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Cognitive debiasing 2: impediments to and strategies for change

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ABSTRACT

In a companion paper, we proposed that cognitive debiasing is a skill essential in developing sound clinical reasoning to mitigate the incidence of diagnostic failure. We reviewed the origins of cognitive biases and some proposed mechanisms for how debiasing processes might work. In this paper, we first outline a general schema of how cognitive change occurs and the constraints that may apply. We review a variety of individual factors, many of them biases themselves, which may be impediments to change. We then examine the major strategies that have been developed in the social sciences and in medicine to achieve cognitive and affective debiasing, including the important concept of forcing functions. The abundance and rich variety of approaches that exist in the literature and in individual clinical domains illustrate the difficulties inherent in achieving cognitive change, and also the need for such interventions. Ongoing cognitive debiasing is arguably the most important feature of the critical thinker and the well-calibrated mind. We outline three groups of suggested interventions going forward: educational strategies, workplace strategies and forcing functions. We stress the importance of ambient and contextual influences on the quality of individual decision making and the need to address factors known to impair calibration of the decision maker. We also emphasise the importance of introducing these concepts and corollary development of training in critical thinking in the undergraduate level in medical education.

INTRODUCTION

In the first of these two papers, we suggested that cognitive debiasing is an essential skill in developing sound clinical reasoning. We reviewed the origins of innate and acquired cognitive biases and some proposed mechanisms for how debiasing processes might work.[1] In this paper, we first examine some barriers to debiasing and then review multiple strategies to address them.

Over the years, various strategies have been adopted to deal with shortcomings and failures in decision making. As early as 1772, Ben Johnson outlined a 'moral algebra' to improve his judgements and avoid rash decisions.[2] Proverbs, aphorisms, caveats, mnemonics, lists and many other strategies have emerged that serve a similar purpose. Investigations on their effectiveness have not been so frequent and, presently, cognitive debiasing is an inexact science. Here, we offer a variety of strategies from both behavioural sciences and medicine that have been developed in recent years, which vary from experimental studies to simple observations to opinions, with varying levels of evidentiary support. Our purpose has been to develop an inclusive collection of strategies in a framework for learners, researchers and educators that will provide a practical scaffold for the work ahead.

Cognitive debiasing involves changes that rarely come about through a discrete, single event but instead through a succession of stages—from a state of lack of awareness of bias, to awareness, to the ability to detect bias, to considering a change, to deciding to change, then initiating strategies to accomplish change, and finally, maintaining the change. These key steps are outlined in figure 1,[3] which may help our understanding of how physicians might engage in debiasing. Several caveats need to be applied to this model: first, a clinician making a biased response does not necessarily mean that the decision maker was unaware of correct approaches to make decisions[4]; second, for biases to be successfully addressed, there needs to be such awareness as well as the motivation for change; third, the clinician needs to be aware of the direction in which the bias is taking him or

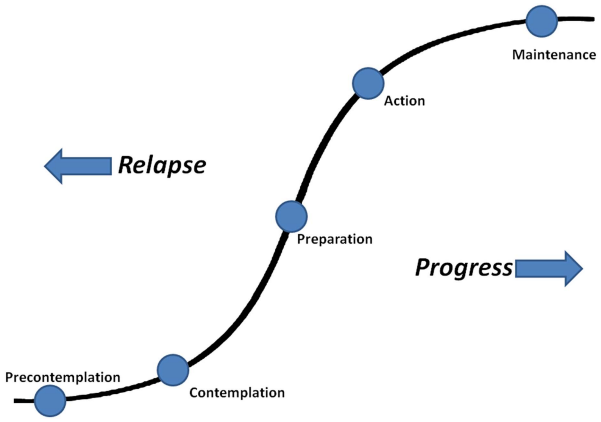

Figure 1 Transtheoretical model of change.

her and its magnitude; and finally, even if the clinician is aware of a potential for bias in a particular situation, he or she might still be unable to shake the conviction of his or her biased judgement.[5]

