

Cognitive Overload? How Big Brother Manages Too Much Information

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A Scottish schoolgirl recently won the right to use an iPod in exams, claiming she can only concentrate while listening to her favourite music. She may be the talk of the playground, but experts say she's misguided. The fewer distractions people have when they are trying to think, the better. When the brain is overloaded with competing demands, people literally can be lost for words – or answers. Even their voices change under the stress.

Researchers at the University of New South Wales (UNSW) have been using this effect as a measure of when people in the workplace have too much on their minds. A new technology is proving a useful tool for call centre employers to test job candidates to determine their ability to juggle multiple calls. It's also helping bosses to spot the overload signals among existing staff who are too mentally stretched.

The system, called BrainGauge, has been used by the NSW Roads and Traffic Authority in the stressful business of managing Sydney's traffic. An Australian defence research organisation uses it to assess mental load during training operations, while emergency services in Canada are also using the software to measure mental workload.

The BrainGauge technology allows managers to measure the workloads of call centre workers from live phone calls in real time, and is claimed as a world first. It has its origins in the work of [John Sweller](#), a professor in the UNSW School of Education, who developed the theory of "cognitive load" in the 1980s. "The more irrelevant information you give people the less they are going to learn," asserts Sweller. He believes students should not listen to music while studying. "A group of students learning without music would do better than one with music because music imposes an unnecessary cognitive load."

Unnecessary cognitive loads can be inflicted in a variety of unexpected ways, reports Sweller. For instance, modern technology allows us to easily transform written information into sound, and static information into animation. "While sometimes more attractive, it is changing permanent [information] into transient information that immediately disappears, so you can't go back and have another look," Sweller says. "There are consequences. We have a working memory that holds things for only a few seconds. Transient information can impose an impossible cognitive load because we must remember previous information while simultaneously processing current information."

Similarly, in PowerPoint presentations – when the presenter says the same words that are written on the screen – "co-ordinating what we read and what we hear puts too much load on the mind and decreases ability to understand what is being presented", notes Sweller. His framework emphasises the limitations of [working memory](#) load on learning during instruction. People learn better by building on what they already understand – or their schema, which are organised patterns of thought.

What's Front of Mind?

With complex tasks, such as learning to drive a car, the driver has to fit all the elements together first, which takes up a lot of space in your working memory, notes BrainGauge team researcher Natalie Ruiz. "There are movements, visual and hearing aspects involved. You have to respond by turning wheels, pressing buttons and pulling levers. When you know what to do, it is organised in a schema because you have learnt and stored them into long-term memory. This can be downloaded into your working memory



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and takes up very little space when you go for a drive. It has a lot of rules and complex relationships so that when a pedestrian walks out, you lower your speed."

In 1956, US cognitive psychologist George Miller famously quantified the limit of short-term memory to seven bits of information, plus or minus two. Long-term brainpower is vast but, as Miller showed, the short term is limited. "(Short-term memory) generates speech. And from changes in your speaking we know how much brainpower you are using and how much is left over," says BrainGauge's chief executive [Fang Chen](#), a conjoint professor at the UNSW School of Computer Science and Engineering and manager of the Making Sense of Data research team at [National Information and Communications Technology Australia](#) (NICTA). "It's the same for eye movement and other actions. Our research has found solid evidence that eye movement is related to the level of workload. When you are cognitively overloaded, you blink less, but the duration is longer."

The researchers are dealing with a large range of human behaviours, shown by brain signals in an electroencephalograph (EEG), which records electrical activity along the scalp. Speech, sweating and eye movements indicate brain activity and can be turned into a measure of cognitive load. "They are an indirect way of tapping into the brain," says Chen. And in employment agencies, such measures are now being used to show whether candidates have the capacity to do the job.

The growing call centre industry wants workers who can cope with the pressure of high volumes of increasingly complex information. Strong verbal communication skills are required. Operatives need to be capable multi-taskers, have solid memory and problem-solving abilities and be able to rapidly respond to situations under time limits. BrainGauge is being used as a screening tool to assess the cognitive capability of job applicants. The company claims this reduces staff turnover by 50% and represents a A\$1 million saving per annum for a typical 300-seat call centre.

Predicting Performance

Based on the premise that cognitive ability affects the handling of complex tasks under pressure, the technology predicts performance. It has different tests for different skills. For example, the job test takes less than 15 minutes and uses a standard computer microphone and web based voice-analysis software. It collects a relaxed speech response as a base to compare changing voice patterns.

When an agent is overloaded, the software triggers an alert and automatically reallocates work to other members of staff. It is independent of a particular language or accent, and works with decentralised staff and home workers.

Each person has a maximum workload that they can handle and perform. In a typical call centre, for example, an operator has to respond to a large variety of support requests, by working out solutions based on the information retrieved from a number of sources. All these activities happen in real-time, and the operator has to deal with multiple communication channels in this process. Cognitive overloading causes mistakes, and errors or extended handling times are common outcomes. Overloaded staff are likely to be upset, less motivated, and eventually will leave.

"Normally in call centres we have a quality check by supervisors who lift up the phone and listen in on conversations," says Chen. "But they can only do one person at a time and can only listen to about 0.5% of the calls. There could be thousands of calls. With this system, they can check on everyone all the time." So when a phone call is prefaced with "this call may be recorded for training purposes", it may mean software is analysing the live conversation.

A red bar on a supervisor's dashboard indicates when an agent is overloaded and intervention is required. At the same time, the software may be re-routing incoming calls and re-allocating work. Offline, the system analyses the average cognitive load levels of the call centre staff. The ranking system crawls through all call recordings and forwards the highest ranked calls for manual review. It can profile staff by tracking their cognitive load history over a period, "providing critical information for workforce management, and therefore improving the workforce", says Chen.

Strictly speaking, BrainGauge directly measures cognitive load, not stress. Cognitive load is different to common psychological or emotional stress because it is likely to cause errors or low performance. Emotional stress may actually improve the task performance in certain cases.

In high-pressure environments, the ability for organisations and managers to monitor how individuals cope under high demand is useful, says [Alannah Rafferty](#), a professor in Organisation & Management at the Australian School of Business. There is a limited attention capacity in demanding environments, known as the "threat-rigidity" principle, Rafferty notes. "Essentially, demanding environments that threaten us may result in restriction of information processing, such as a narrowing in the field of attention. We concentrate less on other things around us and focus our attention more on the stressor or the thing that is threatening to us."

While monitoring staff may raise privacy concerns, Chen points out that it's standard to monitor call centre workforces. Rafferty sees privacy as an interesting issue. In this instance, the right to individual privacy needs to be balanced with efforts to reduce employee stress, she argues. "This is a serious issue in the workplace – role change, organisational change, restructuring and working longer all increase stress, particularly in very demanding environments. This technology reflects concern about stress in the workplace and finding ways to reduce it."

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