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Putting cognitive psychology to work: Improving decision-making in the medical encounter

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ABSTRACT

Empirical research in social psychology has provided robust support for the accuracy of the heuristics and biases approach to human judgment. This research, however, has not been systematically investigated regarding its potential applications for specific health care decision-makers. This paper makes the case for investigating the heuristics and biases approach in the patient–physician relationship and recommends strategic empirical research. It is argued that research will be valuable for particular decisions in the clinic and for examining and altering the background conditions of patient and physician decision-making.

In a well known study, Gigerenzer and Hoffrage (1995) demonstrated that likelihoods described as frequency formats (as opposed to probability formats) led to more accurate judgments by naïve and expert decision-makers. These effects may be attributable to the difference between the need to apply Bayes Theorem for probabilities and the need to subtract and divide for frequencies. Regardless, Gigerenzer and Hoffrage's study demonstrated a predictable limit to naïve and expert judgment and developed a strategy to sidestep or overcome that limit.

Following Gigerenzer and Hoffrage's model of identifying a limit on human judgment and producing a means of addressing this limit, the aim of this essay is twofold: (1) defend the application of the heuristics and biases approach to medical practice, and (2) use the robust conclusions of existing cognitive and social psychology research to identify and resolve decision biases in medical care.

Defending the approach to medicine

The heuristics and biases approach is an empirically supported view in social psychology that human judgment is governed by generally expedient heuristics (a flipped coin will come up heads half the time), that lead to predictable biases (people expect a flipped coin to land heads, then tails, then heads, then tails, etc.) (Griffin & Tversky, 1992; Tversky & Kahneman, 1974: 1125). Research in this area has also identified certain strategies to avoid or limit the effect of such biases: multiple presentations of information (Tversky & Kahneman, 1981), cuing certain activities (e.g., considering an alternative outcome) (Koriat, Lichtenstein, & Fischoff, 1980) or cuing certain mindsets (e.g., reminding decision-makers that all things fade with time) (Igou, 2004; Vaughn & Weary, 2003).

Despite the robust demonstration of heuristics in decision-making and their attendant biases, the heuristics and biases approach has met with resistance. Shafir and LeBoeuf (2002: 500–501) identify three general strategies that have been used to challenge research that supports the heuristics and biases approach. Shafir and LeBoeuf give adequate rebuttals to these challenges that will not be reviewed here. There are, however, reasons to believe that the first two challenges are less significant for medical decisions than they might be for other decisions, and there are additional reasons to reject the third.

One set of challenges claims subjects misinterpret the task at hand: "participants' responses, which are rational in light of their own construals of the task, are coded as

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irrational by experimenters who fail to appreciate the participants' construals of the decision" (Shafir & LeBoeuf, 2002: 503). In medical practice, however, misconstruals are unlikely. When a medical decision needs to be made, it is unlikely that the patient or the patient's family has a fundamentally different construal of the decision than the physician or other medical practitioner. In these situations, a decision needs to be made about a treatment or lifestyle that should be started, continued, stopped, and so on. Though there may be trenchant disagreements about which option should be chosen, there is little room for misunderstanding that a decision must be made about the treatment or lifestyle in question.

Others challenge the approach by arguing that the experiments make inappropriate demands on average decision-makers. That is, the problems are not presented to research subjects in formats conducive to good decisions. For the medical setting, however, this criticism highlights the need for additional research in these areas. If certain formats degrade the quality of decisions, identifying the features of these formats will be instrumental so that such formats may be avoided as much as possible in medical practice. When they cannot be avoided, other research is needed to address the predictable problems these formats produce. That the demands of decision-making may predictably outstrip the abilities of decision-makers increases the concern for bias in difficult circumstances.

