

What is your maximum workload?

by **Professor Sidney Dekker**

Workload makes intuitive sense to most people. They can typically tell when their workload is “high.” But what is too high?

In Hindsight 8 of 2009, I told of a trial at some European airport that wanted to go up to a throughput of 55 aircraft an hour in some sectors. A group of controllers volunteered to try this and I predicted that the trial would be successful. It probably was, depending on who you ask. I also predicted that the airport would probably soon go up to sixty aircraft per hour or more. They have.

So how do we know what your maximum workload is? In an even earlier 2007 Hindsight column, I quipped that to determine your maximum workload, you should talk to your union, not a human factors specialist. I apparently did not have much confidence in the science of my own field.

It hasn't grown a lot. At least not in respect of the question raised in the title of this column. My colleague Jim Nyce and I recently wrote about the measurement of workload in a scientific journal as “psychological alchemy.” Alchemy, of course, was the medieval forerunner of chemistry. It was particularly concerned with turning base metals into gold. As far as we know, it never succeeded (notwithstanding, even Isaac Newton was an alchemist – and his were hardly medieval times anymore).

Psychological alchemy is concerned with turning its own base data into numerical gold. Wilhelm Wundt, working in his 19th century Leipzig psychology laboratory, once declared that he wanted to develop a “chronometry of the mind.” He later abandoned the idea as too ambitious a research goal.

But today's workload measurement has picked up where he left off. Take a workload rating scale (like the NASA TLX). It deploys a bunch of psychological terms (mental demand, physical demand, temporal demand, performance, effort, and frustration) and gives people scales to mark how much they experienced of each. People are asked to “introspect” or “look inside” and reflect on their own subjective experience. How was your mental demand? Well, uh, just reflecting, I'd say this much: tick. How was your performance? Uhhh, I dunno, what about... here, tick. How frustrated were you? Aaaargh, now that you ask, here, this much: tick.

As soon as your tick is on the scale, then the psychologist has her or his number. Because the scale has numbers, and your tick falls on or somewhere between them it produces a non-zero number (typically up to seven or nine or some other arbitrary figure). The point for the psychologist is that numbers are good; they make the whole exercise look like science. Because numbers are no longer subjective. They are no longer just your opinion. They are objective data. Objective psychological data.

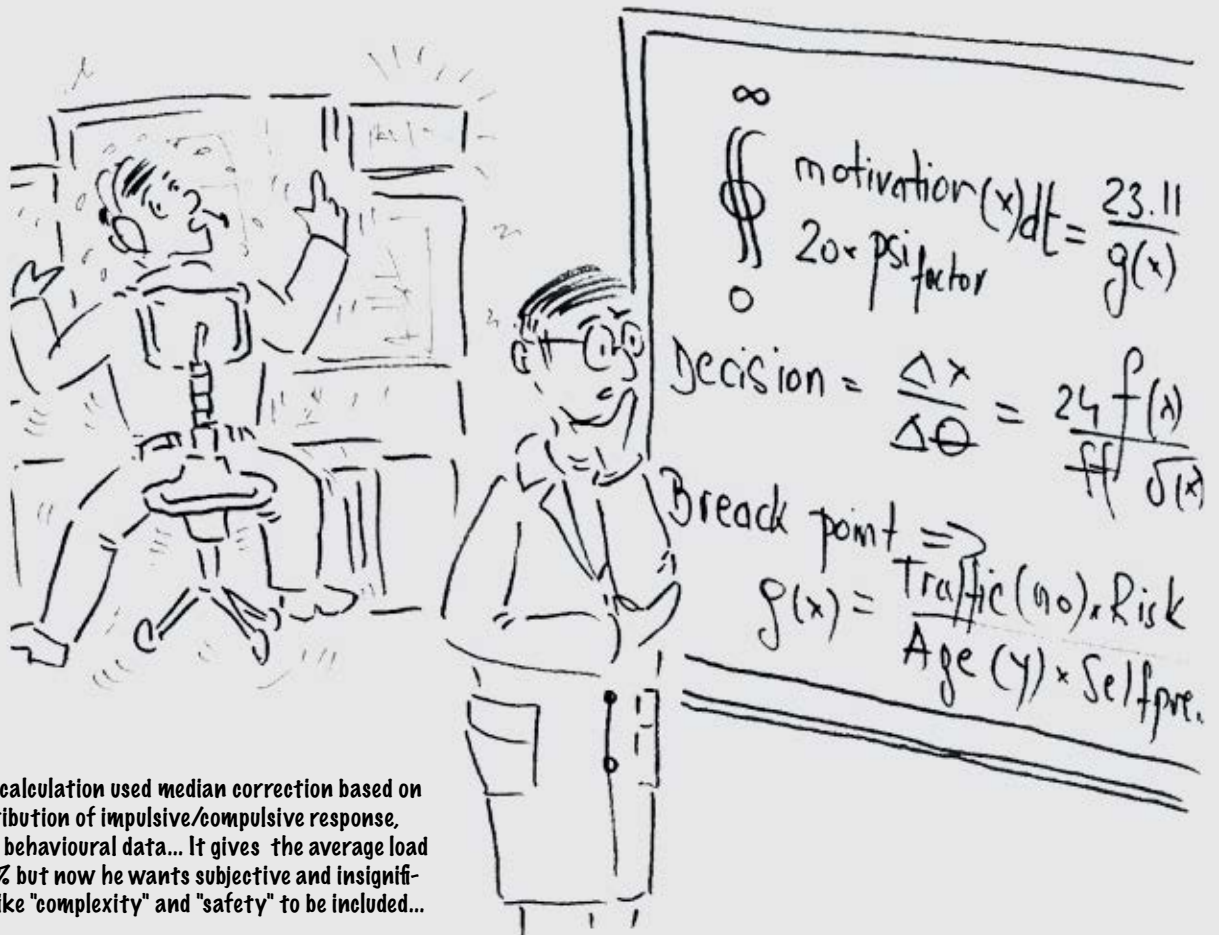
Huh? Yes, psychologists can even do statistics on these data! For the nerds among you, a team in Oklahoma once proudly conducted an analysis of variance (yes, ANOVA) on the data derived from such scales. The data came from an air traffic control experiment aimed at demonstrating that paper flight strips were unnecessary. But the workload scales are, in technical parlance, ordinal. That is, they just order things (this is less than that, or more than that). It is not a ratio scale. If you have measured “mental load” with an ordinal scale, you can never claim that the difference between 1 and 2 is as large as the difference between 4 and 5. Or that the difference between 2 and 4 is twice as large as the difference between 3 and 4. The problem is, you can only do fancy statistical analyses on ratio scales. Never mind, the Oklahoma team set to work, pulling out a ruler to measure the distance between the left side of the scale and where controllers had put their tick.



