Context Is Everything *or* How Could I Have Been That Stupid?

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Abstract
Dual Process Theory provides a useful working model of decision-making. It broadly divides decision-making into intuitive (System 1) and analytical (System 2) processes. System 1 is especially dependent on contextual cues. There appears to be a universal human tendency to contextualize information, mostly in an effort to imbue meaning but also, perhaps, to conserve cognitive energy. Most decision errors occur in System 1, and this has two major implications. The first is that insufficient account may have been taken out of context when the original decision was made. Secondly, in trying to learn from decision failures, we need the highest fidelity of context reconstruction as possible.

It should be appreciated that learning from past events is inevitably an imperfect process. Retrospective investigations, such as root-cause analysis, critical incident review, morbidity and mortality rounds and legal investigations, all suffer the limitation that they cannot faithfully reconstruct the context in which decisions were made and from which actions followed.

In the *National Post* in 2008, columnist John Moore related details of a murder: "a man fatally shot his wife in the chest and got away with it." Our reaction is an immediate sense of outrage at the ills of modern society. This is yet another example of wanton domestic violence and of a judicial system that has failed, once again, to bring the perpetrator of a horrifying crime to task – "bleeding heart liberal judges and their hugs for thugs."

We later learn that the accused was an elderly man diagnosed with a terminal illness, married for many years to a woman who had developed Alzheimer's disease. He was fearful she would suffer unduly without his care. Knowing, too, that his own death was imminent, he chose to end her life. He was never charged with the murder and was released home to await his own death, at least content in the knowledge that his wife would not endure prolonged neglect and suffering. The context, says Moore, removes our outrage; we now understand both the husband's and the judge's decisions (Moore 2008, April 7). After learning this, we might then wonder, on reflection, "How could I have been so stupid to have made the first judgment?"

We make decisions continuously throughout our waking lives. These decisions vary in complexity from the simple, automatic processes involved in executing a well-rehearsed habit, such as driving a car, through more consequential decisions, such as choosing a partner or deciding on a career. Decision-making is the most important thing we do; it is the engine of all human behaviour. In fact, how we live our lives derives from how we make decisions (Gigerenzer et al. 2002). Yet, it is only recently that a consensus has emerged about how the overall process of decision-making occurs; this consensus appears to explain the different ways in which we make decisions, as well as the conditions and constraints that prevail.

Context

One of the major constraints on decision-making is context, as described in the homicide example given above. It is graphically illustrated in Figure 1. In the top line, the middle symbol is clearly read as the letter *B*, whereas in the lower line, the identical symbol is read as the number *13*. A second example is given in Figure 2, where two vertical bars are perceived to be of different lengths because they are placed in the context of perspective lines. The right bar appears to be extending both higher and lower than the left line, thus appearing longer; but both lines are the same length.

Figure 1. The effect of context on meaning

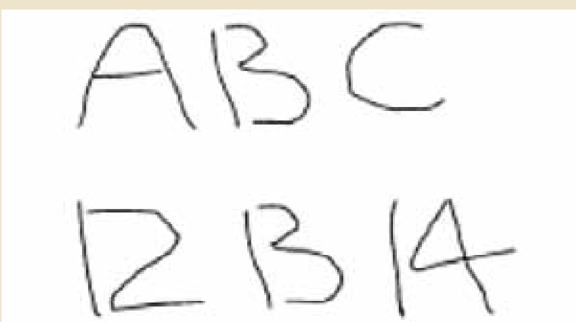
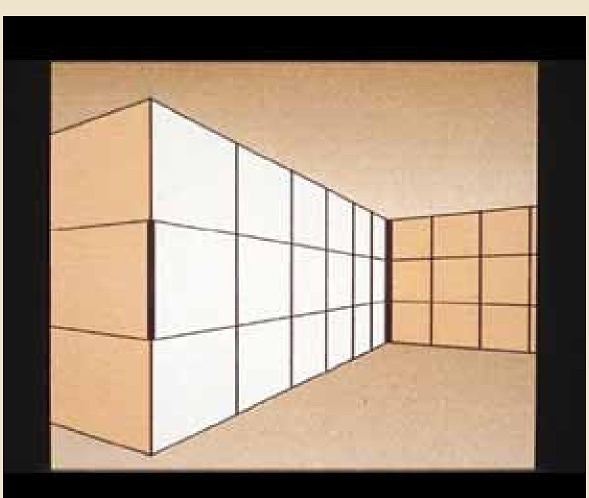


Figure 2. Effect of context on perception of line height



Many other visual illusions depend, for their effect, on misleading context. Figure 3 shows the impact of juxtaposition on the perception of size. The two white circles are the same size, but the one on the left appears to be smaller.

