



50 Cognitive and Affective Biases in Medicine (alphabetically)

Pat Croskerry MD, PhD, FRCP(Edin), *Critical Thinking Program*, Dalhousie University

Aggregate bias: when physicians believe that aggregated data, such as those used to develop clinical practice guidelines, do not apply to individual patients (especially their own), they are exhibiting the *aggregate fallacy*. The belief that their patients are atypical or somehow exceptional, may lead to errors of commission, e.g. ordering x-rays or other tests when guidelines indicate none are required.

Ambiguity effect: there is often an irreducible uncertainty in medicine and ambiguity is associated with uncertainty. The ambiguity effect is due to decision makers avoiding options when the probability is unknown. In considering options on a differential diagnosis, for example, this would be illustrated by a tendency to select options for which the probability of a particular outcome is known over an option for which the probability is unknown. The probability may be unknown because of lack of knowledge or because the means to obtain the probability (a specific test, or imaging) is unavailable. The *cognitive miser function* (choosing an option that requires less cognitive effort) may also be at play here.

Anchoring: the tendency to perceptually lock on to salient features in the patient's initial presentation too early in the diagnostic process, and failure to adjust this initial impression in the light of later information. This bias may be severely compounded by the *confirmation* bias.

Ascertainment bias: when a physician's thinking is shaped by prior expectation; *stereotyping* and *gender* bias are both good examples.

Attentional bias: the tendency to believe there is a relationship between two variables when instances are found of both being present. More attention is paid to this condition than when either variable is absent from the other.

Availability: the disposition to judge things as being more likely, or frequently occurring, if they readily come to mind. Thus, recent experience with a disease may inflate the likelihood of its being diagnosed. Conversely, if a disease has not been seen for a long time (is less available) it may be under-diagnosed. The *availability cascade* occurs when a collective belief becomes more plausible through increased repetition, e.g. 'I've heard this from several sources so it must be true'.

Bandwagon effect: the tendency for people to believe and do certain things because many others are doing so (cf. the tyranny of the majority). *Groupthink* is an example and may have a disastrous impact on team decision making and patient care.

Base-rate neglect: the tendency to ignore the true prevalence of a disease, either inflating or reducing its base-rate, and distorting Bayesian reasoning. However, in some cases clinicians may (consciously or otherwise) deliberately inflate the likelihood of disease, such as in the strategy of 'rule out worst case scenario' to avoid missing a rare but significant diagnosis.

Belief bias: the tendency to accept or reject data depending on one's personal belief system, especially when the focus is on the conclusion and not the premises or data. Those trained in logic and argumentation appear less vulnerable to the bias.

Blind spot bias: the general belief physicians may have that they are less susceptible to bias than others due, mostly, to the faith they place in their own introspections. This bias appears to be universal across all cultures.

Commission bias: results from the obligation towards beneficence, in that harm to the patient can only be prevented by active intervention. It is the tendency towards action rather than inaction. It is more likely in over-confident physicians. **Commission bias** is less common than **omission bias**.

Confirmation bias: the tendency to look for confirming evidence to support a diagnosis rather than look for disconfirming evidence to refute it, despite the latter often being more persuasive and definitive.

Congruence bias: (similar to confirmation bias) refers more to an over-reliance on direct testing of a given hypothesis, and a neglect of indirect testing. Again it reflects an inability to consider alternative hypotheses.

Contrast effect: occurs when the value of information is enhanced or diminished through juxtaposition to other information of greater or lesser value. Thus, if an emergency physician was involved in a multiple trauma case and subsequently saw a patient with an isolated extremity injury, there might be a tendency to diminish the significance of the latter.

Diagnosis Momentum: once diagnostic labels are attached to patients they tend to become stickier and stickier. Through intermediaries, (patients, paramedics, nurses, physicians) what might have started as a possibility gathers increasing momentum until it becomes definite and all other possibilities are excluded.

Ego bias: in medicine, is systematically overestimating the prognosis of one's own patients compared with that of a population of similar patients. More senior physicians tend to be less optimistic and more reliable about patient's prognosis, possibly reflecting **reverse ego bias**.

Expectation bias: when researchers tend to believe, certify and publish data that are in accord with their own expectations for the outcome of an experiment, or downgrade or minimize data that appear to be in conflict with those expectations. (See also: **experimenter bias** and **my-side bias**.) It can lead to researchers unconsciously manipulating their data to obtain an expected or desired result.

Feedback sanction: a form of *ignorance trap* and *time-delay trap bias*. Making a diagnostic error may carry no immediate consequences as considerable time may elapse before the error is discovered (if ever), or poor system feedback processes prevent important information on decisions getting back to the decision maker. The particular bias that failed the patient persists because of these temporal and systemic sanctions.

Framing effect: how diagnosticians see things may be strongly influenced by the way in which the problem is framed, e.g., physicians' perceptions of risk to the patient may be strongly influenced by whether the outcome is expressed in terms of the possibility that the patient may die or that they might live. In terms of diagnosis, physicians should be aware of how patients, nurses and other physicians frame potential outcomes and contingencies of the clinical problem to them.

