CHAPTER 4

Cognitive and Affective Influences on Health Decisions

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People appear to comprehend and respond to information during decision making by using two separable but interacting modes of information processing (Epstein, 1994; Kahneman, 2003; Reyna, 2004). For instance, Epstein’s (1994) model defines a deliberative and an experiential system. The experiential system is intuitive, automatic, and nonverbal, whereas the deliberative system is an analytical system that functions by way of established rules of logic and evidence (e.g., probability theory). While everyone employs both of these information-processing systems to at least some degree, individuals may differ in the extent to which deliberative or experiential thinking influences their processing of information in decisions. For example, whereas a medical professional’s understanding of risk as statistical probability may be more heavily influenced by the deliberative system, a layperson’s understanding may rely on more experiential ways of knowing (Reventlow, Hvas, & Tulinius, 2001). Even within a single individual, different decision contexts or primes may lead to greater reliance on the deliberative versus experiential systems in decision making.

Under ideal conditions, patients making medical decisions would use the deliberative mode of information processing, with approaches such as subjective expected utility theory (SEUT; Savage, 1954), to decide on the best choice among their available options; that is, they would consider the probability of each possible event occurring and their perception of the utility or personal value of each outcome and then integrate both pieces to come up with a single aggregated valuation of each choice that could be used to find the personally best option. However, as shown in numerous studies by Kahneman and Tversky (Kahneman, Slovic, & Tversky, 1982; Kahneman & Tversky, 1973; Tversky & Kahneman, 1974), people’s decisions frequently violate SEUT. These violations have been shown in a vast array of conditions, including many in the domain of medical decision making. Many of these violations occur because information processing also occurs in the experiential system and, in fact, this system may be the default mode with which

1 Although Epstein uses the term “rational,” we prefer to use the term “deliberative” for this mode of information processing because the experiential mode can also produce quite rational decisions.
people process information for decisions (Kahneman, 2003).

In this chapter, we begin by discussing a number of the most prevalent decision-making biases that emerged from the experiential system and were identified by Kahneman, Tversky, and others. We also suggest ways in which they are likely to influence people's medical decision making. A full discussion of health-care-relevant decision-making biases is, however, beyond the scope of this chapter.2

The influence of the experiential system is also demonstrated in the role that affect plays in decision making. SEUT is a pure information-processing model, without consideration of the decision maker's current affective state or anticipated affective reactions to outcomes except insofar as they are incorporated into utility estimates. Affect, however, has been shown to influence both perceptions of likelihood and valuations of outcomes, a set of effects dubbed the “affect heuristic” (Slovic, Finucane, Peters, & MacGregor, 2004). More generally, affect appears to function in multiple ways, guiding judgment and decision processes in health and other domains (Peters, Lipkus, & Dieleman, 2006). The second part of the chapter focuses on the role of affect in decision making.

Finally, even in SEUT, people's decisions about their health care should be dependent on their understanding of the likelihood of different outcomes. Yet strong evidence exists that people's risk perceptions often diverge from the true level of risk, and that how risk information is presented to patients can have a significant effect on their understanding and reactions. We conclude our chapter by discussing how risk perceptions are formed and how they can be influenced by both affective and cognitive biases. Then, because quantitative information is becoming an increasingly important component of health decision making, we review the liter-
as a result of undergoing the mammogram (Edwards, Elwyn, Covey, Matthews, & Pill, 2001). If the goal of a health message were to persuade women to undergo a mammogram, a loss-framed message (which would focus on the risks of “losing” by allowing an undetected cancer) would be expected to be more effective than a gain-framed message (e.g., emphasizing peace of mind, one of the benefits of mammography).

The framing effect has been tested in several medical domains with similar results. In one of the first examples of the framing effect in a medical scenario, McNeil, Pauker, Sox, and Tversky (1982) surveyed ambulatory patients, graduate students, and physicians. Members of all three groups were asked to imagine they had lung cancer and to make a treatment decision (surgery vs. radiation) based on cumulative probabilities and life-expectancy data. The authors manipulated whether this data was presented in a survival or mortality frame. In all three populations, more individuals chose surgery if the information was presented in a survival frame rather than if the same information was presented in a mortality frame. The survival frame seemed to induce more risk aversion as all patients would survive radiation treatment, but some patients would not survive surgery (i.e., 10 would die during surgery).