Figure 3. Effect of context on perception of size

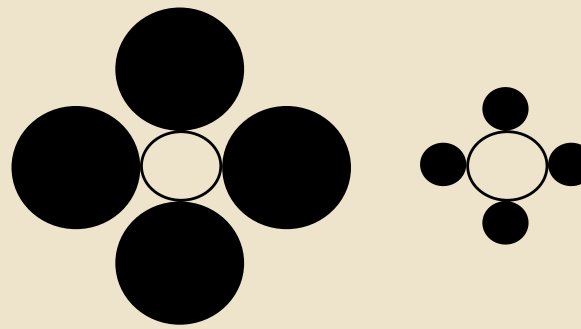


Figure 4 shows the impact of contrast on the perception of shading. The circles in each of the squares are actually the same shade. The effect of contrast does not apply just to the shading in illustrations – these contrast effects of context on decision-making processes have been noted in the psychology literature (Tversky and Simonson 2000).

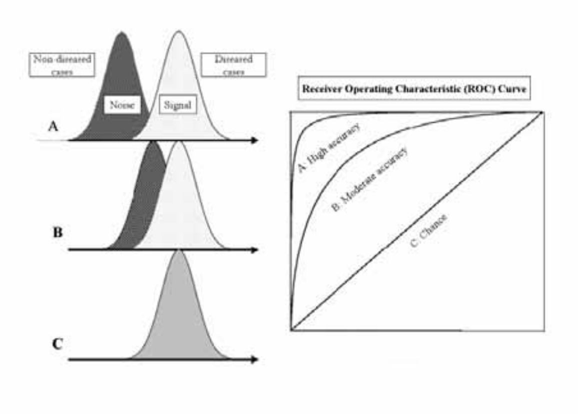
Figure 4. Effect of context on perception of shading

Signal-to-Noise Ratio

Another way of looking at the issue of context is by applying signal detection theory, so that we treat context as "noise." To accurately perceive things around us, we need to be able to distinguish critical signals from background noise (Swets et al. 1961). Few signals arrive in complete isolation; they are usually accompanied by some degree of noise or interference. In each of Figures 2, 3 and 4, our perception of the critical signal is influenced by the surrounding visual noise. Similarly in medicine, a particular problem for physicians is the degree of overlap among diseases. Pathognomonic conditions (e.g., shingles, basal skull fracture or shoulder dislocation; shown as *A* in Figure 5) usually present little challenge for diagnosis; they are relatively unambiguous and readily identified. They are accompanied by very little noise. Other diseases (e.g., pericarditis and acute myocardial infarction; *B* in Figure 5) manifest themselves less clearly and may be mimicked by other conditions. Worse still, some conditions (e.g., ureteral colic and dissecting abdominal aneurysm, or subarachnoid hemorrhage and migraine; *C* in Figure 5) may show complete overlap in their symptomatic presentation. With these latter examples, the probability of diagnosing the disease on the basis of clinical presentation may be no better than chance; noise may completely overlap the signal.

In medicine, generally, there are many examples other than disease mimics of distraction by noise. The decision-making of care providers may be influenced by distracting cues (noise) from the patient in front of them. Care providers may be influenced by factors that may be irrelevant to the provision of appropriate care, such as gender (Borkhoff et al. 2008; Hamberg 2004), race (Green et al. 2007; van Ryn 2002), obesity (Hebl and Xu 2001; Hoppe and Ogden 1997), psychiatric illness (Daumit et al. 2006; Mukherjee et al. 2002) and age (Alliance for Aging Research 2003; Podolsky and Silberner 1993).