Finally, some challenge the relevance of the heuristics and biases approach. Concerned that incentives are lacking in these studies, they worry that the hypothetical decisions of this research do not reflect real-world decision-making. As much as this suggestion challenges the conclusions of the research conducted in controlled environments, it indicates the need for field research, which will be discussed in more detail in the next section. Moreover, Arkes, Dawes, and Christensen (1986) show how incentives pervert decision-making: they can actually decrease the quality of judgments. This finding is particularly disturbing because medical decisions have substantial built-in health and well-being incentives. Other challengers claim the experiments are irrelevant because the experimenters' fail to require justifications and so limit the decision-maker's involvement. As will be discussed in the third part of the essay, however, requiring decision-makers to justify or explain does not improve judgment, but (once again) actually diminishes the quality of judgment.

Shafir and LeBoeuf (2002: 503–504) also mention a challenge regarding expertise, which, for obvious reasons, is a significant issue for the discussion of improving medical decision-making. Specifically, experts, some critics claim, are more interested in and more familiar with the subject matter, and so are less likely to make biased judgments. Several studies, however, show that experts are subject to biased decision-making as well (Arkes, Wortmann, Saville, & Harkness, 1981; Baumann, Deber, & Thompson, 1991; Gigerenzer & Hoffrage, 1995; Henrion & Fischhoff, 1986; Redelmeier & Tversky, 1990).

In her tidy argument for applying the heuristics and biases approach to medical practice, Hall (2002) also notes the effect of biases on expert decisions. Specifically, Hall recommends, as an ameliorative step, altering medical education to make future physicians aware of both the predictable problems with judgment and the means to address these problems. Although this is an important recommendation, following it will not completely resolve the problem of bias in expert judgment. Awareness of a bias and increased cognitive efforts to avoid the known bias does not always debias a decision (Harkness, DeBono, & Borgida, 1985; Lerner & Tetlock, 1999; Petty & Cacioppo, 1984). Furthermore, in the final sections of this essay, discussion of statistical prediction rules and the fact that they often outperform the best experts will further illustrate that a reliance on expert judgment to shore up decision-making is misguided.

Chapman and Elstein (2000) also systematically review research regarding health and medical decision-making. They provide an excellent overview of specific areas, but their recommendations are constrained. As they acknowledge, their review is limited to controlled laboratory research. They note that further research is needed on clinical practice, patient outcomes, and potential debiasing strategies (2002: 204). In short, field research into biases and debiasing is needed. Without more systematic study of the cognitive biases in medical practice it will be difficult to have appropriate confidence that the heuristics and biases (so robustly illustrated in controlled settings) are present in medical practice. The earlier studies, though indicative, are not definitive. Moreover, identifying strategies to counteract these biases also requires systematic research. Accurately identifying the quality of the biases is important. It is also important to develop or identify effective techniques for eliminating or attenuating bias. An accurate diagnosis is beneficial, and an effective treatment plan even more so.

Biased and biasing explanations and imaginations

Koehler (1991) and Hirt and Markman (1995) among others, have noted the avalanche of empirical research showing that explanation and imagination tasks bias judgment. Subjects imagining a hypothesis to be true, or producing an explanation for why it is true, unjustifiably increase their confidence that said hypothesis is true (Anderson, Lepper, & Ross, 1980; Anderson & Sechler, 1986; Hirt & Sherman, 1985; Ross, Lepper, Strack, & Steinmetz, 1977). If the only difference is the imagination or explanation task, the likelihood that the hypothesis is true remains unchanged, so the subject's increase in confidence is uncalibrated (that is, unrelated to the actual likelihood). Imagination tasks also affect subjective probability judgments. Sherman, Cialdini, Schwartzmann, and Reynolds (1985) show that individuals tasked with thinking about a disease with difficult-to-imagine symptoms (e.g., a vague sense of disorientation, a malfunctioning nervous system, and an inflamed liver) consider themselves less likely to contract the disease than individuals tasked with merely reading about the same disease.