Many clinicians presently appear to be at the *precontemplative* level. They may be unaware of the powerful influence of unconscious factors on their reasoning, may not realise that cognitive and affective biases can affect their decision making, and therefore, see no reason to take any action to change their thinking. Introducing these ideas and raising awareness is a prerequisite for debiasing. Sometimes a sentinel event can catalyse the uptake of an important idea such as the publication of Groopman's book *How Doctors Think*.[6] Conventional forms of information exchange, such as rounds, seminars, and morbidity and mortality conferences, may provide opportunities to address cognitive pitfalls within the context of engaging case examples. At times, however, a single experience, which can be shared in such moments, can change thinking. This happens especially if the event is emotionally laden because we tend to be particularly influenced by emotionally arousing experiences.[7 8] For example, if a physician misdiagnoses a headache as benign and the patient subsequently dies from a subarachnoid haemorrhage, the powerful impact of this experience might produce long-standing changes in the physician's approach towards the diagnosis of patients presenting with headache.

Increasing physicians' awareness of the need for debiasing does not guarantee, however, that debiasing actually occurs. Indeed, since Fischoff's pioneering work,[9] a general mood of gloom and doom towards cognitive debiasing in the psychology and medical literature seems to have prevailed[5 10]; it is accepted to be a difficult but not an impossible task. A variety of factors may explain the intractability of cognitive bias and why it is so difficult to change. In addition to lack of awareness of the impact of bias in clinical reasoning, clinicians' overconfidence in their own judgements may be one of the most powerful factors preventing debiasing.[11] Even those physicians who are aware of the potential impact of biases on clinical judgement may not believe that they are vulnerable to them. Moreover, it is a human tendency to bolster existent beliefs rather than searching for new approaches, and it is easier to stay with the status quo rather than make efforts to learn new approaches and change current practice. Physicians are not immune to these tendencies. Finally, the invariably abstract, arid form of the discussions of cognitive processes contributes to these impediments: they typically lack the vividness and concrete nature of clinical disease presentations that are more appealing to clinicians.

This becomes even more challenging if one considers that biases tend to act unconsciously. A general problem with debiasing, as Horton notes, is that 'the same kinds of biases that distort our thinking in general also distort our thinking about the biases themselves'.[8] Indeed, many biases are applied unconsciously, and if physicians are unaware of them, they will have difficulty recognising the need for debiasing. Clinicians themselves may be just as vulnerable as their patients to a number of psychological factors that might compromise decision making.[12 13] Nevertheless, the topic has attracted considerable interest and effort, reflecting a widespread perception of the need for solutions to the vulnerability of human reasoning.[14]

STRATEGIES FOR COGNITIVE DEBIASING

In the first of these combined papers, we suggested that debiasing would require a physician to detect the need to override the initial intuitive responses to a problem in order to engage in analytical processes to restructure reasoning and find alternative solutions. The extent to which a physician tends to engage—and succeed—in debiasing depends not only on his/her prior knowledge and experiences but also on thinking dispositions. Some of the strategies described aim at making physicians aware of the risk of biases, intervening during the contemplation and preparation steps to enhance their ability to detect the need for debiasing in the future; we have grouped these under 'educational strategies' in table 1. While educational strategies aim mostly to enhance physicians' ability to debiasing *in the future*, other strategies may be implemented by the physician *at the time of problem-solving*, while reasoning about the problem at hand. These strategies have been grouped under 'workplace strategies' in table 1 and include both strategies that depend basically on physicians' cognitive processes and those that require interventions in the settings of practice. Whereas some of these strategies have been evaluated and some empirical evidence exists that supports their use, others are supported mostly by research in other domains; still others have a long-standing tradition in clinical practice but have not usually been subjected to formal investigation.