Professor Sidney Dekker

is Professor and Director of the Key Centre for Ethics, Law, Justice and Governance at Griffith University, Brisbane, Australia.

Author of best-selling books on human factors and safety, he has had experience as an airline pilot on the Boeing 737.



The workload calculation used median correction based on Gaussian distribution of impulsive/compulsive response, normalised by behavioural data... It gives the average load as below 97.5% but now he wants subjective and insignificant factors like "complexity" and "safety" to be included...

A question about some unproven psychological category (...mental load? What in the world is mental load?) became a tick, a tick became a distance from the left side of the scale as measured in whatever units the ruler offered, the distance from the left side of the scale became a number, the number became a data point in a statistical analysis and finally, the statistical analysis became proof that your paper flight strips were a waste of everybody's time.

Right. That is called alchemy: psychological alchemy. What is worse, it performs what my colleague Jim Nyce called a strategic retreat. A retreat from you, the operator, the controller. It produces numbers, and statistical "proof" so that your managers or engineers feel more confident to take action based on it. Like removing paper flight strips. Or re-sectorising so that you can now do it all alone, all by yourself! Or that you now get 55 airplanes to talk to. Or 60! But where are you, the controller, in this? What happened to your actual experience of workload? Well, you were asked about it. And your answers to those questions became a tick, and the tick became...

OK, I think you get the drift.

Fortunately, researchers today are actually not just interested in figuring out maximum workload anymore. What matters more to them is workload transitions – and particularly going from low workload (also known as "underload") to high workload. This has been shown to be related to all kinds

or problems: too many task demands and things competing for visual attention, severe time constraints, the difficulty of ramping up psychologically and physiologically. In air traffic control, the opposite has also generated concern: coming off a traffic peak, or going from high to low(er) workload, has been shown to have negative effects on controller vigilance and directed attention in some cases.

This kind of research is more interesting and perhaps even more genuine. What it shows is not numbers (55 per hour – or 60!), but patterns. It shows how things interrelate, interconnect and interact (this traffic low after this traffic peak at this time of day in those sectors, given this roster and this manning). Those patterns hide possibilities for action and intervention. Different ways to schedule you. To build rosters in other ways. To re-sectorise at different times or in different ways. Nobody needs to be shown right or wrong with such results either. Instead, this kind of research gives us things to think about, talk about and try out. So what do you do now? Have a healthy distrust of numbers produced by the psychologists and human factors people who swirl around your workplace. Ask them, and yourself, and your manager, questions about patterns and interrelationships that together make up the workload as you experience it. Don't worry too much about maximum or minimum numbers.

If you don't mind, I will stop writing now. Even though I don't have a union to help me determine it, I think I have exceeded my maximum workload for the day. ☐