

Mackworth's clock is still ticking

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Even the easiest task can become difficult if repeated over extended time: spotting a spelling mistake in a single sentence is straightforward, but reviewing a long text is more challenging.

In the 1940s, Norman Mackworth conducted a systematic study to determine the optimum shift length for airborne radar operators. The fundamental phenomenon of interest was the gradual deterioration in vigilance, defined as the psychological readiness to perceive and respond, while monitoring a radar—an ostensibly easy task—over extended periods.

To study this vigilance decrement, Mackworth designed the 'Clock Test', where participants monitored a 6-inch pointer (resembling a clock's hand) that moved on a plain white surface in a circle. The pointer moved the same distance every second, except for rare cases when it skipped a step. Participants were asked to report this 'skip' event, which occurred 12 times in 20 min.

The task duration varied, with participants taking part in a 1 h session, a 2 h session, or two 30-min sessions separated by a 30-min break. In two other experimental conditions, participants also completed a secondary task over the 2 h period. In one of these dual-task conditions, participants monitored the clock while also waiting for instructions by telephone. Only one message arrived, after 1 h, encouraging them to try harder. In the other dual-task condition, participants also monitored a second display board showing an aircraft that (supposedly) entered a danger zone after 1 h; participants were warned to be on high alert when the arrow passed through the danger area, and to expect more signals at that time.

Performance declined drastically after the first 30 min of the task (that is, participants missed more 'skips') and remained low throughout. A break after the first 30 min led to a full recovery in performance. The secondary task of waiting for a phone call impaired overall performance, but a sharp increase in performance occurred upon receiving the motivating message. Adding a second display board and briefing participants about the (alleged) 'danger zone' had no effect on performance. Therefore, making participants more explicitly aware of the task's aims does not alleviate vigilance decrements.

There are two main findings of this study. First, maintaining performance over long periods is beyond human capacity. Second, performance is non-linear and is best captured when accounting for its dynamics. In other words, measuring how performance changes over time reveals critical information beyond simple averaging. Mackworth's work is exceptionally relevant today: students, drivers, pilots, surgeons, radiologists, and many more individuals, must sustain vigilance for longer than 30 min.

The paper by Mackworth is a 'classic' paper that has had an incredible influence in the field of psychology and is still highly relevant to research today. It set the groundwork for the study of vigilance and fluctuations in human performance. Mackworth reported that human observers show a marked decrement in performing very simple tasks over time, a seemingly trivial observation that became central to many psychological phenomena. In theoretical research, the finding of a vigilance decrement was later merged with concepts such as sustained attention, alertness, and the study of infra-slow oscillatory processes in the brain. It also influenced work on learning, motivation, automaticity and habituation. In translational research, the concept of vigilance has shaped the way we understand diverse populations, including individuals with attention deficit hyperactivity disorder and stroke survivors.

Today, researchers use novel techniques to elicit deterioration in attentional capacity within minutes, for example by making the task more challenging or by studying cognitively diverse populations that struggle to sustain performance over time. Excessive difficulty in sustaining attention characterizes several behavioural syndromes and cognitive conditions. An open question is whether decrements occurring within an hour (decreases in 'vigilance') and those occurring over minutes (decreases in 'sustained attention') reflect the same phenomenon. Vigilance decrements might represent a distinct capacity with unique substrates and dynamics that emerge exclusively from repetitive, boring, and prolonged tasks.