI)
Neuroscience
Transforming Education

SECTORS IMPACTED

Communication Technologies & Systems
Cyber & Information Security
Data Science, AI & Machine Learning
Education
Health & Healthcare
Immersive Technologies
Materials & Biotechnology

What if we could learn new skills while we sleep?

RESTFUL RETENTION

Advanced sleep studies, neuroscience, and brain–computer interfaces, augmented by advanced machine intelligence, deepen our understanding of of learning during sleep enabling our ability to retrieve learning when awake.

WHY IT MATTERS TODAY

The ability to deepen knowledge or enhance cognitive functions during sleep and to retrieve sensory connections and retained knowledge when awake hold out hope for enhancing cognitive rehabilitation for people after a stroke,[888] with brain trauma[889] or moderate dementia,[890] and for skills development more generally.

Related to health, stroke is the second leading cause of death worldwide, with 6.6 million deaths in 2020, 86% of which were in low- and middle-income countries,[891] and stroke mortality is projected to increase by 50% to 9.7 million between 2020 and 2050.[892] Traumatic brain injury affected 55 million people in 2022 and costs over $400 billion annually.[893] Besides the burden of care, it increases the risk of other neurodegenerative diseases later in life.[894] Over 55 million people globally have dementia, with 60% in low- and middle-income countries and 10 million new cases annually.[895] Dementia is the seventh leading cause of death globally and a major cause of disability, with a global economic impact of $1.3 trillion in 2019.[896]

Given the expected impact of technology on the future of work, cultivating new skills is essential. Employers surveyed within the World Economic Forum's Future of Jobs report expect that 44% of employees' skills will shift, in some way, in the next five years.[897] Accelerated education and upskilling could add $8.3 trillion to global gross domestic product (GDP) by 2030.[898]

OPPORTUNITY

Learning new skills during sleep has been an area of neuroscientific research for nearly six decades,[899] although results have been inconsistent.[900] Besides rest and improving memory retention by up to 40%,[901] the processing of memories from waking hours occurs during sleep.[902] What is not typically linked to sleep is the encoding of new memories or, in other words, learning.[903] Techniques like transcranial alternating current stimulation can induce lucid[P] dreaming[904] and thus enable interactive learning and communication.[905]

A combination of advanced sleep studies, neuroscience, and brain–computer interfaces enhanced by advanced machine intelligence enhances our understanding of how rapid eye movement (REM) and non-REM (NREM) stages of sleep are tied to learning[906] and enables our ability to retrieve learning when awake.[907] This would also guide the design of a feedback system during sleep to reinforce learning. So far, the approaches used for learning have mostly revolved around using sound and odour as stimuli, with reflex responses or electroencephalogram reactions,[908] during sleep to confirm learning,[909] but the success of these methods can be subjective.

BENEFITS

Enhancing, recovering, and gaining cognitive functions[910] particularly after a stroke,[911] brain trauma,[912] or moderate dementia.[913] More time and opportunities for learning that can meet changing societal and economic demands for diverse skills and expertise.

RISKS

Advanced technologies that are designed to stimulate learning during sleep could impact on neurological health or be misused through thought manipulation. Rising expectations about learning might create further inequalities for those who do not have access to such technologies.

[P] Lucid dreaming is the state of consciousness during sleep.