Figure 5. ROC curves and their relationship to the degree of overlap between the probability curves of non-diseased and diseased cases



Dual Process Theory

The dominant universal model of decision-making is Dual Process Theory, which has attracted converging lines of support from philosophical (Epstein 1994; Henden 2004), psychological (Evans 2008), neuroanatomical (Lieberman et al. 2004), neurophysiological (Buschman and Miller 2007) and genetic (Oades et al. 2008) studies and has recently been reviewed by Evans (2008). In Dual Process Theory, there are two major decision-making modes: System 1 and System 2. The processes of System 1 are intuitive, automatic, fast, frugal and effortless. Examples of System 1 at work include our initial reaction to the homicide described by Moore, and our interpretation of Figures 1–4. In System one, contextual cues are very important.

System 1's application to problem solving is nicely illustrated by the Cognitive Response Test described by Frederick (2005). This test consists of three questions:

1. A bat and a ball cost $1.10 in total. The bat costs $1.00 more than the ball. How much does the ball cost?
2. If it takes five machines five minutes to make five widgets, how long would it take 100 machines to make 100 widgets?
3. In a lake, there is a patch of lily pads. Every day, the patch doubles in size. If it takes 48 days for the patch to cover the entire lake, how long would it take for the patch to cover half the lake?

The majority of answers given by respondents are wrong. For question one, the usual answer is that the bat costs $1.00 and the ball costs 10¢. This fast, intuitive response is incorrect because the bat would then cost only 90¢ more than the ball. (The correct answer is that the ball costs $.05 and the bat costs $1.05.) For question two, the usual intuitive answer is 100 minutes, but again this is wrong. One machine makes a widget in five minutes; therefore, 100 machines would still take only five minutes to make 100 widgets. For question three, the usual answer is 24 days, whereas the correct answer is 47 days. In each case, the answer looks easy and intuitively plausible, but a moment's reflection reveals that the first impulsive answer is wrong. Higher mathematical skills are not required to calculate the correct answer. These predictable errors can be explained, in part, by the brain's "cognitive miser" function. This is an important but often overlooked property of the brain – the tendency to limit cognitive effort in reasoning (Krueger and Funder 2004), a kind of "energy saving."

In contrast, the reasoning and decision-making processes of System 2 are analytical, deliberate, slower, costly and effortful. They are characterized, for example, by the reasoning processes that allow the precise categorization, staging and location of a brain tumour through neurological assessment, brain biopsy and magnetic resonance imaging. A summary of the properties of the two systems is given in Table 1.

Interaction between the Systems

There are several important ways in which the two systems interact with each other, as is indicated by the broken lines in Figure 6 (Croskerry 2009). Firstly, repeated presentations of the same problem to System 2 can eventually result in the decision mode being relegated to a System 1 level. This shows the benefits of familiarity and practice – and the consequent development of automaticity. Secondly, System 2 can exert an executive function and override the impulsive output of System 1, the equivalent

Table 1. General properties of the two systems

Property	System 1: Intuitive	System 2: Analytical
Reasoning style	Heuristic Associative Concrete	Normative Deductive Abstract
Awareness	Low	High
Prototypical	Yes	No, based on sets
Action	Reflexive, skilled	Deliberate, rule based
Automaticity	High	Low
Speed	Fast	Slow
Channels	Multiple, parallel	Single, linear
Propensities	Causal	Statistical
Effort	Minimal	Considerable
Cost	Low	High
Vulnerability to bias	Yes	Less so
Reliability	Low, variable	High, consistent
Errors	Common	Few
Affective valence	Often	Rarely
Predictive power	Low	High
Hard-wired	May be	No
Scientific rigour	Low	High
Context importance	High	Low

Sources: Adapted from Dawson (1993), Croskerry (2005) and Evans (2008).

of "turning off one's hot buttons." In the Cognitive Response Test examples given above, a System 2 override takes no more than a few seconds to run a mathematical check on the reflexive response. Generally, this override function serves us well as taking immediate action on first impressions can prove catastrophic. However, System 1 responses can often be quite appropriate and best left alone. In fact, too much scrutiny can result in "paralysis by analysis." A good example of this is the memorable scene from the musical, *Oliver!* in which Fagin repeatedly finds System 1 ideas appealing but each time rejects them by "reviewing the situation." This System 2 override eventually incapacitates him, and he ends up doing nothing.