Furthermore, a review of the literature (Edwards et al., 2001) examining the effectiveness of loss- versus gain-framed messages for detection behaviors revealed that loss-framed messages were generally more effective than gain-framed messages, thus supporting prospect theory. When the target behavior is prevention (rather than detection), research has consistently shown that gain-framed messages are more effective in some situations (e.g., use of infant car restraints, regular physical exercise, and obtaining sunscreen) (Apanovitch, McCarthy, & Salovey, 2003; Rothman, Martino, Bedell, Detweiler, & Salovey, 1999). This finding is explained by the fact that gain-framed messages work better in situations where the outcomes are certain (e.g., using an infant seat can reduce the risk of serious injuries and deaths of children), whereas where there is uncertainty and risk (e.g., whether or not a mammogram will have a positive result), loss-framed messages are more effective in promoting the desired behavior (Apanovitch et al., 2003).

**Default or “Status Quo” Biases**

A “default bias” occurs when people actively fail to choose an option and instead go with the default option, even if it is not in their best interest. As Kressel, Chapman, and Leventhal (2007) note, people will accept the default position (the choice implied by no response) “regardless of its implication” and thus accept (or reject) options they would not have accepted (or rejected) if the choice had not been the default option. The default bias is especially prevalent when people do not have strong preferences to influence their decisions or in situations with considerable barriers to choosing a new course of action (Halpern, Ubil, & Asch, 2007; Slovic, 1995).

The default bias has been shown to influence many domains of consumer choice (e.g., what stocks to invest in, water allocation plans; Samuelson & Zeckhauser, 1988), as well as health care decision making. Some specific health-related examples include organ donation (Johnson & Goldstein, 2003, 2004), flexible spending accounts (Halpern et al., 2007), mandated flu vaccinations for all health care workers (Halpern et al., 2007) and end-of-life care preferences as recorded in living wills (Kressel & Chapman, 2007; Kressel et al., 2007). We discuss two of these domains, organ donation and use of living wills, in more detail.

Johnson and Goldstein (2003, 2004) have conducted several studies examining the impact of default options in organ donation. In one study (2003), they randomized participants into one of three groups. In the first group, participants were told to imagine they had just moved to a new state, and the organ donation default was that they were not willing to donate their organs (opt-in default). In the second group, participants were told that their new state’s donation default was that they were willing to donate their organs (opt-out default). In the third group, there was no default and participants just had to choose whether to donate their organs. When they examined the number of people who effectively consented to organ donation, a remarkable outcome was observed: Only 42% of those in the opt-in consented
to organ donation, compared to 82% of the opt-out subjects and 79% of those in the no-default condition. In a more ecologically valid study, Johnson and Goldstein (2004) examined consent to donate rates across European countries that differed in terms of whether they had opt-in or opt-out defaults for organ donation. The four countries that used opt-in defaults had significantly lower rates (range: 4.25–27.5%) than those countries that had opt-out defaults (range: 85.9–99.98).

The default bias can also be found in people's completion of living wills. Living wills are fraught with problems (Fagerlin & Schneider, 2004), and recent studies have shown that people's end-of-life treatment preferences, as outlined in living wills, may be strongly influenced by the default options present in the document (Kressel & Chapman, 2007; Kressel et al., 2007). In one study, older outpatients (65 years and older) were given living will forms that described 22 different care decisions (Kressel et al., 2007). The forms differed only in terms of whether a default option was provided and whether the default option, when provided, was to want treatment to be given or to be withheld. Individuals provided the give-treatment default option were more likely than those provided the withhold-treatment default option to indicate they wanted treatment. This finding held in 21 out of 22 decisions (and was significantly higher in seven of those decisions).

There have been a number of explanations for the default bias. Choosing the default option may minimize decisional conflict and reduce the cognitive effort required to make a choice (Chapman & Elstein, 2000). Additionally, many people view default options as recommendations made by a policymaker/authority figure (Halpern et al., 2007; Johnson & Goldstein, 2004) and thus attribute more validity to them. This would be particularly true in cases in which the authority is a trusted figure (Halpern et al., 2007).