In table 2, we describe a number of strategies that are collectively referred to as 'forcing functions'. The

Table 1 Educational and workplace strategies for cognitive debiasing

Strategy	Comment	Examples
Educational		
training on theories of reasoning and medical decision making	Achieving improved diagnostic reasoning requires an understanding of cognitive theories about decision making and the impact of cognitive biases[15–18]	▶ Educational curricula covering theories of decision making, major cognitive and affective biases and their application to diagnostic reasoning[19–21]
Bias inoculation	A key recommendation is to teach about cognitive and affective biases and develop specific tools to test for them[22–24] and for debiasing	▶ A 'consider-the-opposite' procedure marginally reduced anchoring in judgements of personality traits[25] ▶ Cognitive forcing strategies to counteract cognitive bias showed minor effects[26]
Specific educational interventions	Teaching specific skills may mitigate particular biases by providing basic knowledge leading to greater insight	▶ People trained in inferential rules committed fewer base rate errors[27 28] ▶ Combining a non-analytical with an analytical approach in reading ECGs improved diagnostic accuracy[29]
Cognitive tutoring systems	Computer-based systems can be used to construct a learner's profile of decision making and provide feedback on specific biases and strategies to mitigate them	▶ Decision monitoring software of virtual slide cases detected cognitive biases according to preset criteria[30]
Simulation training	Simulation may be a venue for teaching about, identifying and remediating cognitive errors[31]	▶ Residents experienced a simulation involving a difficult diagnosis with a cognitive error trap[32]
Workplace		
Get more information	Heuristics and biases often arise in the context of insufficient information. Diagnostic accuracy is related to thoroughness of cue acquisition[33]	▶ The greater the number of attributes of a problem that can be identified, the greater the likelihood of selecting the best alternative[34]
Structured data acquisition	Forcing deliberate data acquisition may avoid 'spot diagnoses' [35 36] by ensuring that less obvious symptoms are considered	▶ Traditionally, data acquisition has been pursued by establishing a differential diagnosis list, and more recently by employing a differential diagnosis checklist tool[37]
Affective debiasing	Virtually all decision making involves some degree of affective influence. Many affective biases are hard-wired. Decision makers often are unaware of the affective influences on decision making[38 39]	▶ Overview of affective biases and recommendations for debiasing are available[20]
Metacognition, decoupling, reflection, mindfulness	A deliberate disengagement or decoupling from intuitive judgements and engagement in analytical processes to verify initial impressions[1]	▶ Deliberately reflecting upon initial diagnoses led to better diagnoses in difficult cases[40] and counteracted availability bias[41]
Slowing down strategies	Accuracy suffers when diagnoses are made too early and improves with slowing down	▶ A planned time-out in the operating room[42 43]
Be more sceptical	A tendency in human thinking is to believe rather than disbelieve. Type 1 processing occurs by viewing something as more predictable and coherent than is really the case[10 44]	▶ No published examples
Recalibration	When the decision maker anticipates additional risks, recalibration may reduce error	▶ When bias is anticipated, (eg, medical comorbidities in psychiatric patients),[45] the decision maker may recalibrate
Group decision strategy	Seeking others' opinions in complex situations may be of value. Crowd wisdom, at times, is greater than an individual decision maker[46]	▶ Group rationality exceeded individual rationality in studies with experimental games in other domains[47]
Personal accountability	When people know their decisions will be scrutinised and they are accountable, their performance may improve	▶ Participants who knew they would be justifying their responses performed better than participants who thought that their responses were anonymous[48]

Continued

Table 1 Continued

Strategy	Comment	Examples
Supportive environments	Friendly and supportive environments improve the quality of decision making[49]	▸ Avoid cognitive overload, fatigue and sleep deprivation.[50] Ready availability of protocols, clinical guidelines and patient care pathways reduce variance
Exposure control	Limit exposure to information that might influence judgement before an impression is formed[51]	▸ Although there are no published examples, some emergency physicians avoid reading nurse's notes until after they have assessed the patient. Similarly, clinicians can discourage patients from giving them another physician's diagnosis, or physician colleagues from giving their diagnosis, until they have formed their own impressions
Sparklines	Informational mini-graphics can be embedded in context in clinical data. Graphics have the potential to mitigate specific biases[52]	▸ A graphic outlining paediatric respiratory virus prevalence provided immediate and accurate estimates of respective base rates and trends[53]
Decision support systems	Support systems have been developed for clinical use[54 55]	▸ A reminder system reduced diagnostic errors of omission and improved diagnostic quality score[55]

degree of force can range from absolute constraints such that an erroneous response cannot be made, for example, removal of concentrated potassium solutions from hospital wards, to explicit 'if this then this' rules, to simply encouraging a desired response. Cognitive forcing functions are rules that depend on the clinician consciously applying a metacognitive step and cognitively forcing a necessary consideration of alternatives. Some of these functions can be easily recognised in clinical adages or warnings that, although rarely investigated, have long been part of clinical teaching. They do not all need to be explicit; sometimes it is possible to gently nudge people in a particular direction in order to obtain better outcomes.[68]