Koehler suggests that offering an explanation unjustifiably increases confidence because it changes the individual's perception of the problem, his or her interpretation of relevant evidence, and the search for additional information about the problem (Koehler, 1991: 510–511). This explanation has been supported by several later studies

(Galinsky & Moskowitz, 2000; Hirt & Markman, 1995; Hirt, Kardes, & Markman, 2004). As it turns out, producing an explanation may actually diminish the quality of decision-making. Consider an individual who refuses chemotherapy for unknown reasons and is subsequently asked for an explanation. The medical practitioner may unwittingly crystallize the frame through which this patient views the decision. In the worst case scenario, demanding an explanation may end the conversation even though the patient's view includes misperceptions of the problem, the evidence, and so on.

Imagination and explanation tasks also have behavioral effects. As Gregory, Cialdini, and Carpenter (1982) illustrate, the percentage of individuals that later purchased cable television service was higher among subjects prompted to imagine enjoying cable television than among subjects simply provided with information about cable television. Tasks predictive of behavioral changes are not, however, monolithic. In one experiment by Sherman, Skov, Hervitz, and Stock (1981), explaining failure without prediction was predictive of better performance than explaining success without prediction or no explanation without prediction. Sherman's team interprets this to suggest that explaining failure may produce incentives or information that helps avoid failure. Surprisingly, though, explaining failure when coupled with a prediction was devastating; this group performed worse than every other group at the task. At the same time, Sherman's team shows that explaining success leads to more successful behavior than no explanation at all, but success explanations coupled with a prediction leads to even greater degrees of success. Prediction, then, appears to have a complicated correlation with explanation and performance. Moreover, these findings have been complicated even further. Another finding of the study by Sherman et al. (1981) was that success explanation alone corresponded to the same performance as prediction without any explanation. Either explain success or make a prediction, either way the final result is the same. In direct contrast, Sherman and Anderson (1987) showed that when individuals generated reasons to explain why they would return to a mental health office for a check-up (success explanation alone), they were more likely to take that course of action than if they were simply asked if they would (a prediction with no explanation), suggesting that explaining success is more predictive of success than only making a prediction.

Finally, there is some evidence that the biases arising from these tasks can be debiased. Explanation tasks about a different outcome or a different explanation of the same outcome have been shown to limit or eliminate explanation biases (Hirt & Markman, 1995). The best available theoretical explanation for this debiasing effect is that producing an alternative explanation (called a consider-an-alternative strategy or a counterfactual prime) of the same outcome cues the serious consideration of alternative outcomes (Koehler, 1991). The debiasing effects of consider-an-alternative tasks, however, have significant limitations. Despite the fact that these tasks limit the overconfidence (among other things) resulting from the initial explanation task, the initial hypothesis is still held with more confidence than when no explanations are made (Koehler, 1991: 502). Given the findings regarding the effects of difficulty on imagination, it should be unsurprising that Hirt and Markman (1995) illustrate that the attenuation of explanation bias by alternative explanations is also limited by the plausibility of the alternative explanation.

Imagining improvements

Biases arising from imagination, explanation, and prediction tasks are significant because such tasks are commonly found in the medical encounter. Physicians explain a diagnosis and prognosis to patients. Patients explain why they prefer one course of treatment over another and often imagine what the treatment will be like. Family members explain why the unconscious patient would have decided to continue aggressive treatment (or not). Determining the effects of explanations on physician and patient decision-making will indicate the structure of clinical interactions that is conducive to good decision-making. Imagination tasks are also potentially valuable low-cost interventions. The following three areas of research can identify (1) the effects of explanation and imagination tasks on clinical decision-making and (2) the means for limiting or eliminating negative effects.

First, do explanation tasks settle patient and physician views of medical facts and treatments? If explanations increase patients' confidence in their judgments even if they are mistaken, asking a patient to explain his or her choice of treatment may solidify mistaken views and complicate future conversations. If explaining their diagnosis or prognosis keeps physicians from seriously considering other alternatives, routine explanations may be counter-productive to good health care.

Evaluating the role of explanation tasks may be easier than first imagined. For patient explanation tasks, a simple two pronged process could be employed: first, physicians ask one set of patients to estimate their confidence level about a medical decision; second, physicians ask a second set of patients to explain why they made the decision they have and, subsequently, ask these patients to estimate their confidence level. Records of patient confidence levels could be combined and analyzed to determine patients' confidence levels. Similarly, attending physicians could follow the same basic process for residents and interns who are and are not asked to explain their diagnosis, prognosis, etc.