**Omission Biases**

An "omission bias" is defined as perceiving bad outcomes caused by omissions (failures to act) as being more acceptable than equally severe outcomes caused by direct acts (commissions; Ritov & Baron, 1990; Spranca, Minsk, & Baron, 1991). This distinction may result from perceiving omissions as resulting from ignorance, whereas commissions may be the product of malicious intent and/or be due to more active behavior (Spranca et al., 1991). One of the earliest studies of the omission bias presented a scenario in which a disease would kill 10 out of 10,000 children (Ritov & Baron, 1990). A vaccine is available that can prevent the disease in all children, but it is accompanied by side effects that can result in the death of children receiving it. A significant number of individuals indicated they would reject the vaccine on behalf of their child even when the likelihood of dying from the vaccine was lower than the likelihood of dying from the disease. These participants revealed that they preferred to have their child die from the disease (which they did not cause) than to die from receiving the vaccine (which they would have ordered). Another study found a significant link between responses on such hypothetical scenarios and actual vaccination behavior among readers of *Mothering* magazine (Meszaros et al., 1996). In a more recent study, Wroe, Turner, and Salkovskis (2004) found that parents' worries about anticipated regret resulting from acts of omission or commission predicted their likelihood to vaccinate their children.

Yet harms of omission are not always preferred to harms of commission. Fagerlin, Zikmund-Fisher, and Ubel (2005a) found an opposite effect in which action was preferred for hypothetical cancer treatment decisions. In this study, participants who were asked to imagine they had been diagnosed with cancer chose between watchful waiting and surgery. Sixty-five percent of respondents indicated they would choose surgery over watchful waiting, even though the risk of death from watchful waiting was only 5%, whereas the risk of death from surgery was 10%. This discrepancy compared to previous studies may be due to the type of scenario used; that is, prevention decisions (e.g., vaccines) may be fundamentally different than treatment decisions from which people may derive particular solace or value by doing something rather than nothing.
When people have beliefs about how likely something is to occur (i.e., a probability estimate), those beliefs should logically be revised whenever new information suggests that the true probability is higher or lower than previously thought. However, people tend to place too much weight on their initial estimates and fail to adjust their estimates adequately, a bias known as “anchoring and adjustment” (Tversky & Kahneman, 1974) or “conservatism” (Edwards, 1968). Anchoring can occur even under conditions with no logical link between original and new information. For example, Ariely (2008) describes a study in which students were shown nice bottles of wine, imported chocolate, a cordless trackball, a cordless keyboard, and a graphic design book. Students were then asked to record the last two digits of their Social Security number and to write those numbers in the form of a dollar amount next to the names of the items previously shown. After indicating whether they would be willing to pay that amount for the item, students recorded the maximum price they would be for each item. Those whose Social Security numbers were in the upper 20% made bids that were between 216 and 346% higher than those whose Social Security numbers were in the lowest 20%—even though there is no logical reason why one's Social Security number should in any way be related to how much one values good food or computer accessories.

This effect has also been shown in several health psychology domains. For example, Poses, Bekes, Copare, and Scott (1990) asked physicians in a surgical intensive care unit (ICU) to estimate the probability of patients' survival until they were discharged from the hospital. Then, 48–72 hours later, they were asked to make a new set of estimates. Even with the introduction of considerable new information during the intervening 2–3 days, physicians’ estimates varied very little from their initial estimates. Patients show similar effects in estimating their disease risk. In one study, participants were asked whether they believed their risk of colon cancer was higher or lower than 70%, or higher or lower than 30%. They were then asked to estimate their risk of colon cancer. Respondents who were asked whether their risk was higher or lower than 70% gave higher point estimates than those who were asked whether their risk was higher or lower than 30% (Klein & Stefaneck, 2007).

A fundamental requirement of SEUT is that patients must be able to make accurate predictions about how they would feel if they experienced various outcomes (Ubel, Lovenstein, Schwarz, & Smith, 2005). Such assessments of quality of life define the outcome or “utility” values that are the direct inputs into SEUT calculations. Yet the utility (or disutility) that one experiences something (e.g., pain) may be very different than what one predicts based on prior experience (including earlier times when one was in pain).

To start, research in “affective forecasting” has shown that people have difficulty predicting their future feelings (Wilson & Gilbert, 2003). When making predictions about future feelings, people must make predictions about (1) the valence of their future feelings, (2) the type of emotions they will experience, (3) the initial intensity of those emotions, and (4) the duration of those emotions (Wilson & Gilbert, 2003). While errors in any of these four areas can occur, they are most common in people’s predictions of the intensity and duration of their emotions.