These three groupings show considerable overlap and are not intended to be seen as discrete but as a spectrum. We have not included here in detail the diverse initiatives in clinical research and practice that fall under Cognitive Bias Mitigation (CBM). The main purpose of CBM is to modify cognitive and affective biases that underlie psychological dysfunction, associated mostly with anxiety and depression.[69] Insofar as cognitive debiasing and CBM are both directed at changing biased cognition and behaviour, it would be expected that some CBM techniques would be effective for those interested in debiasing outside the psychiatric setting, especially for affective bias.

PRESCRIPTIVE DEBIASING: ARE THERE SPECIFIC COGNITIVE PILLS FOR COGNITIVE ILLS?

The different sources of bias might have implications for the choice of strategies that can effectively counteract them. While standard biases such as availability and representativeness likely have an evolutionary origin, that is, derive from heuristics that were adaptive in ancient environments, other biases may be acquired through individuals' particular experiences. Examples of the latter are emotional dispositions and specific biases towards particular classes of patients, for example, drug seekers, patients with psychiatric comorbidity or the 'frequent flyer'. These biases are usually acquired unconsciously through simply being in specific environments and passively taking cues from others.

Given the differing aetiologies of bias, we might ask if some are more robust, and therefore, more resistant to change than others, and should there be different approaches to debiasing them?[70] Perhaps the hard-wired 'evolutionary' biases would be the most resistant to change and may need several different debiasing strategies as well as multiple interventions. Major cultural, sociocentric and other biases that have been established through learning may be easier to change, although it would be preferable that these biases not be allowed to form in the first place. Good role modelling, good teaching programmes and optimal learning environments will help minimise them.[49] Locally acquired

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Table 2 Forcing functions

Forcing function	Comment	Examples
Statistical and clinical prediction rules (SPRs and CPRs)	Explicit SPRs and CPRs typically equal or exceed the reliability of expert 'intuitive' judgement. Easy to use, they address significant issues	▶ The superiority of SPRs and CPRs over clinical judgement has been shown.[56] Physicians demonstrate pretest probability variability in specific diagnoses[57]
Cognitive forcing strategies (CFSs)	CFSs are special cases of forcing functions that require clinicians to internalise and apply the forcing function deliberately. They represent a systematic change in clinical practice. CFSs may range from universal to generic to specific	▶ Training might be given to identify situations (cognitive overloading, fatigue, sleep deprivation, others) that promote the use of heuristics and biases leading to decision errors. Clinical scenarios can be identified in which particular biases are likely to occur [1]and explicit CFSs can be taught to mitigate them[58]
Standing rules	May be used in certain clinical settings that require a given diagnosis not be made unless other must-not-miss diagnoses have been ruled out	▶ No published examples
General diagnostic rules in clinical practice	Many diagnostic 'rules' are often passed to trainees that are intended to prevent diagnostic error	▶ Specific tips to avoid diagnostic error[59]
Rule Out Worst-Case Scenario (ROWS)	A simple but useful general strategy to avoid missing important diagnoses	▶ No published examples
Checklists	A standard in aviation and now incorporated into medicine in intensive care units, surgery and in the diagnostic process[60]	▶ Catheter-related bloodstream infections were sustainably reduced by clinicians' adopting five evidence-based procedures on a checklist and reminders such as reinforcing strategies[61] ▶ The implementation of a surgical safety checklist led to reductions in death rates and complications in non-cardiac surgery in a multicenter study[62]
Stopping rules	Stopping rules are an important form of forcing functions—they determine when enough information has been gathered to make an optimal decision[63 64]	▶ No published examples
Consider the opposite	Seeking evidence to support a decision opposite to your initial impression may be a useful way of forcing consideration of other options	▶ Experimental studies in psychological research have shown considering the opposite counteracted biases,[25 65 66] for example, a consider-the-opposite strategy led to less biased judgements of personality traits[67]
Consider the control	Causal claims are often made without an appropriate control group[67]	▶ No published examples

and individualistic biases might be expected to be the least intransigent and the most amenable to change. Regardless of their origin, affective biases may need fundamentally different approaches from cognitive biases.

