Critical Reasoning 06 – Heuristics

Heuristics from the Greek word Εὑρίσκω (heurisko) for "I find" or "I discover" refers to a class of problem-solving or decision making techniques that involve mental shortcuts, rules of thumb and educated guesses. More often than not, in everyday life, we do not have the luxury of analysing arguments the way we have been. We may be pressed for time or lack complete or accurate information, however to paraphrase the poster at right: "If you wait for perfect information, you'll never get anything decided."

It is not clear to just which discipline the topic of heuristics actually belongs, though there have been multiple inputs from Cognitive Science as Psychology, Philosophy, Computer Science, Law and even Media Studies. The following definition by Judea Pearl is perhaps both more precise and inclusive than that in the informal introduction above:

> Heuristics are strategies using readily accessible, though loosely applicable, information to control problem solving in human beings and machines. (Pearl 1983)

The problem with heuristics however, is that while the might lighten the cognitive or computational load under most circumstances; they are also more error prone. Rather than present an overarching system by which to classify heuristics, we will simply examine them case by case, beginning with the more familiar types below.

The **Representativeness heuristic**, proposed by Amos Tversky and Daniel Kahneman (1972, 1973) refers to a group of mental shortcuts we use when judging the probability of uncertain events. We do this in two ways: by judging

1. the similarity or representativeness of events or things to the population from which they are derived; and
2. the degree to which it reflects the salient features or processes by which it is generated (such as randomness.)

Consider for example, the sequence of births in two families that have six children each. B is for boy and G is for girl.

Family A: G B G B G B Family B: G B G G G G

What would be the probability of each family having the birth sequence that it did?

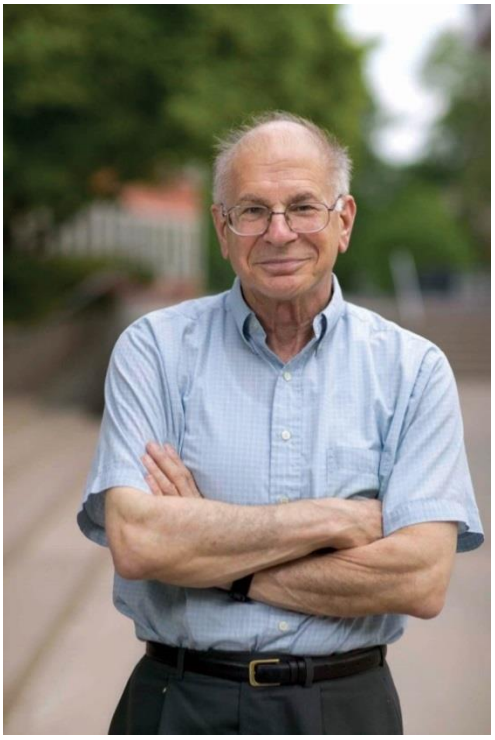
Most people would say that family A's birth sequence would be more probable than that of family B. The correct answer however, would be that they are both equally likely (or rather unlikely.) Since the

birth of one child does not determine the sex of the next, the probability of one child being either a boy or a girl will be exactly half; so that the probability of any particular sequence of six births would be $(½)^6$ = 0,015625 or 1 in 64. The reason that most people judge family A's birth sequence more probable than family B is that:

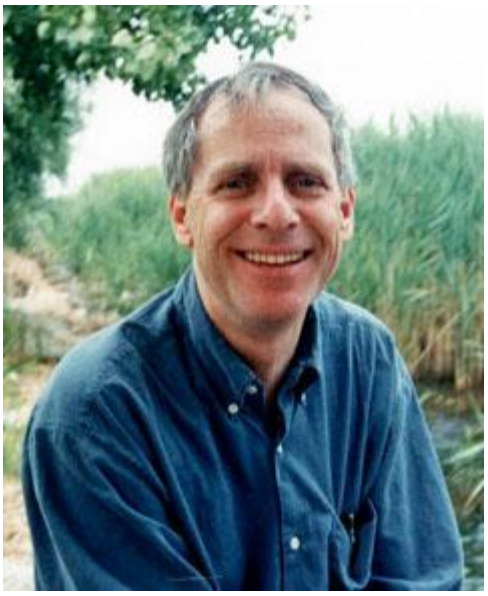
1. A looks more similar or representative of the general population of children than B; and
2. B look more random than A, whereas the order of any birth sequence is entirely random (as far as we know.)