Mispredictions can result through a number of mechanisms. First, people may misconstrue how an event will play out (Griffin & Ross, 1991). More specifically, by incorrectly imagining how an event will occur, people may mispredict how they will feel in that situation. For example, if a pregnant woman imagines an unmedicated childbirth that involves no unexpected complications (and the emotions that result from such a scenario) and then has an emergency Caesarean section, she likely will have misconstrued the valence of emotions experienced, the specific emotions she will feel, and the intensity and duration of those emotions (Wilson & Gilbert, 2003).

Second, people may make incorrect predictions about what parts of the experience will have the greatest impact on their emotional states (Dunn, Wilson, & Gilbert,
2003). For instance, Redelmeier and Kahaneman (1996) asked patients to rate their level of pain (using a handheld computer) while undergoing a colonoscopy. Within an hour of the colonoscopy and again 1 month after the procedure, patients were asked to make a retrospective evaluation of the “total amount of pain experienced.” Results showed that the retrospective judgments were significantly correlated with the peak intensity of pain and the pain that occurred in the final 3 minutes of the procedure. Longer procedures were not rated any more negatively than shorter procedures. Even more strikingly, the researchers later conducted a randomized clinical trial of normal versus extended colonoscopy (in which the procedure was artificially lengthened by leaving the scope in without moving it in order to end the experience with relatively less discomfort) and found that extended colonoscopy patients not only gave the procedure a better retrospective evaluation but also had higher rates of repeat colonoscopies in the future (Redelmeier, Katz, & Kahneman, 2003). Other research has found that duration matters during the experience, but that duration is not a significant predictor of the recall of that experience (whereas peak and final pain did influence recall; Ariely, 1998; Fredrickson & Kahneman, 1993). These results suggest significant discrepancies between people’s actual experiences and their recall of those very same experiences. Since people make most decisions based on their recall, erroneous judgments likely result. Understanding these judgments, however, may help medical professionals design interventions that encourage healthy behaviors.

Third, people overestimate how much an event will affect their lives because they do not consider how the event fits into the broader context of their lives. This concept is referred to as “focalism” (Wilson, Wheatley, Meyers, Gilbert, & Axson, 2000). For instance, when imagining what life would be like with a colostomy bag, people likely focus on images of plastic pouches and how their lives would be limited by having such a pouch (e.g., no more bikinis!) (Ubel et al., 2005), and although people might experience these types of feelings, they may fail to imagine all the events in their lives that will not be affected by the colostomy (e.g., enjoying dinner at their favorite restaurant, watching their child do something especially adorable, going to an entertaining movie). Thus, people underestimate how all these other events will impact their happiness, and overestimate how much the focal event (i.e., having a colostomy bag) will influence their happiness.

Fourth, people have difficulty predicting how they will behave in a state that is different than their current state. Lowenstein (1999, 2005) called this the “hot–cold” empathy gap.” In this situation, people who are in a “cold” state have difficulty predicting how they would feel in a “hot” state, and vice versa. For example, drug addicts underestimate how much would they would crave their drugs when in withdrawal; pregnant women, prior to labor, overestimate their desire to have an unmedicated birth compared with preferences during labor (Christensen-Szalanski, 1984); and sexually active individuals who are not in the “heat of the moment” overestimate their likelihood of using condoms during a sexual encounter. Conversely, when people are in a “hot” state, they underestimate the influence of that state and overestimate the stability of their preferences: For example, a person in drug withdrawal cannot imagine a state in which the craving does not exist.

There are numerous studies examining how affective forecasting can affect medical decision making, several of which are nicely described in Lowenstein’s (2005) paper on the impact of hot–cold empathy gaps. Lowenstein argues that many medical decisions are made at times of duress—for instance, when people are in pain or have just received a dire diagnosis (thus causing considerable stress). In these cases the hot-to-cold empathy gap results in people overestimating the duration and intensity of these negative feelings. Furthermore, people underestimate the impact of these feelings on their medical decision making.