Finally, and for the most part regrettably, System 1 can override System 2. Often, this amounts to an irrational act, what Stanovich (1993) has termed *dysrationalia*, a condition that resonates with the ancient Greek *akrasia*: lacking command over oneself, or the state of acting against one's better judgment (Rorty 1980). There are a variety of examples of System 1 override in medicine: physicians ignore well-developed clinical decision rules, even though the rules will consistently outperform them, or they persist with clinical practices for which there is no substantive evidence, or otherwise sustain habits that may actually be counter-therapeutic. In a landmark study in the United States, barely half of patients were found to be receiving recommended standards of care (McGlynn et al. 2003).

Thus, we need to appreciate the vulnerability of System 1, that most errors in decision-making occur here. System 1 is especially prone to the human tendency to contextualize features of situations, and there are many ways in which such context adds meaning to our perceptions and comprehension of events in the world around us. But on occasions, the situation actually calls for reasoned and more deliberate decision-making, which may require some cognitive flexibility in decoupling features that are irrelevant. It appears that when decisions fail, we have probably mis-contextualized information or failed to ignore distracting features.

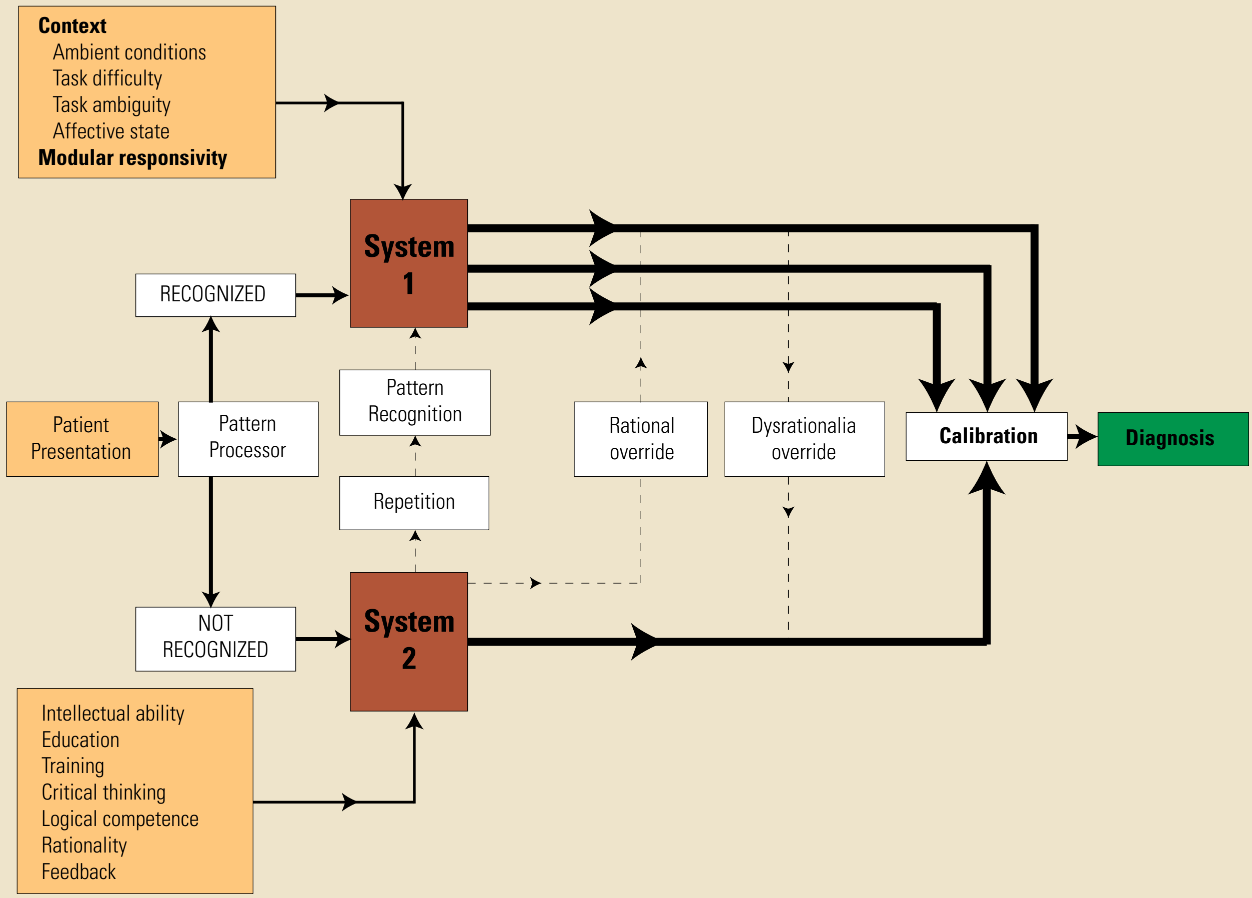
The Rational-Experiential Inventory

It is not simply the situation or context, however, that determines whether System 1 or System 2 reasoning will prevail. Individual proclivities exist, reflecting different ways of looking at the world (Epstein 1994), presumably based on personality and other individual differences (Stanovich and West 2002). On the basis of cognitive-experiential self theory, Epstein and colleagues have developed the 40-item Rational Experiential Inventory (Pacini and Epstein 1999), which allows estimates of individuals' tendencies toward System 1 and System 2 thinking.

Contextual Decision-Making

All decisions are made in some sort of context. It can be adjacent, as in the perceptual examples in Figures 1–4, or situational, as in the homicide example, where a variety of factors, such as previous experience, ambient conditions, current affective state of the decision-maker, fatigue, sleep deprivation, expectations etc., are co-determinants. Also, as noted above in the variety of factors known to influence physicians' decision-making, context can simply be the visual presentation or some other characteristic of the patient (e.g., gender, race, obesity, psychiatric co-morbidity, age). In *How Doctors Think*, Montgomery discusses the practical reasoning integral to physicians' judgment (Montgomery 2006). This requires a hermeneutic approach – making sense of and interpreting context. Some part of the context will always be noise and irrelevant to the signal. Not

Figure 6. Schematic model for diagnostic decision-making



Broken lines indicate significant interactions between System one and System two.
Source: Adapted from Croskerry (2009) with permission.

infrequently, we fail to recognize noise for what it is.