Consider another example: Beth and Dave are placing bets on a sequence of six coin tosses. H is for heads and T is for tails.

Beth: H T H H T H Dave: H T T T T T



Daniel Kahneman, above and Amos Tversky, below, Pioneers in the Field of Heurstics in the Early 1970's



Most people would judge the probability of Beth's sequence of coin tosses much higher than Dave's, whereas they are exactly equal for the same reason as above: The probability of an H or a T per toss is exactly half; so the probability of any particular sequence of six coin tosses would be $(½)^6$ = 0,015625 or 1 in 64. Similarly the reason for believing Beth's sequence to be more probable than Dave's is that Beth's sequence "looks more random" than Dave's.

Another instance of the representativeness heuristic is the **gambler's fallacy**. What is the probability that Dave's seventh toss of his coin will be heads? Most people would say: higher that even because Dave has just had a run of tails, so somehow heads is due. Because the toss of one coin is causally independent from that of the next, the odds of any particular coin toss being either heads or tails is exactly half, irrespective of what went before.

Yet another variant of the representativeness heuristic is the **hot-hand fallacy** or **hot-hand phenomenon**, which is the belief that someone who has experienced success with a random event has a greater chance of success in subsequent events. Empirical investigations however have confirmed such events to be causally independent of one another, so that one is no more or less likely to succeed in subsequent random attempts, irrespective of a prior "hot streak."

If the representativeness heuristic is so error prone, why do we rely on it so often? Robert Sternberg (2012 p. 448-9) explains: Suppose we decide to bring an umbrella to work based on the fact that it

rained yesterday, looks overcast today and is late autumn, all of which represent characteristics of days on which it rains, then we are using the representativeness heuristic correctly. However when we mistakenly believe that small samples of events or people that are familiar to us, represent the characteristics of the population from which they are drawn, we may generate conclusions that suit ourselves based on anecdotal evidence alone.

Another reason why people misuse the representativeness heuristic is that they fail to take into account the relevant **base rate**, which refers to the prevalence of an event or characteristic in the population from which it is drawn. Suppose for example that we learn that 100 people have recovered from a cold within seven days using medicine X. We may be highly impressed, until we learn that in the clinical trial those 100 who recovered using medicine X, were only 1% of the total of 10 000 participants. We may no longer be impressed. Suppose we further learn that of those taking the placebo, 10% also recovered from their cold within seven days. Now medicine X is looking worse than ineffective, which means it is at best a **nocebo** (a sham treatment that causes adverse effects; the opposite of a placebo) or at worst toxic; none of which wold we have been able to reliably estimate had we not taken the base rate into account.

The **availability heuristic** (Tversky & Kahneman 1973) is the tendency to make judgements about the frequency of events based on how easy it is to recall similar events. People tend to overestimate the frequency of instances similar to those that they can recall with ease, while underestimating those for which similar instances are harder to recall. *E.g.* Are there more words in the English language beginning with the letter R than with R as their third letter? Most people wold say that there are more words beginning with R because it is easier to think of examples of words beginning with R, when in fact there *are* many more words with R as their third letter. The same is true for K, L, M and V.

So while the availability heuristic saves on the time it takes to form such judgements by considering only similar examples that come easily to mind, it is much prone to error because what comes easily to mind is seldom, if ever, representative of the true frequency of events out there.

The Placebo *vs.* Nocebo Effect

The placebo effect (from Latin for "I will please") is observed in subjects who are given sham treatments (*e.g.* sugar pills with no active ingredient but that do resemble real pills,) who never the less derive some measurable benefit, presumably because they believe in the curative properties of the treatment they receive. On the other hand the nocebo effect (from Latin for "I will harm") is observed in subjects who are given harmless sham treatments, but who experience measurable adverse effects, presumably because they believe that the treatment that they have received will harm them in some way. Both the placebo and the nocebo effects are demonstrably real and appear to stem from mental or emotional causes, which are largely unconscious.

Clinical trials of prospective medical treatments, besides having to prove that they are safe, also have to prove that they are more efficacious than placebos before they receive approval.