Second, how robust are the behavioral effects of explanation (and prediction) and imagination tasks in medical practice? The applications of behavioral primes are nearly endless in medicine. To begin, these tasks could be used to address patient compliance with treatment regimens and physician self-reporting of technical or judgment errors. Similar to the research into the effect of explanation tasks on confidence, physicians could simply follow and record the actions of three sets of patients. As above, one set would simply be asked if they would adhere to the treatment regimen, another set would be asked to imagine themselves following the treatment regimen, and the final set would be asked to explain why they would adhere to the treatment regimen. Each of these sets could also be divided into one group that predicts and one group that does not.

With standard follow-up, the behavioral effects could be identified.

Third, how effective are alternative explanations in attenuating explanation bias in the medical encounter? This research would respond to the results of the research described above while adding a third prong: a set of patients who are asked to (1) explain why they made the decision they did and (2) why a different decision might produce as good or better results. After both tasks, these patients could be asked to estimate their confidence level. Again, a similar strategy could be employed with physicians, residents, and interns, as well.

The effects of explanation and imagination will likely affect both patient and physician decision-making. Other biases of human judgment, however, are more likely to affect patients' decision-making but not physicians', and vice versa. Accordingly, the following sections are split between patient decision-making and physician decision-making, beginning, as every medical encounter does, with an examination of the patient.

Patient decision-making

Bias is likely to disrupt patient decision-making at at least two moments. First, patients may or may not trust their physicians. Patients' judgments about the trustworthiness of their physician are important for the potentially pervasive effects on the clinical interactions and the resulting decisions (Steginga & Occhipinti, 2004). Second, even when patients trust physicians (and the physicians are trustworthy), their decisions may be biased. Specifically, patients' affective forecasting and the effects of framing are likely to diminish the quality of decision-making.

Untrusting patients

When patients do not trust their physician, they have made (at least an implicit) judgment about the systemic and/or episodic trustworthiness of their physician. They may have judged that the health care system, of which the physician is a part, is untrustworthy, that the physician is untrustworthy despite the trustworthiness of the system, or that the physician and the health care system are untrustworthy. Importantly, patients may be overconfident in this judgment. For example, the patient may have an internal and inaccurate representation of what a trustworthy physician will be like; or the patient may incorrectly assume that everyone, physicians included, is not trustworthy.

Even apart from explanation bias, the bias of overconfidence—the systematic overestimation of the accuracy of judgment—has been demonstrated for over 30 years (Fischhoff, Slovic, & Lichtenstein, 1977). This evidence cannot responsibly lead, however, to an a priori judgment that patients are mistaken or that their judgments are biased when they decide a physician is or is not trustworthy. Hence, it will be important to evaluate the confidence calibration of patient judgments about the trustworthiness of physicians and the health care system. These evaluations will require supplemental evaluations of patient confidence in their own competence to make medical judgments, and, presumably, efforts to identify debiasing strategies. Anyone who has spent time talking to physicians about the frustrations of clinical care knows that direct-to-consumer advertising and internet research produces patients who judge themselves to be competent diagnosticians and medication prescribers.

Studies by Hirt and Markman (1995) illustrating the means of attenuating the explanation bias also showed that consideration-of-an-alternative debiased (to some extent) overconfident judgments. Limits on the debiasing effect are correlated, again, to the ease of generating alternatives as well as the need for structure of the individuals in question (Hirt et al., 2004). So, for example, it may be easier to debias a patient's overconfidence in his or her diagnostic abilities than his or her overconfidence that the health care system is fundamentally flawed. Imagining an inadequate internet search or a misleading advertisement is easier than imagining a health care system that functions in a just way.

Trusting patients

Patients who trust trustworthy physicians in a trustworthy system will also make biased decisions. Specifically, these patients' decisions may be biased by uncalibrated affective forecasting and the effects of framing. These two biases will now be discussed.

