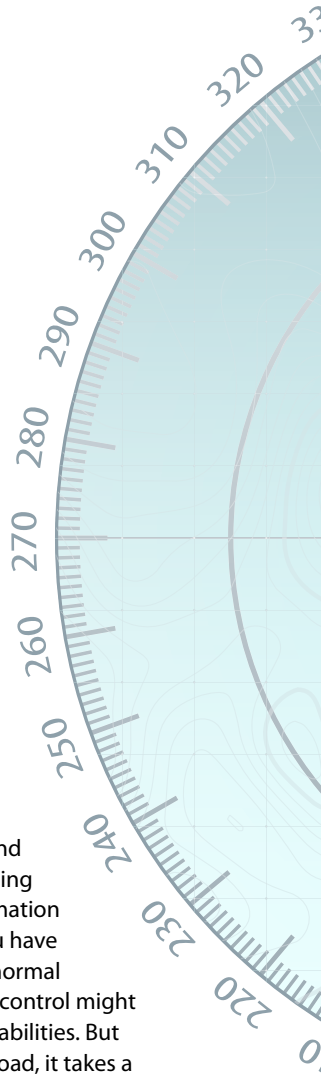
HUMAN PERFORMANCE IN THE SPOTLIGHT: UNDERLOAD



In this series, human performance issues are addressed by leading researchers and practitioners in the field. **Mark Young** gives some insights into mental workload and the problem of 'underload'.

What is mental workload?

This is one of those human factors concepts that is very difficult to pin down and, consequently, there are numerous definitions of mental workload. But the common theme among most definitions centres around a balance between objective task demands on the one hand (that might be something measurable like the number of aircraft in a sector) and, on the other, the individual's resources to deal with those demands. 'Resources' could be attention, skill, experience, or technological support. Some researchers say mental workload is very much a subjective thing, so it's about the experienced demand as much as anything.

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What is 'underload' and how is it different to boredom?

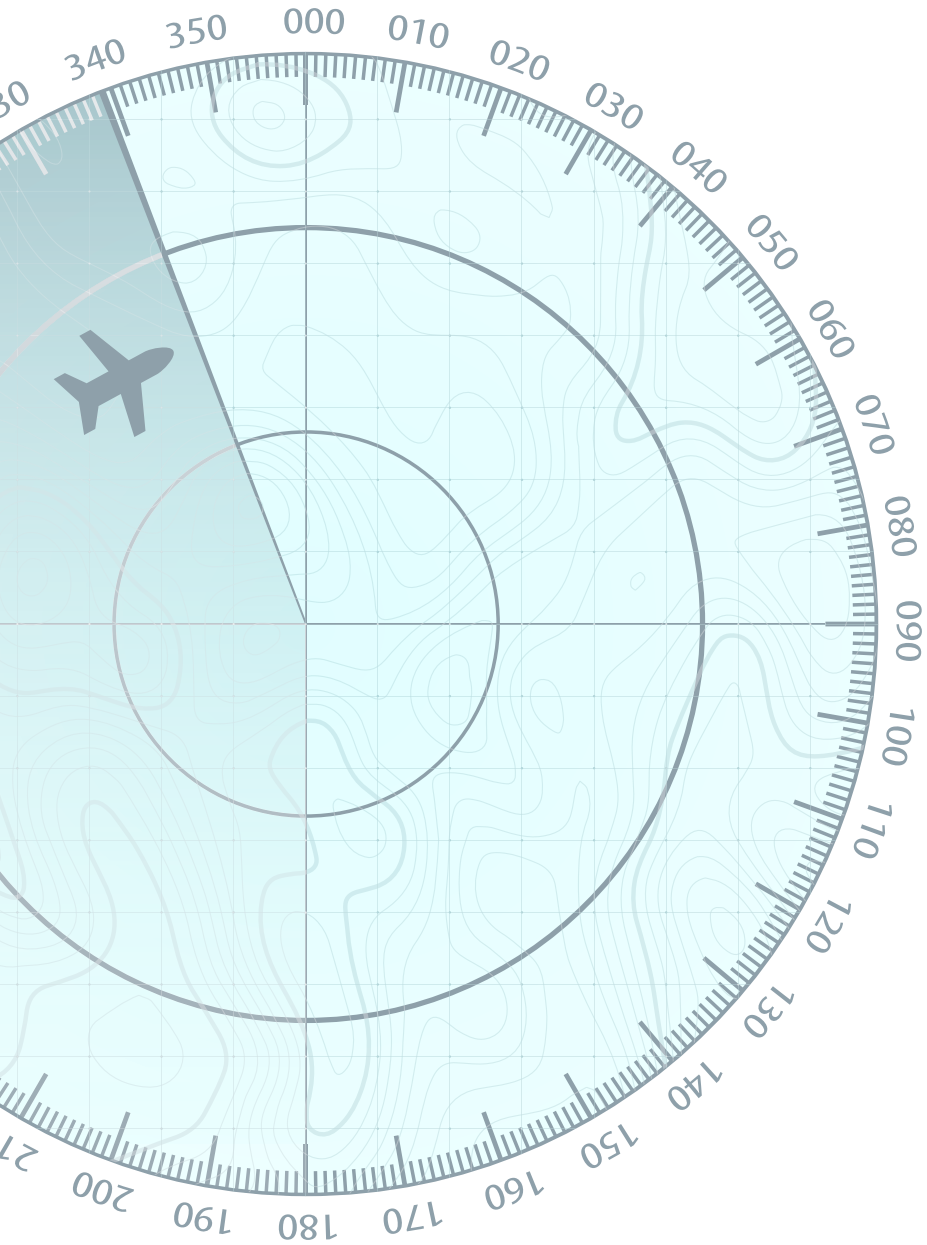
To me, *underload* is about having to be engaged in a task where the demands are exceptionally low, but they are not non-existent – for instance, supervisory control of an automated system. *Boredom* is more about having nothing interesting or meaningful to do, or a lack of engagement. The other close relative is *vigilance* – having to monitor for a low-frequency event, such as an automation failure. Research consistently shows that performance on this kind of task starts to fade within 20-30 minutes, but some argue that maintaining this kind of vigil is actually a high demand task, which would make it quite the opposite of underload.