A practical investigation: If you live with a partner, housemate or even a roommate, ask a neighbour who knows you both well to draw up a list of 20 chores that you do around the house, such as taking out the trash or doing the laundry, excluding those that you might do together, such as walking the dog. Now make a copy for your partner so that you both have one. Without looking at each other's list, tick off all the items that you do. Both of you would probably have ticked off about 16 of the 20

items each or about 80%. But this is practically impossible because your 80% plus your partner's 80% does not equal the 100% of the chores that get done. What is going on here is that both of you have been using the availability heuristic to tick off tasks for which it is easier for each of you to think of having done, hence the overestimate on both sides.

The availability heuristic is an unconscious process, that according to Tversky & Kahneman operates on the notion that "if you can think of it, it must be important," so it is unlikely that we could avoid it altogether. What we should guard against however is making decisions based solely on what we can readily call to mind.

The **familiarity heuristic** applies to various situations in real life which appear similar to previous situations, especially under high cognitive load. The familiarity heuristic developed out of the discovery of the availability heuristic which, recall, reveals that the estimated frequency of events is based on how easily such examples come to mind, thus the familiarity heuristic in turn, proposes that people judge events as more frequent or important based on how *familiar* they are in memory.

For example, in one experiment Tversky and Kahneman drew up four lists with 39 names on each, 19 female and 20 male. These were then shown to two groups: one was asked to recall as many names as possible, the other to judge whether there were more male or females on their list. Those whose list included famous female names reckoned that there were more female names on their list than males, while those whose list included famous male names reckoned that there were more male names on their list than females, presumably because famous names are more familiar.

One down side is that lay persons are more likely to make decisions regarding their health based familiarity or availability than on factual information, as would a health professional. Thus they are more likely to opt for treatments that might have worked for them in the past, rather than what is indicated in the present. Indeed they may even shun more appropriate or generic alternatives in favour of brand name medicines that they are familiar with. (Cytryn 2001)

The **anchoring and adjustment heuristic** (Tversky & Kahneman 1974) describes how people rely too heavily on the first piece of information they are given by using it as a reference point or "anchor" from which they then make insufficient incremental adjustments based on further information. In one of their studies Tversky and Kahneman asked participants estimate the product of the first eight natural numbers either as 1 x 2 x 3 x 4 x 5 x 6 x 7 x 8 or in reverse as 8 x 7 x 6 x 5 x 4 x 3 x 2 x 1, the first number of each sequence (either 1 or 8) serving as the anchor. When 1 was the anchor the average estimate was 512; however when the anchor was 8 the average estimate jumped to 2 250, yet well short of the actual answer of 40 320. Thus both groups made insufficient adjustments from their anchor number.

A more commonplace example comes in the form of second hand car purchases: A used car salesman will always start out high and negotiate his way down, in the hope that the customer will anchor at the higher price, so that any offer lower than the initial will seem reasonable, even if it is still overpriced.

Unfortunately the anchoring an adjustment heuristic very hard to avoid, even when the anchors given are obviously wrong or we are forewarned to correct for its effect. Moreover it appears to affect people's judgement in spite of their level of expertise or cognitive ability. There is no

consensus in the literature on how to avoid the kinds of errors that we make when anchoring and adjusting, except to say that this may be just another feature of our all too human nature.

The **escalation of commitment heuristic** (Straw 1976) or **sunken costs fallacy** describes people's tendency to justify increased investment based on cumulative investments in the past (the sunken costs,) irrespective of new evidence suggesting that the cost of continuing investment might outweigh returns. The proverbial "In for a penny, in for a pound" or "throwing good money after bad" captures the sentiment. The investment *per se* need not be money; it could be time, human resources or even human lives in the case of protracted military conflicts such as the Vietnam War or the war in Iraq. More mundane examples include people who continue to invest in long term projects with diminishing yields on the grounds that they have already invested so much or the gambler who erroneously reasons that he has to go on playing because he has already spent an inordinate amount at some table and that to walk away would be a waste of the money he has already played.

The escalation of commitment heuristic can also lead to aggressive bidding wars, in which bidders end up paying far more for an item than it is worth because they justify further escalation of bids on the basis of the initial costs of bidding. And it is not just humans who are prone to this effect: in 2011 pricing bots on Amazon raised the cost of the book *The Making of a Fly* to over $23 million.