Typically, when we review decisions – our own or those of others – we cannot reproduce the exact context in which the decisions were originally made, achieving usually no more than an approximation. Given that much of our learning occurs in hindsight (i.e., we accrue wisdom after events), the fallibility of human memory and the lack of awareness of contextual factors inevitably lead to imperfect learning. Hindsight is typically (but not necessarily) subject to bias. Our failure to reconstruct context reliably is a major impediment to learning.

Hammond (2000), in his seminal work *Human Judgment and Social Policy*, emphasized the irreducible uncertainty of decision-making in several spheres, including medicine and the judicial system. Both are especially vulnerable when critical events are judged retrospectively; difficulties are inevitably encountered in trying to reconstruct the context in which decisions and actions originally occurred. This is the case for most evaluations of criminal acts – with the passage of time, failed memories, unconscious acts and hindsight bias, the past may be reconstructed as only a pale and blurred image of what it really was. Judges and juries may sit in dispassionate isolation from important contextual information that might have strongly influenced the decisions that were made at the time. Similar constraints apply to morbidity and mortality conferences and critical incident reviews. A single case, and the decision-making that went along with it, is typically separated from the context in which it occurred. Usually, no account is taken of ambient conditions, such as other cases being managed concurrently, team dynamics, fatigue, sleep deprivation and other variables critical to performance.

Conclusions

The emergence of the dual process model of reasoning has allowed closer scrutiny of the processes that underlie decision-making and especially permits a focus on vulnerable aspects of the process. Despite the fallibility of System 1 reasoning, it is clear that we cannot live without it. In any event, we could not depend exclusively on System 2. It requires a major commitment of time and resources that simply is often not available. Thus, both systems are essential, performing functions vital to the commerce of daily living. The key to a well-calibrated performance is some optimal balance between the two.

However, most errors do occur in System 1, so we need to understand its vulnerability. It is especially prone to the human tendency to contextualize features of situations requiring decision-making. Failed decision-making is due, in part, to an under- or over-appreciation of contextual cues. Further, when we are engaged in formal processes that systematically review decisions that have been made, we need to reconstruct the context as accurately as possible.

Law and medicine both lean heavily on retrospective processes. The proper purpose of the legal system is to establish an understanding of past events such that justice might be fairly administered. The nature of medicine is significantly dependent on learning about disease, usually after the fact, so that future patients might be better diagnosed and treated. HQ

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