Affective forecasting

Put simply, affective forecasting occurs anytime an individual predicts his or her affective state during some future states of affairs. Affective forecasting is particularly important in medical decision-making. For example, a patient deciding about a set of treatment alternatives that includes significant side effects will be guided by his or her affective forecasting about these side effects. The more serious the side effects, the more significant role affective forecasting can play.

The accuracy of affective forecasts in general has been shown to be consistently miscalibrated (Gilbert, Driver-Linn, & Wilson, 2002; Liberman, Sagristano, & Trope, 2002; Woodzicka & LaFrance, 2001). In their conceptual analysis of the research on affective forecasting, Wilson and Gilbert (2003) categorize four areas of affective forecasting: direction, emotion, degree, and duration. People almost always accurately predict the direction (negative vs. positive) and, most of the time, the particular emotion (e.g., anger or happiness) that will result from a future event. They are consistently poor predictors, however, of the degree and duration of future affective states: they usually overestimate one or both, expecting a greater and/or longer lasting affective result. These overestimations in affective forecasting were initially dubbed durability bias (Gilbert, Pinel, Wilson, Blumberg, & Wheatley, 1998) and have since been recast as impact bias (Wilson & Gilbert, 2003).

Wilson and Gilbert (2003) define and describe seven distinct roots of miscalibrated affective forecasting: misconstrual, framing effects, recall/affective theories, correction for unique influences, expectation effects, actual unique influences, and underestimation of sense-making processes. Each of these areas can lead to bias in affective forecasting, but this essay will be limited to discussion of the definitions of sense-making processes and one particular unique influence—focalism.

Sense-making processes are the psychological means for making life-events less meaningful over time. A friend's insult can be explained by a bad mood, an unexpected gift by an ulterior motive. Regardless of the event, sooner or later there is a return to the baseline affective state. As Wilson and Gilbert (2003: 369–383) note, decision-makers regularly underestimate the effects of these sense-making processes on future affective states. Focalism is shorthand for when individuals fail to account for the complexity of events at a future time. When asked to predict their affective response to a given event, individuals focus solely on that event and ignore other aspects of the situation (2003: 366–369). This isolation overemphasizes the importance of the event in question, while failing to account for other events that will be significant at that time. If asked how they would feel if their favorite team won the championship, decision-makers tend to imagine only that particular aspect of life, implicitly discounting other aspects affecting how they feel.

Wilson and Gilbert (2003: 383–384) argue that sense-making processes and focalism are the most consistent producers of impact bias. If Wilson and Gilbert are right, research into calibrating affective forecasting in medical decision-making should start with them. This does not, however, require neglect of other roots of poorly calibrated affective forecasting. For example, there may be unique influences (other than focalism) that arise during certain treatments. Take, for example, chemotherapy. If a patient has been informed that chemotherapy is a treatment regimen that is repeated over a period of time, he may both overestimate the initial intensity, and compound the overestimation by overestimating it for each round of therapy. These overestimations may bias not only because they are overestimations, but also because he may develop coping mechanisms that decrease the intensity and/or the duration of his affective response for each subsequent round of treatment.

Determining the extent of impact bias on patient decision-making will require surveys of patient expectations when they are considering treatment options with follow-up surveys of patient subjective well-being throughout the course of treatment. These longitudinal surveys will illustrate the biased (or not) affective forecasting of patients. These surveys need to be attentive to the findings of Redelmeier, Katz, and Kahneman (2003) who show that an unnecessary but significantly less painful addition of time to the end of a colonoscopy led to more positive evaluations and increased the likelihood of returning for another colonoscopy. Because contingent aspects of previous experience can have surprising effects on memory and future behavior, similar alterations in treatment means and modality should be evaluated for their effect on impact bias for future decisions.

