4.3 Biases and their Implications for Research Projects

That people do not process data as computers do is evident to anyone using a computer, but the differences really go very deep. With some effort humans are capable of rigidly logic thought for short periods, but it is clear that most of the time that is not typical. While that is not necessarily a bad thing, ingrained human thought processes lead to some bad headaches for research projects, bad because they can be so hard to spot until damage is done. It is worth knowing something about these because they explain many features of scientific protocols, methodologies and training that appear on the face of it rather odd or wasteful of time, but these features often exist to evade or overcome problems caused by human thinking.

It is not hard to demonstrate that the human mind uses shortcuts or approximations without much awareness of doing it. Driving a car, for example, would be very difficult if the driver constantly had to think consciously about every action; this is only seen in learner drivers. We catch a ball by rapid reflex, quickly decide where to lunch in a city full of cafes, cross a busy street unhurt and recognise a friend in a crowd of strangers. These and a million other amazing things we do with those rapid approximations (or *heuristics*) that work most of the time, good enough for hunting wildebeest in the savannah and not so bad in a modern city. Notably enable us to be good at making decisions under uncertainty, such as choosing birthday presents for teenage nieces, where logic is not enough.

Wondrous they may be, but these unconscious shortcuts lead to a very curious and shadowy side of the human mind: the cognitive biases. These are the systematic errors we make, particularly in decision making. They affect virtually every field of human endeavour, crucially so in scientific research. Indeed, the scientific method can be thought of, in large part, as a way to overcome the errors these biases cause. There are now a very large number of cognitive biases that are documented and defined; below is a very biased sample of the more interesting ones.

Confirmation bias
All people have a strong tendency to overestimate the importance of information that supports their existing beliefs, and underestimate information that does not. A good way to get around this is to check our definitely correct beliefs against hard reality.

Hindsight bias or outcome bias
Things that have happened seem inevitable in retrospect; similarly, it seems things that did not happen could not have happened. Since we cannot re-run past events this is a very pernicious bias.

The availability heuristic
A very weird but common bias is to overestimate the importance of information immediately available to us. An important example is that we estimate the prevalence of crime by how easily we recall instances of it. For example, people consistently overstate the toll of terrorist victims (which are fresh in the mind from prominent news reporting) yet understate the toll of traffic accident victims.

Survivorship bias
Related to hindsight bias, this is a very common mistake that comes from considering only surviving examples. Thus, entrepreneurship seems easy because we hear little about businesses that fail and disappear. When we seek to imitate those who were successful, without recognising those who did

similarly were unsuccessful, we fall prey to this bias. Bill Gates dropped out of college, but not many college dropouts do as well as him.

Overconfidence bias
We obviously and strikingly overestimate our abilities while underestimating our overconfidence, leading us to take far greater risks than otherwise, hence the recklessness of youth. This bias influences much of what we do. Related to this is the *Dunning-Kruger effect*, whereby those with high expertise tend strong to underestimate their expertise. Those with low expertise tend to overestimate their expertise, with unfortunate effects.

Narrative bias
The tendency to put strong and inappropriate faith in information that fits well with a good story.

The ostrich effect
A tendency to ignore dangerous or negative information, which is related to confirmation bias.

Selective perception
The tendency for expectations to influence how strongly we perceive things. This is particularly important in pain management.

Zero risk bias
Humans are very poor at estimating risk. Thus, even small risks cause stress, leading to preference for certainty even though it may be counterproductive. This is an important consideration in counselling patients about procedure risks and disease outcomes.

Pro-innovation bias
The tendency to overestimate the usefulness of something if it shows novelty.

Anchoring bias
A puzzling tendency to over-rely on the first piece of information encountered. Thus, the first number suggested tends to frame a negotiation over price, or affect estimate of a quantitative parameter.

Clustering illusion
The tendency to see patterns in random events or data, rather like seeing faces in the clouds. A lot of false beliefs come from this bias.

Choice support bias
The strong tendency to feel positive about something you have chosen or publicly support. This is why your own dog is great even if no one else agrees.

Collider bias
A hard one to but very important in clinical research. Collider bias arises when risk exposure and outcomes affect a third variable (the 'collider'); controlling for the latter variable distorts interpretations. Thus looking at an association between two diseases in hospital inpatients can cause bias both diseases increase the likelihood of hospitalisation. The latter increasing the co-occurrence of the two diseases disproportionately (since only hospitalised people are studied) compared to the general population.

Recency bias
Believing (for no good reason) that newer data is more reliable than older data, and that recent trends have a high likelihood of continuing into the future.

Bandwagon effect
That well known tendency of other people to adopt a belief based on how many people believe it.

Blind spot bias, or cognitive bias bias
The lack of recognition of our own biases while being aware of the biases in others.

The Catalogue of Bias
The large number of biases affecting biomedical research have been systematically documented (with updating as new ones become defined) by a project called the Catalogue of Bias. This is worth a look, as it gives examples as well as strategies to overcome them – go to the website catalogofbias.org

Research and the scientific method
While there are many ways to make mistakes, there are also many ways to overcome them. In science, the way is the systematic checking of ideas and

concepts against reality. There are many 'thinking tools', such as philosophical logic (e.g., induction, falsifiability and paradigms), controlled experiments, statistical analysis, systematic reviews, peer review, seminar presentations, writing grant applications and a plethora of features of the culture of science. Other particular conscious strategies may also be needed – see the Catalogue of Bias website above. Together, these approaches are potent (if not always time-efficient) and necessary ways of tackling biases. Even so the struggle continues, as current low rates of research reproducibility testifies. But foremost we must always be mindful of biases, they never go away because they are part of us.

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