What are the human performance problems that tend to be associated with underload?

When underload is associated with routine, repetitive tasks, it can lead to a cognitively automatic mode of responding – habitually doing the same thing over and over, without much conscious thought. On the face of it, this might sound like it has some benefits, but the lack of attention can result in errors. A clear example of this was highlighted in a UK Rail Accident Investigation Branch (RAIB) investigation of an accident on the London Underground, in which a passenger became trapped in the doors of a departing train and dragged into the tunnel, suffering serious injuries. The train was highly automated, leaving the driver with very little to do other than attend to station duties – a task which had become very routinised, as just described. Consequently, the driver did not notice the passenger trapped in the doors before starting the train.

But typically, problems occur when workload suddenly increases. Imagine this scenario from the not-too-distant future: you've been behind the wheel of a self-driving car on the motorway for a while and then, suddenly, something happens that the automation can't cope with and you have to take control. Under normal circumstances, manual control might be well within your capabilities. But after a period of underload, it takes a while for our attention to 'spin up' and get back to a state of being able to deal with that. We're only talking maybe tens of seconds or even a minute or so, but that can be a long time in a critical situation.

There are various theories about why this happens. Some say it's about effort regulation, because at extremes of workload people find it difficult to match their effort appropriately to the task. It could also be about low physiological arousal associated with the lack of stimulation – there is a classic 'inverted-U' curve relating arousal with performance, where anything too low or too high causes problems, but somewhere in the middle is just right. My own research suggested that our attentional capacity actually shrinks when we are faced with underload (which could also be related to arousal), so that when workload suddenly increases again (like in the automation failure scenario), we don't have the resources to cope with it. This can cause problems in how people respond to the critical situation – slower reaction



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times, less effective reactions, and even whether they react at all.

What can individuals, teams and organisations do to reduce the risks associated with underload?

I'm very much an advocate of designing out these problems in the first place, so I would not want to suggest much that puts the onus on front-line personnel to deal with it. It shouldn't be their problem. I guess at the most, an awareness that underload can be a problem is helpful, so if they feel their performance might be at risk as a result, they can feed that back up through the appropriate channels.

Personally, I don't think training is the answer. There are some strategies that have been advocated to try to keep your attention up. Probably the most useful of these is to try some kind of running commentary on the task, but this is often not realistic in tasks that involve a lot of verbal communication or where it could be distracting to others.

Really, this is one of those human issues to which we're all susceptible, so the solution should be about the task. A lot of underload research has been driven by automation – the technology-centred push to automate as much as we can without thinking about the impact on the person. I'm not technophobic, but I would just say let's look at ways to support the person in doing the task that they are already good at without taking too much of it away.

Frequent short breaks could help to restore attention, and they are particularly useful to counter the vigilance decrement I mentioned earlier. Even a few minutes off-task can help.

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