The causes of the escalation of commitment heuristic among humans are several and diverse, including psychological, sociological as well as cultural and environmental inputs. What is important from the point of critical reasoning however is to be able to identify such patterns as sunken cost fallacies in appeals for escalating commitment to lines of argument or principles that derive less benefit than such commitment might justify. The following is a fictitious example about how one such scenario might unfold:

> Sally and Anne are both veterinarians who jointly run a successful practice specialising in large mammals. One day a large wooden crate arrives without any paperwork. An animal can be heard pacing about inside. Based on the history and type of shipments to their practice, Sally theorises that the animal in the crate must be a tiger. Anne is intrigued and sniffs around the crate for a clue. She announces to Sally that the animal in the crate can't be a tiger because it doesn't have that "big cat smell." Sally is undeterred, reminding Anne that there is a rare genetic condition among big cats that sometimes renders them odourless. Anne concedes that this *just may* be such a cat but that she wants to get a better look. She shines a torch into one of the cracks in the wood but can only make out patches of white fur. "Well at lest we know it is a mammal," she tells Sally who agrees but still insists it must be a tiger and an albino at that. Both veterinarians know that albinism is very rare but well documented among big cats. Anne however, growing impatient with Sally, breaks apart one corner of the crate and rashly thrusts her hand in. The creature licks her hand gently. Sally is unmoved, maintaining that the animal within must be an extremely rare, tame, odourless, albino tiger…

What is going on here is that Sally is prepared to qualify her theory at every turn in the face of contrary evidence, rather than simply conceding that the creature in the crate is probably not a tiger. If she persists in this manner her pet theory will succumb to a "**death by a thousand qualifications**," not because it can be proven wrong by any shadow of a doubt but because at each turn she is demanding an escalation of credulity that is not warranted. Many defunct philosophical

and scientific theories have gone this way but on a practical level we should simply resist being drawn into such arguments or schemes at any stage.

Other cognitive biases

A **cognitive bias** is any pattern of deviation of judgement from some rational norm. In this sense all heuristics and fallacies belong to the class of cognitive biases, however not all cognitive biases are heuristics or fallacies because they aren't necessarily rule or argument based respectively. There are perhaps twenty to thirty named cognitive biases, some variations on others, therefore we shall consider here only those that are most common or salient.

The **framing effect** refers to that cognitive bias whereby people react differently to a particular choice, depending on how it is contextually framed, either positively or negatively. In general we are more risk averse when presented with a positive frame, *i.e.* we favour small but certain gains over large but uncertain gains. On the other hand, we are more risk seeking when presented with a negative frame, *i.e.* we favour large but uncertain losses over small but certain losses. One of the problems with the framing effect is that people are typically exposed to only one frame when presented with options from which to choose.

Tversky and Kahneman (1981) for example, investigated how different frames affected people's responses to a hypothetical life and death situation. Suppose you have to choose between two treatments for 600 people infected with a deadly virus. Vaccine A has a 33% chance of saving all 600 people and a 66% chance of saving no one, whereas Vaccine B has a 33% chance that no one will die but a 66% chance that all 600 will die. If we convert the probabilities to numbers we see that the survival rates for both vaccines are the same: 200 will live while 400 will die. However when Vaccine A was presented with a positive framing, such as "saves 200 lives," it was chosen by 72% of the participants in the study. However when the same vaccine was presented with a negative framing, such as "400 people will die," it was chosen by only 22% of the participants.

The framing effect manifests in childhood and grows stronger with age, becoming strongest among older adults. However when provided with sufficient and credible information the framing effect diminishes or may even be extinguished. Interestingly, the framing effect appears to vanish when thinking in a foreign language. (Keysar *et al*. 2012) The lesson is clear: a) forearm yourself with ample and credible information before making a decision that might be influenced by the way it is framed and b) think it through in another language. If you don't already speak a foreign language this is yet another incentive to learn one.

Illusory correlation (Chapman & Chapman 1967) was first used to describe people's tendency to overestimate relationships between two groups when presented with distinctive and unusual information. For example Hamilton and Gifford (1976) asked participants to read a series of sentences describing ether desirable or undesirable behaviour which were attributed to either a majority group A or a minority group B proportionately so that there was, by design, no correlation between behaviour and group membership. Abstract groups were used so as not to introduce any bias. Participants were accurate in their associations when they regarded positive and hence indistinctive behaviour, however negative and hence distinctive behaviours were overestimated in the minority group.