An interesting example of this is Chochinov, Tataryn, Clinch, and Dudgeon’s 1999 study of terminal cancer patients. Patients were asked twice a day to rate their quality of life on a number of criteria, including the will to live. The results showed that patients’ will to live fluctuated considerably—and the fluctuation was positively correlated to patients’ ratings of negative emotions. As Lowenstein (2003, p. 552) argued, “Patients, it
seems, did not base their will to live on a long-run average of their health and happiness, but, as hot-to-cold empathy gaps would predict, weighted their immediate feelings very heavily when assessing their own will to live." In another example, Ditto, Jacobson, Smucker, Danks, and Fagerlin (2006) asked older adults (age 65+) to indicate their end-of-life treatment preferences in a cold state (Time 1). A subset of individuals were hospitalized during the course of the study period. Participants who were hospitalized for 48+ hours were asked to again indicate their treatment preferences for a subset of those preferences (Time 2). Because these preferences were typically assessed within 7 days of hospitalization, the preferences were assessed in a hot state. Following this relatively serious hospitalization, people's desire for life-sustaining treatment declined significantly compared to their preferences when they were first assessed. Yet when preferences were assessed again (Time 3), approximately 6 months later, desire for life-sustaining treatment returned to their original "cold-state" preferences.

Several studies have shown the potential consequences of mispredicting one's affective responses to a major medical procedure. First, Smith and colleagues (2008) interviewed kidney patients on a waiting list for a renal or renal-pancreatic transplant. Patients were asked to estimate the magnitude of improvement in their lives following transplantation (e.g., how much more they would work and travel, and their overall quality of life). In each case, people significantly overestimated the benefits they would secure by receiving a transplant. In contrast, studies have shown that people overestimate how much their quality of life would be negatively affected by a colostomy and therefore having to defecate into a bag (Smith, Sherriff, Damshrodorfer, Loewenstein, & Ubel, 2006). In both of these cases, people's inability to predict their actual future quality of life likely impaired their ability to make the best decision possible.

**Cognitive and Affective Biases in Risk Perception**

Risk perceptions play a significant role in people's health decision making, even when objective risk information is explicitly communicated. Furthermore, cognitive and emotional biases can distort people's perceptions of the value of different outcomes, as well as influence their subjective perceptions of likelihood.

**Availability Bias**

For instance, the "availability bias" (Tversky & Kahneman, 1973) describes people's tendency to estimate the likelihood of an event by searching their memory and deriving a sense of relative risk based on how easy or difficult it is to come up with relevant examples. As a result, the probabilities of rare, recent, or especially vivid events are consistently overestimated, whereas likelihood of ordinary, dated, or less memorable events is underestimated even if the events are common. An example of this bias in medical decision making has been documented in physicians' diagnoses. Detmer, Fryback, and Gassner (1978) asked surgeons to estimate in-hospital mortality rates for all surgical patients. Estimates made by surgeons from high-mortality specialties (in which patient deaths were more likely to have occurred recently) were more than double the estimates made by surgeons from low-mortality specialties for the identical patients.

Patients also poorly calibrate their quantitative estimates of health risks, such as the chance of developing cancer. For example, women asked to estimate their lifetime risk of breast cancer often provide figures that are 10–25% higher (and sometimes even more) than the true percentage (Croyle & Lerman, 1999; Fagerlin, Zikmund-Fisher, & Ubel, 2005b; Lerman et al., 1995). Such overestimates are likely due to the salience of cancer messages in the media and the visible impact of cancer on interpersonal relationships, two factors that increase the availability of cancer memories. Similarly, when celebrities develop cancer, people's risk perceptions and worry about that particular cancer may increase, especially when compared to other types of cancer and other diseases (Klein & Stefanek, 2007). Klein and Stefanek (2007) suggest that physicians can counteract availability biases by providing vivid counterexamples. For example, if a patient is reluctant to undergo a treatment because he or she knows of someone who has had a negative experience, the physician can provide alter-
native vivid or salient stories of patients who have benefited from it.

Risk as Feelings

Researchers have recently begun to examine links between risk perceptions and feelings. When patients are provided with specific risk information rather than estimating it themselves, the information presented is translated into intuitive "gist" representations that may include anxiety, worry, or distress about disease risks (Reyna, 2004; Rothman & Kiviniemi, 1999). These powerful emotions can have significant impacts on people's responses to their health conditions (Cameron, Leventhal, & Love, 1998; Lerman et al., 1991; Lofters, Juffs, Pond, & Tannock, 2002; McCaul & Tulloch, 1999; Rothman & Kiviniemi, 1999; Trask et al., 2001), yet it remains unclear whether emotional responses mediate cognitive risk perceptions, shape behavior independently, or both (Finucane, Alhakami, Slovic, & Johnson, 2000; Loewenstein, Weber, Hsee, & Welch, 2001). Resolving such questions is especially important given that perceptions of both value and likelihood may differ substantially when considering emotion-laden outcomes (e.g., as electric shocks) versus affect-poor outcomes (e.g., money) (Hsee & Rottenstreich, 2004; Rottenstreich & Hsee, 2001).