Fundamental attribution error: the tendency to be judgmental and blame patients for their illnesses (dispositional causes) rather than examine the circumstances (situational factors) that might have been responsible. In particular, psychiatric patients, minorities and other marginalized groups tend to suffer from this bias. Cultural differences exist in terms of the respective weights attributed to dispositional and situational causes.

Gambler's Fallacy: attributed to gamblers, this is the belief that if a coin is tossed 10 times and is heads each time, the 11th toss has a greater chance of being tails (even though a fair coin has no memory). An example would be a physician who sees a series of patients with chest pain in clinic or the emergency department, diagnoses all with an acute coronary syndrome, and assumes the sequence will not continue. Thus, the pre-test probability that a patient will have a particular diagnosis might be influenced by preceding, but independent events.

Gender bias: the tendency to believe that gender is a determining factor in the probability of diagnosis of a particular disease when no such pathophysiological basis exists. Generally, it results in an over-diagnosis of the favored gender and an under-diagnosis of the neglected gender.

Hawthorne effect: the tendency for people to perform or behave differently (usually making themselves look better than they really are) when they know they are being observed.

Hindsight bias: knowing the outcome may profoundly influence perception of past events, and prevent a realistic appraisal of what actually occurred usually leading to the decision maker being seen as better or worse than they really were. In the context of diagnostic error, it may compromise learning through either an underestimation (illusion of failure) or overestimation (illusion of control) of the decision maker's abilities.

Illusory correlation: the tendency to believe that a causal relationship exists between an action and an effect, often because they are simply juxtaposed in time. It is also the basis of stereotyping, assuming that certain groups of people and particular traits go together.

Information bias: the tendency to believe that the more evidence one can accumulate to support a decision the better. While gathering *sufficient* information is always important, it is also important to anticipate the value of information and whether it will be useful or not in making the decision, rather than collecting information because we can, or for its own sake, or out of curiosity.

Multiple alternatives bias: a multiplicity of options on a differential diagnosis may lead to significant conflict and uncertainty. The process may be simplified by reverting to a smaller subset with which the physician is familiar, but may result in inadequate consideration of other possibilities. One such strategy is the three diagnosis differential: 'it is probably A, but it might be B, or I don't know (C)'. While this approach has some heuristic value, if the disease falls in the C category and is not pursued adequately, it will minimize the chances that some serious diagnoses can be made.

Mere exposure effect: the development of a preference for something simply because you are familiar with it. Also known as the *familiarity principle*, it can have widespread effects in medicine, e.g., merely seeing a pharmaceutical product or being told about it may increase the likelihood of choosing it over other products.

Need for closure: the bias towards drawing a conclusion or making a verdict about something when it is still not definite. It often occurs in the context of making a diagnosis where the clinician may feel obliged to make a specific diagnosis under conditions of time or social pressure, or to escape feelings of doubt or uncertainty. It might be preferable to say instead that the patient's complaint is 'not yet diagnosed' (NYD).

Omission bias: the tendency towards inaction; rooted in the principle of non-maleficence. In hindsight, events that have occurred through the natural progression of a disease are more acceptable than those that may be attributed directly to the action of the physician. The bias may be sustained by the reinforcement often associated with not doing anything, but may prove disastrous. *Omission biases* typically outnumber *commission biases*.

Order effects: information transfer is a U-function: a tendency to remember the beginning part (primacy effect) or the end (recency effect) are referred to as serial position effects. Primacy effect may be augmented by anchoring. In transitions of care, where information transferred from patients, nurses, or other physicians is being evaluated, care should be taken to give due consideration to all information, regardless of the order in which it was presented. In re-framing a problem to oneself or others, a useful strategy is to change the order.

Outcome bias: the tendency to opt for diagnostic decisions that will lead to good outcomes, rather than those associated with bad outcomes, thereby avoiding chagrin associated with the latter. It is a form of *value bias* in that physicians may express a stronger likelihood in their decision making for what they hope will happen rather than what they really believe might happen. This may result in serious diagnoses being minimized.

Overconfidence bias: there is a universal tendency to believe we know more than we do. This is a pervasive and powerful bias. Overconfidence reflects a tendency to act on incomplete information, intuitions or hunches. Too much faith is placed in opinion instead of carefully gathered evidence.

Playing the odds: also known as *frequency gambling*, is the tendency in equivocal or ambiguous presentations to opt for a benign diagnosis on the basis that it is significantly more likely than a serious one.

Posterior probability error: occurs when a physician's estimate for the likelihood of disease is unduly influenced by what has gone before for a particular patient. It is the opposite of the **Gambler's fallacy** in that the physician is gambling on the sequence continuing, e.g., if a patient presents to the office five times with a headache and is correctly diagnosed as migraine on each visit, it is the tendency to diagnose migraine on the sixth visit.

Premature closure: is a powerful bias accounting for a high proportion of missed diagnoses. It is the tendency to apply premature closure to the decision making process, accepting a diagnosis before it has been fully verified. The consequences of the bias are reflected in the maxim 'when the diagnosis is made, the thinking stops'.