Finally, several other studies have implications for debiasing affective forecasting. Vaughn and Weary (2003) suggest that individuals should be reminded about sources of their judgments. They illustrate that individuals assume their judgments arise from the subject matter of their decision and not from features of themselves. Reminded about this latter possibility, their efforts will more likely focus on correcting the bias in their judgment. Nussbaum, Liberman, and Trope (2006) demonstrate that temporal distance from a future event also affects judgment. Specifically, when more distant from an event, decision-makers use more abstract bases for judgment and have more confidence in judgment. Alongside strategies for debiasing overconfidence (noted above), emphasizing the concrete aspects of distant future events may improve decisions about such events.

Effects of framing

Medical information is often put in terms of gains and losses. Medical procedures can be described in terms of survival or mortality rates, and pharmaceuticals like birth-control pills can be described in terms of effectiveness or failure rate. Controlled research has shown repeatedly that the framing of such information pushes decision-makers to one choice or the other (Kuhlberger, 1998).

The effects of framing on health-related decisions and behaviors is one area where field research has been extensive. Salovey and Williams-Piehota (2004) tested the hypothesis that loss-framed messages would promote detection behavior and gain-framed messages would promote prevention behavior. Specifically, they began with the hypothesis that a gain-framed message about sunscreen use would foster preventative (or risk-averse) behavior, and a loss-framed message about mammography will foster diagnostic seeking (or risk-seeking) behavior. The field experiments confirmed this hypothesis (2004: 491–492).

Other research has illustrated that framing works in conjunction with other influences. Lerner and Keltner (2000: 485) hypothesized that different emotional tendencies will affect judgment. Indeed despite the fact that anger and fear share a negative valence, they found that tendencies toward anger or fear produced different assessments of risk (2000: 485). This finding complicates the application of the effects of framing. Framing may affect decision-maker risk-assessments, but the baseline for such assessments may depend on decision-maker dispositions. That the effects of framing are limited by a patient's disposition has been amplified in another field study involving messages tailored to patients' coping style (William-Piehota, Pizarro, Schneider, Mowad, & Salovey, 2005). Specifically, this study illustrated that providing mammography information matched to a patient's predisposition led higher numbers of patients to obtain a mammography over the next 6 months.

Environmental cues may also play a role in limiting the effects of framing. Simon, Fagley, and Halleran (2004: 90) produced studies indicating an inverse relationship between the effects of framing and need for cognition when coupled with deep processing. Individuals with a need to process information cognitively and given the opportunity to process the message were less affected by framing than individuals lacking either condition. Simon's group concluded that susceptibility to gain-loss framing effects depends on characteristics of the individual (e.g., tendency to use cognitive or emotional processes) and environmental demands.

Based on the studies by Salovey and Williams-Piehota (2004), it might appear it is best to frame all decisions such that individuals are pushed to decisions congruent with widely held aims—to avoid or survive cancer. When particular treatment decisions need to be made, however, the aims embodied by each choice may not be so widely held. Yet, one of the interesting things about the effects of framing is that information must be presented in a loss- or gain-frame. Pushing decision-makers one-way or the other cannot be avoided. There is no neutral frame.

Pushing patient decisions via the effects of framing may be desirable in some cases (e.g., suggesting that someone quit smoking), while attempting to eliminate the effects of framing will be best suited for others (e.g., someone deliberating about aggressive treatment for Stage IV pancreatic cancer). Even as more precise information about the effects of framing on medical decision-making is gathered, determining which direction to push will depend largely on physician judgment. Of course, physician judgment can also be biased.

Physician decision-making

In an interesting field study, Baumann et al. (1991) looked at physician and nurse confidence in their recommendations for treatment. Individual physicians and nurses had levels of confidence in their recommendations, but these recommendations were mutually exclusive and inconsistent across the group. The researchers dubbed this "micro-certainty, macro-uncertainty". More generally, Henrion and Fischhoff (1986) also illustrate that experts are susceptible to overconfidence.