One important psychological perspective on these questions is the "affect heuristic" or "risk as feelings" hypothesis (Loewenstein et al., 2001; Slovic et al., 2004). This view recognizes the fact that affective reactions to risky situations can be different than cognitive evaluations, and the resulting behavior is likely to be driven more by affective reactions than by cognitive deliberations (Bechara, Damasio, Tranel, & Damasio, 1997; Damasio, 1994). A strong early proponent of the importance of affect in decision making was Żajonc (1980), who argued that affective reactions to stimuli are often the very first reactions, occurring automatically and subsequently guiding information processing and judgment. If Żajonc is correct, then affective reactions may serve as orienting mechanisms, helping us to navigate quickly and efficiently through a complex, uncertain, and sometimes dangerous world. Risk as feelings suggests that people use their emotional reaction to risky situations (e.g., feelings of fear or excitement) as information to make judgments about the probabilities of outcomes. Feelings about risk are not always sensitive to objective probability differences, and instead are determined by situational factors such as vividness of outcomes, temporal proximity to the outcome, and the feelings of others.

Researchers studying the affect heuristic have proposed that people consult or "sense" an affect pool in the process of making judgments (Finucane et al., 2000; Slovic & Peters, 2006). Just as imaginability, memorability, and similarity serve as cues for probability judgments (e.g., the availability and representativeness heuristics), affect may serve as a cue for many important judgments (including risk perceptions). Using an overall, readily available affective impression can be easier and more efficient than weighing the pros and cons of various reasons or retrieving relevant examples from memory, especially when the required judgment or decision is complex or mental resources are limited. This characterization of a mental shortcut has led to labeling the use of affect as a "heuristic" (Finucane et al., 2000).

The affect heuristic has been studied in risk perceptions in particular. Perceptions of risk and benefit are often negatively correlated in people's minds (and judgments). In reality, however, risks and benefits are typically positively correlated because things that are high in risk but low in benefit do not survive the marketplace. We think that individuals derive their perceptions of risk in part through their affective reactions to them. If one feels good about some treatment or risky activity, then one looks to one's affective reactions to it as a marker of both perceived risk ("I feel good about it; therefore, it must not be risky") and perceived benefit ("I feel good about it; therefore, it must be beneficial"). In other words, affect is used as information to guide perceptions of risk and benefit. Now, clearly individuals do not use their affective reactions only (other information counts, too), but the evidence suggests that affect matters in a causal way to guide these perceptions, at least in part.

Alhakami and Slovic (1994) found that the inverse relationship between perceived risk and benefit of an activity (e.g., using pesticides) was linked to the strength of pos-
itive or negative valence associated with that activity. This result implies that people base their judgments of an activity or a technology on not only what they think about it but also how they feel about it. If people like an activity, they are moved toward judging the risks as low and the benefits as high; if they dislike it, they tend to judge the opposite—high risk and low benefit. Under this model, affect comes prior to, and directs, judgments of risk and benefit, much as Zajonc (1980) proposed. This process, which is called “the affect heuristic,” suggests that if a general affective view guides perceptions of risk and benefit, providing information about benefit should change perception of risk, and vice versa. For example, information stating that benefit is high for a technology such as nuclear power should lead to more positive overall affect, which in turn would decrease perceived risk. These predictions were confirmed (Finucane et al., 2000).

**The Influence of Context on Risk Representations**

Risk perceptions can also be inappropriately influenced by the contextual nature of the situation. More specifically, contextual information could shape patients' comprehension of and affective reaction to critical information, which could influence their subsequent choices. Single numerical probabilities or frequencies, such as “20%” or “14 out of 1,000,” are rather pallid by themselves. As a result, people often have a difficult time knowing how to feel and react to such stand-alone probabilistic information (Teigen & Brun, 2000; Windschitl, Martin, & Flugstad, 2002) because they need additional information for those statistics to have personal meaning, prompt an affective reaction (e.g., concern, surprise, relief), and/or promote action (e.g., seeking prevention). Comparisons with contextual information facilitate meaning and affective responses. For example, research has shown that people's evaluations of medical options change significantly when they compare the numbers for two alternatives side by side versus consider each option singly (Hsee, 1996; Hsee, Blount, Lowenstein, & Bazerman, 1999). Furthermore, highly numerate people are more apt to make such comparisons than less numerate people (Peters et al., 2006).