Illusory correlations underlie much of our negative stereotyping towards minority groups, indeed Chapman and Chapman (1969) used illusory correlations discredit the use of "Wheeler signs" for homosexuality in Rorschach tests in use at the time.

As with the framing effect, children do crate significant illusory correlations however the effect is stronger in adults. Similarly, illusory correlations are dependent upon cognitive load but also on cognitive capacity in the form of **working memory** (that part of memory which holds multiple pieces of transitory information in mind, where they can be manipulated. The average number of items that can be held in human working memory is 7 ±2 according to Miller's (1956) law.) Essentially, individuals with higher working memory capacity view minority group members more favourably than those with lower working memory capacity and an increase in working memory load leads to an increase in the prevalence of illusory correlations. (Eder *et al.* 2011)

Illusory correlations also underlie some of our more quirky behaviour such as wearing a lucky item of clothing or jewellery when participating in a certain activity or avoiding other behaviour so as not to jinx an outcome. Fortunately research has shown that educating people about the way illusory correlations work decreases their prevalence. (Murphy *et al.* 2011)

The **overconfidence effect** refers to that cognitive bias by which our subjective confidence in our own judgements systematically exceeds their objective accuracy, especially when confidence is relatively high. (Pallier *et al*. 2002) When playing a game like Trivial Pursuit for example, we might claim to be "99% certain" of our answers and yet get them wrong 40% of the time. Although this is a trivial example of a trivial game, the practical implications for overconfidence are potentially catastrophic. Indeed many strikes, litigation and even wars may be said to arise from **overplacement** (the false belief that one is better than others. (Alicke & Govorun 2005)) The more confident unions, litigants and even nations are that they are better or stronger than their opponents, the more willing they will be to engage in conflict.

Unfortunately people do not adjust for the overconfidence effect, even when they have been warned about it. (Alpert & Raiffa 1982) Indeed, one group of psychologists and psychology students' confidence increased when they were given more information about a case study even though their accuracy did not improve. (Oskamp 1995) Since the phenomenon is so pervasive we are unlikely escape it, however we would do well to remind ourselves that we are mistaken more often than we believe and that we are not better than others. We may do any number of things exceptionally well, but that does not make any of us exceptionally worthy.

The **correspondence bias** or the **attribution effect** also known as the **fundamental attribution error** is the tendency to draw inferences about a person's unique and enduring character and dispositions from behaviour that can be otherwise entirely explained by the situation in which it occurs. (Gilbert & Malone 1995) In other words, we overestimate the correspondence between some aspect of a person's behaviour and their personality while ignoring the context in which it occurs or is caused to occur. Suppose, for example, that you see a woman beside herself with anger, scolding a child by the side of the road. Naturally you assume that she is an angry woman and probably not fit to be around children. However if *you* were that woman beside the road, scolding your child for running in the traffic you'd believe *yourself* to be entirely justified in *such a situation*. Thus we attribute our actions to our situation, viewing them as perfectly normal. Yet when we observe other people's behaviour we conclude that it corresponds to their character, ignoring their unique history and circumstances.

Although it is not surprising to learn that people tend to be subject to the correspondence bias under cognitive load, when they have little motivation or energy (Gilbert 1989) there is as yet no consensus on what might explain the phenomenon. One hypothesis, for which there is some empirical evidence, observes that we do not take behavioural and situational information simultaneously into account we tend to characterise a person's dispositions. (Gilbert 2002) Initially we characterise a person based on the behaviour we observe via **automaticity** (without occupying the mind with the low-level details required, thus allowing it to become an automatic response pattern or habit.) (Carlson & Skowronski 1994, Moskowitz 1993, Newman 1993, Uleman 1987 and Winter & Uleman 1984) However what we then fail to do is to make the subsequent, effortful and conscious situational adjustments required.

Fortunately we are not powerless against the correspondence bias: The following have been found to be effective in reducing the effect:

- Ask yourself whether most people would behave in the same way in the same situation. If so the situation is most likely to be the cause of the behaviour, not someone's character.
- Ask yourself how you would behave in such a situation.
- Look for less obvious causes that you might have failed to notice.