The recent literature is becoming more specific about biases and their defining characteristics. Various taxonomic strategies have been proposed,[5 71–74] and future work may predict which particular types of strategies might work for certain classes of biases, as Arkes has proposed.[71] Readers interested in the process of tailoring debiasing strategies to specific biases may find a suitable starting point in the taxonomies proposed in Stanovich's work[75] or that by Wilson and Brekke.[5]

HOW DO WE GO FORWARD?

1. A major goal will be to identify the parameters of change. How might the workplace be optimised to avoid bias in the first place? Which interventions are appropriate for which biases and for which group (students, residents, practicing clinicians). What maintenance strategies will be required, and for how long?
2. While this and its companion paper were being prepared, a comprehensive narrative review listing 42 tested interventions to mitigate cognitive errors has been published.[76] The effectiveness of interventions and strategies for debiasing in clinical practice deserves most attention as studies on their use have largely been conducted in other domains.
3. Medical training has traditionally put an emphasis on declarative knowledge (knowing what, or information-based) rather than procedural knowledge (knowing how, or application-based). While clinical adages aimed at preventing cognitive pitfalls are a tradition in clinical teaching, they are addressed occasionally and without a theoretical basis. Recently, efforts have been made to increase emphasis on procedural knowledge by building critical thinking into the undergraduate curriculum.[77] Not surprisingly, the ability to avoid bias is correlated with critical thinking ability.[78 79] Many of the processes

described above would be integral to this initiative: a knowledge and understanding of reasoning and decision-making theories, of cognitive and affective biases, of logical fallacies and of standards for clarity, precision, accuracy, relevance, logicalness, intellectual humility and other attributes.[80] The strategies described in this paper can lead to an educational curriculum that brings the traditional clinical adages into a coherent framework and that engages students and residents with real case examples in which cognitive pitfalls and debiasing are showcased and studied.

4. Many decision makers in clinical practice appear to recognise at least some of their biases and put measures in place to control them. However, the interface between patient and doctor is unique and so dynamic that even the best minds are challenged. Many contextual influences are difficult to control: the patient's characteristics and personality, the demographics and presentation (both typical and atypical) of the disease process itself, the knowledge, experience, expertise, personality and other characteristics of the physician, and the ambient conditions under which the decision will be made. Cultural and other individual differences also play a role in the effectiveness of debiasing initiatives.
5. Type 1 processing is essential to cognitive functioning and generally serves us well; in fact we could not live without it.[81 82] Given that the vast majority of our daily decisions involve Type 1 processes,[83] there is considerable ground to be made in educating intuition.[49] Better environments can be created by providing better mentoring and feedback, by having fewer insults to homeostasis (more rest, sleep and reduced cognitive overloading) and by having trainees learn their skills by making the scientific method intuitive. Strategies to avoid extraneous influences on decision making[84] would also be worthwhile.

Clinicians must be informed and recognise the need for constant vigilance and surveillance of their thinking to mitigate diagnostic and other clinical errors. There is an ongoing imperative to self-monitor for bias and especially to be mindful of faulty decision making at vulnerable times, and for the risk of excessive reliance on intuitive judgements when further reflection is required. This is captured in a current definition of critical thinking: 'the ability to engage in purposeful, self-regulatory judgment'.[85] This paper has reviewed a rich variety of cognitive debiasing initiatives from social science and clinical medicine. Given recent advances in the understanding of clinical decision making, the time appears ripe for renewed research effort and we hope these two papers will provoke such effort.

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