

Cognitive Biases Fatigue Metacognition

Cognitive biases

Ideally, we would accurately and objectively interpret all of the information available to us when making decisions and judgements under pressure. Unfortunately however, our minds can subconsciously misinterpret or even ignore incoming information. These “cognitive biases” frequently lead to errors and are common causes of compromised performance. Examples include the priming effect, anchoring bias, confirmation bias, framing bias, ascertainment bias, the Dunning-Kruger effect and the order effect. These are described in the table below.

Decision making errors due to cognitive biases are particularly common in high pressure situations where we are forced to make judgements and decisions based on information which is incomplete, inaccurate and constantly changing. This is made worse by having to make decisions in limited time periods. When we have less time, we don't seek out all of the information which is available, and we don't clarify ambiguous data. This leads us to make decisions based on partial and misinterpreted information. Similar to system one thinking and emotional appraisal, to minimise time and cognitive workload, our minds also tend to jump to conclusions without appraising the full facts. This predisposes us to errors arising from cognitive biases.

Fatigue and cognitive performance

Sleep deprivation and poor sleep quality significantly impair our cognitive and physical performance. Psychologists describe two types of sleep deprivation. Acute total sleep deprivation occurs when we experience a prolonged period of being awake. Chronic partial sleep deprivation occurs when we have a number of nights with poor quality sleep or sleep periods which are shorter than we need.

A review of all US naval mishaps from 1990 to 2004 found that fatigue was the most common contributory factor. Similar studies of medical errors in hospital have shown significant increases in error rates when staff were sleep deprived.

The need for sleep is driven by two processes: homeostatic and circadian. Homeostatic mechanisms create the need for sleep as periods of wakefulness increase. Circadian rhythms, the body's in-built clock, alter hormone levels at different times of the day which create feelings of tiredness or wakefulness.

When fatigued, an overall reduction in alertness and attention is related to frequent, brief moments of inattentiveness or micro sleeps. These are more likely during prolonged, simple and monotonous tasks such as driving or monitoring a set of machine controls. Fatigue also has the effect of impairing the function of selected parts of the brain. The decrease in function in these areas has been demonstrated on functional magnetic

resonance imaging. The frontal lobes are particularly vulnerable to sleep deprivation. Functions of the frontal lobes include attention and short term, working memory which are important for performance of complex tasks.

Fatigue has the following effects on our ability to gather information, make decisions and carry out physical tasks.

- Auditory and visual attention. Our ability to detect, listen to, see and process information passed to us verbally and visually is impaired.
- Selective attention. The ability to concentrate and focus on individual tasks becomes poorer.
- Executive functions. The frontal cortex of the brain is responsible for controlling the brain's function when shifting between different tasks. This involves moving attention from one task to another and inhibiting information which isn't required for the task in hand. The brain's ability to shift from one task to another is compromised with sleep deprivation.
- Decision making. Sleep deprivation reduces our ability to reason and make decisions. Fatigue has been shown to reduce our ability to recognise and respond to increasing complexity in decision making. Innovation, the ability to create new behaviours and responses based on experience, is also impaired. Decision making becomes more rigid when we're tired.
- Emotional processing. Changes in facial expression are less well assessed and understood in subjects who are tired. When given a range of solutions to interpersonal problems and conflict, fatigued individuals will tend to take the path of least resistance.
- Risk taking. Fatigued individuals have a reduced ability to assess risk and are more likely to undertake activities and make decisions which involve risk of harm.
- Planning. Studies in military subjects have shown that when given complex tasks which require planning, their outcomes deteriorated when they were tired and the time to complete the task lengthened.
- Memory. Tests have shown that our capacity to develop short term, working memories which are required when undertaking complex tasks is poorer in those who are not adequately rested. This resulted in a higher frequency of errors being made. We are also poorer at retrieving information we already have stored in our long-term memories.

Insight. Our ability to assess how well we are performing is impaired when we are sleep deprived. Our ability to pick up errors also deteriorates. Some studies have shown increased confidence in producing answers to problems. One experiment showed higher confidence when the answer was wrong than when it was correct!