("Fundamental attribution error" *Wikipedia* 2013-07-11)

The **hindsight bias** or **creeping determinism** (Fischhoff 1982) more commonly expressed by the phrase, "… knew it all along," is the tendency to view past events as more predictable than they were before they occurred. When we look back at a situation we frequently believe that we can see all the signs leading up to a particular event. In personal relationships we often fail to heed signs of strain until it is too late and a breakup is inevitable, at which point we ask ourselves in disbelief, "Why didn't I see it coming? It was so obvious! I should have seen the signs." (Sternberg 2012 p. 453 - 454)

In a now classic experiment by Fischhoff in 1975, participants were given a short story with four possible outcomes, one of which they were told was true. They were then asked to assign the likelihood of each particular outcome. The participants typically assigned a higher likelihood of occurrence to the outcome they had been told was true. Had they not been using hindsight the likelihood of any particular occurrence should not have exceeded that of chance.

There are several theories that purport to explain the hindsight bias: According to the Causal Model Theory (CMT) (Blank & Nestler 2007) when an event has not turned out as expected we create causal reasoning from the conditions of the starting event. This leads us to think that the outcome was inevitable. Such causal attributions may be motivated by wanting to feel more positive about an outcome and possibly ourselves. When there is a discrepancy between our expectations of an event and the reality of an outcome we selectively retrieve only those memories that support the current outcome because we want to make conscious sense of what has happened. (Nestler et al. 2008)

The hindsight bias appears to affect both children and adults (Bernstein 2004) and continues to manifest even after it has been explained to people. (Pohl & Hell 1996) This is consistent with the CMT's use of sense-making to understand outcomes. The hindsight bias however has been shown to

decrease in tests in which participant's answers were made more accountable. (Blank & Nestler 2007)

Of all the cognitive biases the hindsight bias *appears* to be the most innocuous because, after all, we are looking back upon what has already happened and what we can't change. On the other hand it has been implicated in interfering with certain mental health conditions such as schizophrenia and post-traumatic stress disorder, medical diagnoses, banking and investment decisions as well as the judiciary. Physicians, for example, who had been primed with a possible diagnosis before evaluating a patient's symptoms, were themselves more likely to arrive at the primed diagnosis than those who were provided only with the symptoms. (Arkes *et al.* 1981) The consequences for misdiagnoses are truly alarming. In the legal arena, the hindsight bias makes defendants especially likely to be judged as having been capable of preventing a bad outcome, which they could not have foreseen. Even plaintiffs are affected but to a lesser degree. The hindsight bias may make the assumption of risk seem even riskier when there is a bad outcome, leading to plaintiffs to be judged as having failed to exercise due caution. (Starr & McCormick 2001) The consequences for miscarriages of justice are equally alarming!

Taking Stock

Although much of this study unit has been concerned with how certain heuristics and other cognitive biases can lead us to make bad or faulty judgements based on insufficient or uncertain information, they themselves are not intrinsically bad. More often than not they lead to sound conclusions with very little cognitive effort on our part. And while we may not be perfectly rational, Cartesian agents there is a limit on our irrationality too. (Cohen 1981) We can and do act rationally most of the time and we can improve with practice by:

- Avoiding snap judgements when we can. Don't let people pressurise you into making overhasty decisions. Take time to deliberate, especially if a decision is important. At best sleep on it.
- Clearing our minds of distractions and other thoughts that might be making demands on our finite cognitive resources.
- Assessing the quality of information on which we base our decisions. Is it incomplete? Is it credible? Is any of it ambiguous or lacking in clarity?

In addition Sternberg (2006 p. 454) recommends:

- Obtaining specific feedback on improving our decision making structures.
- Using probabilities appropriately.
- Avoiding overconfidence in our intuitive guesses regarding optimal choices.
- Using careful reasoning in drawing inferences about the options available to us, and
- Cultivating "street-smarts" in utilising our intellectual competence in our daily lives (as opposed to being merely "book-smart," "work-smart" or "internet-savvy," for example.)