One might be tempted to suggest that accountability could be the primary solution to the problem of overconfidence for medical practitioners: if physicians are held to a high standard of accountability, they will be motivated to avoid biased decision-making. Aside from the aforementioned complications caused by and not resolved by incentives (Arkes et al., 1986), a review of research into the effects of accountability by Lerner and Tetlock (1999) also suggest otherwise. They note that 20 years of research illustrates that accountability is not always effective. Specifically, only certain types of accountability increase cognitive effort, this increase may not be beneficial and may be detrimental, and it is not always clear what counts as "better" judgment (Lerner & Tetlock, 1999: 270). On the one hand, when accountability effects that increase cognitive effort are applied, they are useful (they debias judgments) only when biases have arisen from superficial treatment of the judgment process and the relevant cues. On the other hand, accountability can actually exacerbate biases when judgments are based on the wrong information or when the judgment easiest to rationalize is biased (Lerner & Tetlock, 1999: 270). Finally, accountability has no effect when the biases result from inadequate training on formal decision rules and effort will not uncover these rules. Although there is not space here to comprehensively articulate each possible use of accountability, as a strategy to limit overconfidence it does not look promising. Nonetheless, the diverse effects of accountability are particularly important in light of widespread diversity in the provision of healthcare. The effectiveness of holding physicians financially accountable for patient outcomes or for following particular treatment protocols depends on the kinds of bias the incentives are meant to address.

Another possible means for improving physician decision-making is to provide regular and reliable feedback. Calibration of experts' confidence in their judgments improves with feedback (Arkes, Christensen, Lai, & Blumer, 1987; Trout, 2002). And yet, physicians receive minimal clear feedback. Autopsies are not performed regularly in the US (Burton, 2000; Lundberg, 1998), leaving open questions about the cause of death and precluding clear feedback. Moreover, when patients get better, it may or may not have been caused by the intervention. Finally, the hindsight bias—the view that what has already happened was inevitable and, if they had taken the time, they would have predicted it all along—may limit the clarity of any existing feedback. Hindsight bias has been repeatedly illustrated (Fischhoff, 1982; Fischhoff & Beyth, 1975), and to the extent that it is prevalent among physicians, it will skew their retrospective views of their judgment. Improving the quality and quantity of feedback for physicians will be an important systematic step to improving physician decisions.

Another means to improve physician decision-making is increased training. Although training in general, or even increasing the depth or breadth of medical training may not improve physician decisions, other training looks promising. Specifically, one study by Gambara and Leon (2002) has shown that training specifically in decision-making has improved the breadth of considerations included in the decision as well as the orderliness of the strategies employed. Moreover, this training increased the number of alternatives considered, which may help physicians avoid missed diagnoses. This training would match with the recommendations of Hall (2002). Arkes and Harkness (1980: 574) also address the possibility of mis-diagnosis when they recommend that experts like physicians note a diagnosis and all the symptoms observed that led to this diagnosis. Keeping these records avoids distortion of the symptoms presented through memory and also provides an easy reminder of the facts of a case, which may prove useful to combine with other feedback.

And finally, a few words about the use of formal decision rules in medical practice. To put it bluntly, statistical prediction rules (a type of formal decision rule) are an underappreciated resource for improving clinical practice. Statistical prediction rules have been recommended by a number of sources to improve clinical judgment for quite some time. Indeed, the first such recommendation, attributed to Meehl (1954)—that such rules are more reliable than human judgment—has since become a robust one: "Since 1954, every non-ambiguous study that has compared the reliability of clinical and actuarial predictions has supported Meehl's conclusion [that actuarial models outperform clinician judgment]" (Bishop & Trout, 2002: S198). Indeed, Bishop and Trout glibly recommend "*The Golden Rule of Predictive Modeling*": using the same evidence, predictions made with statistical prediction rules will be at least, and likely more, reliable than predictions made by human experts (2002: S198).

Given the robust superiority of statistical prediction rules to "expert" judgment, it is surprising that only a few have advocated for the value of such rules in medical practice. Regarding the interpretation of diagnostic imaging, Getty, Pickett, D'Orsi, and Swets (1988: 240) argue that biases in image interpretation can be improved through systematic identification of human limits. They go on to give some recommendations about how to overcome these limitations through various aids specific to image reading. Moreover, similar recommendations for other areas of medical practice have also been offered (Brannen, Godfrey, & Goetter, 1989; Dawes, 1994: 92–101; Goldman et al., 1988; Lee et al., 1986; Sutton, 1989).