Psych-out error: psychiatric patients appear to be particularly vulnerable to the biases described in this list, and to other errors in their management, some of which may exacerbate their condition. They appear especially vulnerable to **fundamental attribution error**. In particular, co-morbid medical conditions may be overlooked or minimized. A variant of **psych-out error** occurs when serious medical conditions (e.g. hypoxia, delirium, metabolic abnormalities, CNS infections, head injury) are misdiagnosed as psychiatric conditions.

Reactance bias: the tendency towards doing something different from the rules, regulations or protocol because they are seen as threatening autonomy and constraining freedom of choice. This may also occur, for example, when a patient suggests a diagnosis based on what they found on Google to match their symptoms; the clinician's reaction might be due to a perception that they are being undermined or that their clinical acumen is being challenged.

Representativeness restraint: drives the diagnostician towards looking for prototypical manifestations of disease: 'if it looks like a duck, walks like a duck, quacks like a duck, then it is a duck'. Yet, restraining decision making along these pattern-recognition lines leads to atypical variants being missed.

Search satisficing: reflects the universal tendency to call off a search once something is found. It is pervasive and considered one of the most important sources of error in radiology. Co-morbidities, second foreign bodies, other fractures, and co-ingestants in poisoning may all be missed.

Self-serving bias: the tendency to claim more responsibility for successes than for failures. Clinicians may overestimate the number of times they have made a brilliant or insightful diagnosis and fail to remember their diagnostic failures.

Semmelweis reflex: the tendency to reject new evidence or new knowledge because it contradicts established norms, beliefs or paradigms. The bias takes its name from the reaction of the medical community against the findings of Semmelweis, the Hungarian physician who showed that hand-washing by physicians in an antiseptic solution before delivery reduced puerperal sepsis in the mother by 90%.

Sutton's slip: takes its name from the apocryphal story of the Brooklyn bank-robber Willie Sutton who, when asked by the Judge why he robbed banks, is alleged to have replied 'Because that's where the money is!' The diagnostic strategy of going for the obvious is referred to as **Sutton's Law**. **Sutton's slip** occurs when possibilities other than the obvious are not given sufficient consideration.

Sunk costs: the more clinicians invest in a particular diagnosis, the less likely they may be to release it and consider alternatives. This is an entrapment form of bias more associated with investment and financial considerations. However, for the diagnostician, the investment of time, mental energy and, for some, ego may be a precious investment. **Confirmation bias** may be a manifestation of such an unwillingness to let go of a failing diagnosis.

Triage cueing: the triage process occurs throughout the health care system, from the self-triage of patients to the selection of specialist by the referring physician. In the Emergency Department, triage is a formal process that results in patients being sent in particular directions, which cue their subsequent management. Many biases are initiated at triage, leading to the maxim: 'geography is destiny'. Once a patient is referred to a specific discipline, the bias within that discipline to look at the patient only from the specialist's perspective is referred to as **déformation professionnelle**.

Unpacking principle: failure to elicit all relevant information (unpacking) in establishing a differential diagnosis may result in significant possibilities being missed. If patients are allowed to limit their history-giving, or physicians otherwise limit their history-taking, unspecified possibilities may be discounted.

Vertical line failure: routine, repetitive tasks often lead to **thinking in silos** – predictable, orthodox styles that emphasize economy, efficacy and utility. Though often rewarded, this approach carries the inherent penalty of inflexibility. In contrast, lateral thinking styles create opportunities for diagnosing the unexpected, rare or esoteric, e.g., thinking outside the organ system normally associated with a particular disease. An effective lateral thinking strategy is simply to pose the question: 'What else might this be?'

Visceral bias: the influence of affective sources of error on decision-making has been widely underestimated. Visceral arousal leads to poor decisions. **Countertransference**, involving both negative and positive feelings towards patients, may result in diagnoses being missed.

Yin-yang out: when patients have been subjected to exhaustive and unavailing diagnostic investigations, they are said to have been worked up the Yin-Yang (see also the expertise heuristic). The *yin-yang out* is the tendency to believe that nothing further can be done to throw light on the dark place where, and if, any definitive diagnosis resides for the patient, i.e. the physician is let out of further diagnostic effort. This may prove ultimately to be true, but to adopt the strategy at the outset is fraught with a variety of errors.

Zebra retreat: occurs when a rare diagnosis (zebra) figures prominently on the differential diagnosis but the physician retreats from it for various reasons:

- Perceived inertia in the system and barriers to obtaining special or costly tests;
- Self-consciousness and under-confidence about entertaining a remote and unusual diagnosis, and gaining a reputation for being esoteric;
- The fear of being seen as unrealistic and wasteful of resources;
- Underestimating or overestimating the base-rate for the diagnosis;
- The clinical environment may be very busy and the anticipated time and effort to pursue the diagnosis might dilute the physician's conviction;
- Team members may exert coercive pressure to avoid wasting the team's time;
- Inconvenience of the time of day or weekend and difficulty getting access to specialists;
- Unfamiliarity with the diagnosis might make the physician less likely to go down an unfamiliar road;
- Fatigue, sleep deprivation, or other distractions may tip the physician toward retreat. Any one or a combination of these reasons may result in a failure to pursue the initial hypothesis.