Task

There any number of clever tests of varying quality, designed to measure susceptibility to faulty reasoning based on heuristics and other cognitive biases, however because the practical aim of this

study unit is to make of us better decision makers rather than better test takers, you are invited instead to keep a decision diary for just one week or longer if you wish:

> Each day chose one or two decisions that you have to make before doing so. Using the recommendations above, write down the decision you have to make along with the options open to you. Also write down any foreseeable outcomes and assign each a realistic probability from 0% for physically impossible to 100% for inevitable. For all others assign an intermediary value. Now try to infer what each outcome might logically and practically entail. Next jot down what information you have at hand on which to base your decision and gauge its quality. First of all do you actually believe all of it or part of it to be true? Might you need more or better information? If so, would a little research help or are there some areas of uncertainty for which no reasonable amount of research would make a difference? Finally, check to see that you have not succumbed to any of the faulty patterns of judgement described in this study unit nor been swayed by fallacious arguments such as those in critical reasoning unit 04. If you have been, go back. When you are ready, make your decision.
>
> When the outcome of your decision becomes apparent write it down. Was it the outcome you were hoping for? Beware of the hindsight bias in judging your decision. Everyone could have chosen better in hindsight. At this point you might wish to share your decision making process and its outcome with a friend for feedback and for another perspective. A romantic partner of BFF might not give you the most objective feedback, if only because they are likely to share the same cognitive biases as you.
>
> Once you have collected a week of such decisions, review them again, perhaps with the same friend. A pattern or style of personal decision making should emerge from what you have recorded. Certain aspects of your personal style of decision making may be leading to unwanted outcomes. Perhaps you spend too much time gathering as much information as possible and don't devote enough time to making careful, deliberate inferences about possible outcomes. Perhaps you do the opposite and overthink every single possibility but fail to take in much of the initial information available to you. Perhaps you are so focused on what your decision might entail for others that you fail to take your own priorities adequately into account. Yet others leave too much to chance and are just resigned to their "fate." The variations are endless. The point is that we want to effect change for the better and this sort of exercise focuses our attention on those personal styles of decision making that are either working towards the outcomes that we seek or are letting us down. Once we have that insight we can make a conscious decision to do so.
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> In the following critical reasoning unit we will be introducing the logically rigorous method of deduction.

References

ALICKE, M. & GOVORUN, O. (2005) The better-than-average effect. **In** Alicke, Dunning & Krueger (Eds.) *The self in social judgment.* Psychology Press : New York 85 - 106

ALPERT, M. & RAIFFA, H. (1982) A progress report on the training of probability assessors. **In** *Judgment under uncertainty: Heuristics and biases*. Kahneman, Slovic & Tversky (Eds.) Cambridge University Press : Cambridge 294 - 305

ARKES, H. *et al.* (1981) Hindsight bias among physicians weighing the likelihood of diagnoses. *Journal of Applied Psychology* **66** : 252 - 254

BERNSTEIN, D. *et al.* (2004) We Saw It All Along: Visual Hindsight Bias in Children and Adults. *Psychological Science* **15**: 264 - 267

BLANK, H. & NESTLER, S. (2007) Cognitive Process Models of Hindsight Bias. *Social Cognition*, **25** (1) 132 - 147

CARLSTON, D. & SKOWRONSKI, J. (1994). Savings in the relearning of trait information as evidence for spontaneous inference generation. *Journal of Personality and Social Psychology* **66** : 840 - 880

CHAPMAN, L. & CHAPMAN, J. (1967) Genesis of popular but erroneous psychodiagnostic signs. *Journal of Abnormal Psychology 72* (3): 193 - 204

CHAPMAN, L. & CHAPMAN, J. (1969) Illusory Correlation as an Obstacle to the Use of Valid Psychodiagnostic Signs. *Journal of Abnormal Psychology* **74** (3): 271 – 80

COHEN, J. (1981) Can human irrationality be experimentally demonstrated? *Behavioral and Brain Sciences* **4** : 317 - 331

CYTRYN, K.N. (2001) Lay reasoning and decision-making related to health and illness. **In** *Dissertation Abstracts International: The Sciences and Engineering* : 1 - 200

EDER, A. *et al.* (2011) Illusory correlations revisited: The role of pseudocontingencies and working-memory capacity. *Quarterly Journal of Experimental Psychology* **64** (3): 517 - 532.