Nonetheless, there remains a substantial resistance (or lack of attentiveness) to statistical prediction rules in medical practice. For example, Geissbuhler and Miller (2000: 376), in addressing the use of computer programs that might make use of rules, begin with the reasonable restriction that such programs should be evaluated for efficacy. Other types of computerized decision-support are also being developed (Roach, Dawson, Love, & Cebul, 2007). Geissbuhler and Miller (2000: 376) go on, however, to suggest that the use of statistical prediction rules "should be used to augment or supplement, not replace or supplant, such individuals' decision-making". If the rule is more accurate than expert judgment, allowing the expert to ignore the rule short-circuits the rule's effectiveness. Geissbuhler and Miller's view is not unexpected; as Dawes (1994: 204) puts it: "the ineffable, intuitive clinical judgment is very difficult to challenge—at least, not without an extensive statistical study to assess its bias". Dawes refers here to the value bestowed upon a professional's judgment. Intuitively, it may seem that the individual with experience is the best judge of what to do, but this intuition must be supported by empirical evidence and be subject to rebuttal in light of contradictory empirical evidence. There is a temptation to challenge robust evidence in favor of statistical prediction rule because they automate decision-making and so appear to undermine the value of human decision-making. And yet, if the aim is to produce the best results, the value of human decision-making is realized when the decision is made to use statistical prediction rules, avoid the vagaries of expert judgment, and produce the best results.

Some physicians and medical researchers are already involved in the production and dissemination of statistical prediction rules for medical practice. For example, the website of the Mt. Sinai School of Medicine includes a page of commonly used clinical prediction rules, some of which are statistical prediction rules (e.g., the Ottawa ankle rule) (Mount Sinai Hospital, 2006). Further, Partin et al. (1997) produced a statistical prediction rule, albeit quite complex, for helping patients decide whether or not they should use surgery or radiation to treat their prostate cancer. As I have argued at greater length elsewhere (Schwab, 2006), efforts like these should continue.

The limits of debiasing

This article has been keenly focused on the possibility of debiasing the predictably biased judgments of patients, physicians, and other medical practitioners. The aim of producing completely unbiased decisions, however, is a fool's errand. It is difficult, and in some cases impossible, to evaluate whether a particular decision is biased. In controlled environments, the biases of a decision can be evaluated because the game can be fixed—the right answer is known in advance. In the messy areas of health care, the right answer for a single decision often cannot be clearly established in advance or, for that matter, even after the fact.

Debiasing, then, does not work to identify exactly the right decision in each case, but defines procedures to limit or eliminate the predictable effects of bias (or in the case of statistical prediction rules, the predictable limits of expert judgment). Without advance knowledge of exactly the right decision, we can only look back (through research) and identify those ways that decision-making frequently goes awry and incorporate debiasing strategies to avoid these common problems. This does not guarantee the best outcome, but puts each decision-maker in the best possible position to make a good decision. For example, for prescribing physicians, triangulation between the recommendations of the European Medicines Agency, the United States' Food and Drug Administration and similar institutions would be preferable to relying on any single institution. This triangulation will not necessarily produce perfectly accurate views about the efficacy and safety of certain drugs, but it will help avoid any blind spots of a particular agency.

Conclusion

This essay has identified the biases most likely to affect medical practice and has recommended some specific directions for physicians and others involved in empirical research to evaluate bias in medical decision-making. Although explanation bias and overconfidence can affect (differently) both physician and patient decision-making, affective forecasting and the effects of framing are more likely to diminish the quality of patient decision-making just as the failure to use statistical prediction rules may diminish the quality of physician recommendations. Accordingly, the charge is to establish the role of these biases in medical decision-making, and the best means of attenuating their negative effects.

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