In one example, subjects read about two infertility clinics that differed in their *in vitro* fertilization success rates and their distance from the patient (Zikmund-Fisher, Fagerlin, and Ubel, 2004). When each clinic was considered in isolation, study participants had little ability to judge whether clinic success rates (e.g., 28%) represented a positive or negative attribute; thus, they tended to favor the nearby clinic over the more distant one. When compared side by side, however, respondents had a strong preference for the higher success rate of the more distant clinic. This preference reversal demonstrated that the hard-to-evaluate attribute (success rates) was deemphasized in people's decision making because of the lack of context.

However, although context data can provide comparison numbers, sometimes the context is “loaded” and may push people's affective reactions in one direction. The end result can be a systematic bias in people's decisions. For example, Fagerlin, Zikmund-Fisher, and Ubel (2007) found that people's attitudes toward the risks and benefits of treatments were influenced by whether their own personal risk was presented as above or below average. Similarly, Windschitl and colleagues (2002) found that people perceived a female patient to be more at risk for a disease when the prevalence rate among men was lower versus higher, even though the stated risks for female patients remained exactly the same. These results highlight the discrepancy between people's objective knowledge about the risk of an event occurring and their “intuitive perceptions” about whether the event will occur.

**Risk Communication: Providing Information to Support More Informed Choices**

As more and more patients are expected to take an active role in their own medical decisions (Charles, Gafni, & Whelan, 1997; Laine et al., 1996), numerous educational materials and decision aids have been developed to help patients understand their medical diagnosis, and the risks and benefits of their treatment options. Such materials often must communicate significant amounts of risk and benefit information, since patients need to understand precisely the chances
that a treatment may be successful, cause side effects, or reduce future disease risk to make preference-congruent decisions.

Due to the growing requirements to communicate numerical information to patients, there has recently been a significant push toward research that provides direct guidance regarding how best to present numerical information to increase the likelihood of patients making informed medical decisions. While several reviews cover such information in detail (Covey, 2007; Fagerlin, Ubel, Smith, & Zikmund-Fisher, 2007; Lipkus, 2007; Peters, Hibbard, Slovic, & Diekman, 2007), we review some of the most basic issues below.

### Use of Frequencies versus Percentages

Research has consistently shown that both patients and physicians show better understanding of risk information (in terms of gross comparison and risk assessment tasks) if risks are presented in terms of frequencies (e.g., 5 out of 100 people experience a side effect) rather than percentages (5%; Hoffrage & Gigerenzer, 1998) or “1 in N” formats (Cueto, Weinstein, Emmons, & Colditz, 2008). The advantage of frequency over percentage formats, however, does not appear to hold when individuals need to perform calculations with the given numbers (e.g., divide a risk in half; Cueto et al., 2008; Waters, Weinstein, Colditz, & Emmons, 2006). People do, however, prefer to receive risk information in frequencies rather than proportions (Schapira, Nattinger, & McHorney, 2001).

Part of the justification for frequency formats comes from recent work suggesting that individual numeracy (ability to think about and work with probabilities, fractions, and ratios) mediates people’s ability to transform proportions into percentages and vice versa (Peters et al., 2006). Study participants read a scenario about a psychiatric patient and were asked to assess the risk of violence if the patient were discharged. The risk of violence was presented as either 10% or 10 (out of 100). Although ratings by highly numerate individuals did not differ across conditions, less numerate individuals had a strong tendency to view 10% risk as less concerning than a 10 out of 100 risk.

### Use of Absolute versus Relative Risks

Regardless of whether percentage or frequency formats are used, the feelings and perceptions evoked by changes in risk can be very different depending on whether the risk difference is presented in an absolute versus relative form. Although patients consistently report a preference to receive risk information in terms of a relative risk reduction format (Hux & Naylor, 1995; Sheridan, Pignone, & Lewis, 2003), research has consistently shown that changes in risks (e.g., an increase from 6 to 8%) are perceived as much larger when described in relative risk terms (33% more risk) rather than the absolute risk change (an increase of 2%). This inconsistence is well documented in both psychological and medical decision contexts (particularly when discussing risk reductions in which the absolute risk is low; Baron, 1997; Forrow, Taylor, & Arnold, 1992; Malenka, Baron, Johansen, Wahrenberger, & Ross, 1993).