FISCHHOFF, B. (1982) For those condemned to study the past: Heuristics and biases in hindsight. **In** *Judgment under uncertainty: Heuristics and biases*. Kahneman, Slovic & Tversky (Eds.) Cambridge University Press : Cambridge 335 - 351

GILBERT, D. (1989) Thinking lightly about others: Automatic components of the social inference process. **In** *Unintended thought.* Uleman, J. & Bargh, J. (Eds.) 189 - 211 Guilford Press : New York

GILBERT, D. (2002). Inferential correction. **In** *Heuristics and biases: The psychology of intuitive judgment.* Gilovich, T., Griffin, D. & Kahneman, D. (Eds.) Cambridge University Press

GILBERT, D. & MALONE, P. (1995) The correspondence bias. *Psychological Bulletin* **117** (1) 21 - 38

HAMILTON, D. & GIFFORD, R. (1976). Illusory correlation in interpersonal perception: A cognitive basis of stereotypic judgments. *Journal of Experimental Social Psychology* **12** (4): 392 - 407

KAHNEMAN, D. & TVERSKY, A. (1972) Subjective probability: A judgment of representativeness. **In** Kahneman, Slovic, Tversky. *Judgment under uncertainty: Heuristics and biases*. Cambridge University Press : Cambridge

KAHNEMAN, D. & TVERSKY, A. (1973) On the Psychology of Prediction. *Psychological Review* **80** : 237 - 251

KEYSAR, B. *et al.* (2012) *The Foreign-Language Effect. Thinking in a Foreign Tongue Reduces Decision Biases*. http://pss.sagepub.com/content/early/2012/04/18/0956797611432178

MILLER, G. (1956) The magical number seven, plus or minus two: Some limits on our capacity for processing information. *Psychological Review* **63** (2): 81 – 97

MOSKOWITZ, G. (1993) Individual differences in social categorization: The influence of personal need for structure on spontaneous trait inferences*. Journal of Personality and Social Psychology* **65** 132 - 142

MURPHY, R. *et al.* (2011) Making the illusory correlation effect appear and then disappear: The effects of increased learning. *Quarterly journal of Experimental Psychology* 1 **64** : 24 - 40

NESTLER, S. *et al.* (2008) A Causal Model Theory of Creeping Determinism. *Social Psychology* **39** (3) 182 - 188

NEWMAN, L. (1993). How individuals interpret behavior: Idiocentrism and spontaneous trait inference. *Social Cognition* **11** 243 - 269

OSKAMP, S. (1965) Overconfidence in case-study judgements. *The Journal of Consulting Psychology (American Psychological Association)* **2** : 261 - 265. Reprinted **in** Kahneman, Slovic & Tversky (1982) *Judgment under uncertainty: Heuristics and biases*. Cambridge University Press 287 - 293

PALLIER, G. et al. (2002) The role of individual differences in the accuracy of confidence judgments. The Journal of General Psychology **129** (3) : 257ff

PEARL, J. (1983) *Heuristics: Intelligent Search Strategies for Computer Problem Solving.* New York : Addison-Wesley, p. vii

POHL, R. & HELL, W. (1996) No reduction in Hindsight Bias after Complete Information and repeated Testing*. Organizational Behaviour and Human Decision Processes* **67** (1) 49 - 58

STARR, V. & McCORMICK, M. (2001) *Jury Selection* (3rd Ed) Aspen Law and Business

STERNBERG, R.J. (2012, 2006) *Cognitive Psychology* 6th, 4th Eds. Thomson Wadsworth

STRAW, M. (1976) Knee-deep in the Big Muddy: A Study of Escalating Commitment to a Chosen Course of Action. *Organizational Behavior and Human Performance* **16** (1) : 27 - 44

TVERSKY, A & KAHNEMAN, D. (1973) Availability: A heuristic for judging frequency and probability. *Cognitive Psychology* **5**(1) : 207 - 233

TVERSKY, A & KAHNEMAN, D. (1973) Judgment under uncertainty: Heuristics and biases. *Science* **185**: 1124 - 1130

TVERSKY, A & KAHNEMAN, D. (1981) The framing of decisions and the psychology of choice. *Science* **211** (4481) : 453 – 458

ULEMAN, J. (1987) Consciousness and control: The case of spontaneous trait inferences. *Personality and Social Psychology Bulletin* **13** (3) : 337 - 354

WINTER, L. & ULEMAN, J. (1984) When are social judgements made? Evidence for the spontaneousness of trait inferences. *Journal of Personality and Social Psychology* **47** : 237 - 252