Analytical processing	A type of decision making used for complex and unfamiliar problems. Information is gathered and evaluated, options are considered, and a conscious decision on what action to take is made.
Anchoring bias	When evaluating a situation, we can place excessive weight on a judgement made or piece of information encountered early in the evaluation process. This initial piece of information influences our subsequent decision making. In some cases the judgement or piece of information may be erroneous and may be supplied by another person who was involved with the situation prior to us taking responsibility.
Ascertainment bias	This occurs when we associate what we are encountering with previous similar experiences, especially recent ones. We, possibly erroneously, judge that the problem is the same as the previous one which superficially appeared the same.
Automatic processing	Most judgements our brains make are based on experience of similar situations we have encountered in the past. We recognise familiar patterns of incoming information and react to them in an intuitive manner. This decision-making method is known as intuitive processing. Automatic processing is fast and consumes very little of our cognitive capacity. In the majority of situations, this method of processing brings us to accurate decisions and the correct course of action. For familiar, routine, low risk tasks it's an ideal method of thinking.
Choking	Choking occurs as a result of an extreme stress response. We are rendered unable to make decisions or carry out physical tasks.
Cognitive appraisal	<p>Our cognitive appraisal is how we perceive the magnitude and complexity of a situation, and our ability to manage it. We also evaluate how the situation could potentially affect our well-being. Our appraisal of a situation can be divided into primary and secondary appraisal.</p> <p>During our primary appraisal we consider whether we have anything at stake relating to the encounter. This could be a potential benefit, or it could result in physical, emotional or reputational harm to us. In our secondary appraisal we evaluate what resources and abilities we have to deal with the situation i.e. how equipped are we to cope successfully with the problem?</p> <p>A key part of owning the pressure is having an understanding of how our brains appraise and perceive situations and our capability for dealing with it. Assessing the situation as a difficult but achievable challenge helps</p>

	to motivate us and improve our performance. We can however make a judgement that the situation is insurmountable or even a potential threat to our wellbeing.
Cognitive dissonance	Dissonance occurs when a person has a belief or a perception of a situation that is challenged by new, contradictory information. Individuals strive to reconcile their existing belief with the new evidence. Cognitive dissonance is often observed when reviewing episodes of suboptimal performance. Those involved may try to justify their actions in spite of evidence suggesting that they should have done things differently.
Cognitive offloading	The practice of minimising the cognitive burden on an individual or team. This can be achieved by training, use of cognitive aids and delegation.
Cognitive overload	Cognitive overload occurs when the cognitive demands on us exceed our cognitive capacity. This is related to us exceeding the capacity of our working memory.
Cognitive reframing	A method of recalibrating our appraisal of a situation. The aim is to achieve an accurate and rational judgement of the circumstances facing us.
Confirmation bias	Confirmation bias occurs when we place emphasis on information which supports our original judgement and less emphasis on evidence which contradicts that judgement. We subconsciously discount additional information if it doesn't fit with our existing assessment.
Cross check	A second person verifies the accuracy of our judgement, decision or completion of a task.
Deliberate practice	Training to achieve mastery of a skill by splitting it into small parts. The skill is repeatedly practiced, each time with the aim of improving performance of one small part of the task. Requires real time expert review and coaching.
Disconfirming question	Disconfirming questions are used as a technique to reduce the effects of cognitive biases. We actively challenge our judgement and question if all of the information available is consistent with our decision.
Disengagement	When we experience situations with insufficient levels of pressure we have minimal stimuli to motivate us to perform to a high standard. This low arousal, low performance state is known as disengagement.
Dunning-Kruger effect	Less inexperienced individuals tend to overestimate their abilities.
Explicit memory	Explicit memory is a type of long term memory. It is also known as declarative memory. Recalling information from one's explicit memory is a conscious and intentional action. There are two types of explicit memory: episodic and semantic.