An alternative approach to either absolute or relative risk presentations is to focus attention on the absolute increment or decrement in risk, without discussing the relative change. Such “incremental risk” approaches have been demonstrated to reduce worry about risks of medication side effects (Zikmund-Fisher, Fagerlin, Roberts, Derry, & Ubel, 2008), presumably because they highlight how much risk the patient faces regardless of whether the medication is taken. These approaches appear to be adequately comprehended by patients when supported by graphical displays (Zikmund-Fisher, Ubel, et al., 2008).

### Formats Used to Present Numerical Risk and Benefit Information

Statistical information regarding the risks and benefits of treatment can be presented in many formats: verbally (e.g., the risk of incontinence following radical prostatectomy is “moderate”), numerically (e.g., 60 in 100), or graphically (e.g., in a pictograph). However, research has shown that using verbal labels only is the poorest method of communicating risk–benefit information (Burkell, 2004). The primary concern regarding use of verbal labels is that people vary widely in the numerical probabilities they assign to verbal labels. For example, although one in-
individual may equate low risk of a side effect with a 10% risk, another may view low risk as a 1% risk.

Furthermore, other research has shown that presenting information in graphical formats can result in increased understanding and changes in decision making when compared with presenting statistics using solely numbers. One possible explanation for this finding is that graphical displays may facilitate more experiential processing that enables people to comprehend the gist of the graph without interpreting the details. Thus, while tabular presentations may only result in analytical learning, graphical formats (which often also include the raw numbers) may engage both analytical and gist types of processing (see also Reyna, 2004).

Several excellent reviews of graphical communication have explored the strengths, weaknesses, and overall effectiveness of a vast variety of graphs (Ancker & Kaufman, 2007; Lipkus, 2007; Lipkus & Hollands, 1999). These reviews highlight the importance of understanding the goals of risk communication and choosing graphs that achieve these goals. Is the goal to present single-risk numbers or to compare treatments or multiple risks? Alternatively, is the goal to show how risk changes over time, or to show the incremental risk that might be caused by a treatment? For instance, line graphs highlight trends (e.g., effectiveness of a drug over time), whereas bar graphs allow viewers to compare multiple options. A graph to show the differential rates of impotence following each type of prostate cancer treatment (e.g., surgery, external beam radiation brachy therapy), therefore, would be better structured as a bar graph than as a line graph.

Several studies have examined the effectiveness of various types of graphical formats (e.g., line graphs, bar graphs, pie graphs, pictographs). These studies have shown that not all graphical formats are equally effective in communicating risk information. In one study, participants viewing vertical bar graphs and pictographs (image matrices) had quicker reaction times and better comprehension than with other formats (Feldman-Stewart, Brundage, & Zottov, 2007). Another study compared five graphical formats and one table format regarding both verbatim knowledge of the risk information presented (e.g., “Compared to people who did not take a pill, approximately how many fewer people would need bypass surgery if they took Pill B?”) and gist knowledge (e.g., “Who is less likely to need bypass surgery: a person who took Pill A or a person who took Pill B?”) (Hawley et al., 2008). Although tables appeared to result in the best verbatim knowledge, they were among the worst formats for communicating gist knowledge. However, pictographs performed well on both gist and verbatim knowledge measures. These results are consistent with dual-process theories, in that tables (a highly analytical format) tend not to engage the more experiential/associative learning process that often underlies our gist understandings of the world.

Conclusions

This review has highlighted the difficulties people face when trying to make health-related decisions. Numerous biases can affect the decision-making process, in terms of how people make decisions and how critical medical information is presented.

The study of the psychology of judgment and decision making has identified basic heuristics that contribute to biases in probability judgment, valuation of outcomes, and choices between alternative courses of action. In this review, we have traced most of these heuristics to the simultaneous operation of dual cognitive processes in judgment, and particularly to the experiential/intuitive judgment system, which highlights associations between events and offers rapid evaluations of decision situations.

Recent research has demonstrated that the responses of the intuitive system reflect not only cognitive strategies but also considerable input from the affective system. Emotions—experienced, anticipated, and remembered—play an important and increasingly well-recognized role in health decision making by patients and providers. Future study must consider cognitive and affective processes, and their influence on judgment and decision making, to improve both our understanding of how people make health choices and our ability to improve them.
Further Reading


References


a review of the effects of framing and other manipulations on patient outcomes. *Journal of Health Communication, 6*(1), 61–82.