Flash team	In emergency situations individuals from different professional groups, and who may not be previously known to each other, come together to form a team. This team must work together with effective communication, cooperative behaviour and in a coordinated manner.
Flat hierarchy	A flat hierarchy in a team or organisation exists when, although there is an identified leader, each member of the team has autonomy and feels empowered to speak up in order to contribute to decision making.
Flow	A state of optimal performance with the optimal amount of pressure. This results in motivation, arousal and focussed attention. We perceive the situation as a challenge: it is difficult, but we have confidence that we have the knowledge, skills and resources required to achieve a safe and favourable outcome.
Focussed attention	Our ability to concentrate our cognitive abilities on a particular task or decision.
Framing effect	The manner in which information is communicated to us influences our decision making. Identical information can be communicated with a negative or a positive “spin”.
Frazzle	A state of suboptimal performance which occurs when we experience excessive levels of pressure.
Graded assertiveness	<p>A communication technique for communicating concern about another person’s, often more senior, judgement or actions. The technique involves sequentially escalating the force of what is communicated.</p> <p>One acronym for graded assertiveness is “CUSS”:</p> <ul style="list-style-type: none"> • Concern – “I’m concerned that...” • Unsure – “I’m unsure that this is the correct....” • Safety – “I don’t think what we are doing is safe...” • Stop – “Please stop what you are doing”
Mental rehearsal	Repeatedly thinking through and imagining the stages and motor actions of predictable tasks. The imagery should be of us performing the task with excellence and confidence.
Metacognition	How our brains process information and make judgements and decisions. Thinking about thinking. Awareness of what cognitive processes are appropriate for different situations.
Order effect	When receiving information we have a tendency to focus and put weight on the things that are at the start of the communication, and at the end. We pay less attention to information in the middle.

Overlearning	Repeatedly practicing a skill until mastery is achieved, and then practicing more. This leads to a longer lasting ability to maintain the skill. It also helps to achieve automaticity i.e. the ability to carry out the skill without conscious thought.
Priming effect	Our perception and judgement of a situation are influenced by a preceding stimulus or experience.
Procedural memory	This is a type of implicit memory. Procedural memory allows us to carry out tasks and motor skills we have previously practiced without the need for conscious thought. Procedural memory is used in automatic processing. Procedural memory is carried out by the cerebellum and the basal ganglia.
Rally point	A pause in a high pressure situation where the team communicate their personal mental models and plans of action. The aim is to achieve a shared, accurate mental model and a prioritised list of tasks.
SBAR	This is a structure for verbal and written communication. Used in situations such as team briefings, emergencies or when handing over responsibility to another team. <ul style="list-style-type: none"> • Situation – A summary of the situation currently • Background – How we've arrived at this situation and any useful supporting information • Assessment – What I believe to be happening • Recommendations – What I think needs to be done.
Semantic memory	A type of explicit memory. Knowledge of factual information which has been previously learned.
Shared mental model	The team has the same perception of the challenges being faced and the actions required. A common understanding of the situation.
Situational awareness	An understanding of what is happening around us.
Sterile cockpit	A term originating in the aviation industry. During complex and high stakes procedures all non-essential communications and actions are stopped. This reduces the cognitive load on the main operator and stops the negative effects of interruptions and distractions.
Stress inoculation	Stress inoculation is achieved in three stages. Initially participants learn about stress and its effects on how we think, feel and behave. They then learn and practice coping mechanisms to mitigate the effects of excessive pressure. Finally, in simulation under pressure, they practice the techniques in a controlled environment. This is all done under the supervision of an experienced simulation coach. With repeated simulation scenarios,

	<p>the pressure and cognitive load are gradually increased. Over time, learners come to recognise and react to the early stages of stress and cognitive overload in both themselves and their colleagues.</p>
Stress response	<p>Also known as the fight or flight response. Our sympathetic nervous system is activated, causing the release of two stress hormones: cortisol and adrenaline. These cause physiological changes throughout our body. The changes prepare us for a physical confrontation or to extricate ourselves from the situation. Perceptions of threat trigger a fight or flight response.</p> <p>Our hearts start to beat faster in order to supply our muscles with sufficient blood and oxygen for sudden movements and prolonged activity i.e. violence or running. Our pupils widen. Our muscles tense. We start to sweat. At extremes, we have a desire to empty our bladder and bowels to reduce weight while fleeing. Our peripheral vision is compromised, as is our ability to hear.</p>
Task fixation	<p>Task fixation occurs when an operator fully focusses all of their attention on a task or on a decision. This reduces their overall situational awareness.</p>
Working memory	<p>This is the type of memory we use to retain information for a temporary period while making a decision or carrying out a task. It has a limited capacity. Working memory involves the prefrontal cortex and parietal areas of the brain.</p> <p>Stress impairs the function of our working memory.</p>