

Towards new Modes of Decision Making— Complexity and Human factors

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Introduction

This paper will discuss an approach to understanding decision making processes through considering the combination of specific psychological issues with general ideas of complexity. The context is team decision making in commercial and industrial contexts.

The complexity of such a situation is twofold. On the one hand, there is the complexity of the problem space confronting the decision making team, especially in dynamic decisions. By complex problem space, we mean that the system under consideration exhibits such features as, for example, phase transitions, non-linear dynamics or heavy tailed distributions. On the other hand, there is the complexity of the structure addressing that problem space—the decision making team itself.

The decision making team is a complex system not only due to the interaction of its parties but, importantly, due to the possibility of misperception of the complexity of the situation by individual decision makers. Decision makers may perceive a genuinely complex situation as being simple. At other times, they may perceive situations which are merely complicated (and thus able to be resolved by reductive reasoning) as being “complex”. They may thus use inappropriate reasoning without being aware that their reasoning is inappropriate. What is more, team members will misperceive the complexity of the situation to different degrees. They will also react in different and varying ways. Different, because individuals will have objectives and reasoning processes different to those of other team members. Varying, because each individual agent will vary in decision capacity and method depending on her or his emotional state, or “mental mode”. The natural reaction of people working in situations perceived as complex is to change from thinking technically (or “rationally”) to thinking emotionally (where’s my comfort zone?) or socially (how am I going to avoid looking foolish?). If one considers a decision team as a group of agents, the agents are uniform neither between themselves nor in their own behaviour along the arrow of time.

Bringing the domains of the psychology of decision making, and that of complexity theory together could open up avenues to new and innovative modes of decision making. These could provide decision makers with the means radically to improve their decision making in complex problem spaces; especially those where the means used to address the problem space is itself complex, i.e. a team of people. The area of technological innovation and consequent investment decisions is an appropriate area in which to study this subject, since by its very nature it is both highly uncertain and complex.

Human behaviour in dynamic decision situations

Dynamic Decisions

A substantial body of research exists in the behavioural sciences in the area of dynamic decision making. Brehmer¹ defines dynamic decisions as having four characteristics²:

1. A series of decisions is required to reach a goal.
2. Decisions are interdependent. Each decision needs to be understood in the context of the other decisions in the series, either because they are constrained by earlier decisions, or because they may constrain later decisions.
3. The state of the decision problem changes over time, either autonomously (because of the system), or as a consequence of decision makers' actions.
4. Decisions occur in real time. As such the decision maker must make a decision when the environment requires it, not in her or his own time. This is a factor generative of stress, which affects decision performance negatively, since the decision maker under stress reverts to simpler, more task-oriented modes of operation

Individual situations

Brehmer's findings were complemented by Sterman,³ who found that human behaviour in the face of increased perceived complexity (complicated problems) is to make decisions in a more reactive and simplistic manner. He also demonstrated that subjects misperceived the decision situation when feedback delays occurred. Particularly interesting is the "mislearning" that occurred due to subjects attempting to learn through feedback which they had misinterpreted. These factors significantly degraded decision performance in a simulated market situation, and created classic "boom and bust" oscillations.

Brehmer notes that dynamic decision making poses problems for standard decision theory, since decision trees become too complex, and standard decision theory does not take time criticality into account. He concludes that there is *no analytical solution for most dynamic decision problems*. He also concludes that it is impossible to define performance criteria for decision makers in the system, since a small mistake at the beginning of the process can set the decision on a course that excellent decision making later in the process cannot correct, whilst in other scenarios it is the autonomous characteristics of the system that preponderantly influence a "good" or "bad" outcome, rather than the quality of the decision making. He comes tantalisingly close to, but does not explicitly adopt a complexity theory approach.

Other research on decision making has long since discredited the myth of the "rational" decision maker, even in the case of simple or complicated, rather than complex problems. Kahneman and Tversky have famously demonstrated our consistent and persistent violation of rationality.

*Our research shows that the axioms of rational choice are often violated consistently by sophisticated as well as naive respondents, and that the violations are often large and highly persistent. In fact, some observed biases, such as the gambler's fallacy and the regression fallacy, are reminiscent of perceptual illusions. In both cases, one's original erroneous response does not lose its appeal even after one has learned the correct answer.*⁴

The way we perceive—or misperceive—a problem is intimately linked to the way we deal with it.

Modularity of the Mind

Much research suggests that when we move into the “irrational”, this is part of the unfathomable way of how our subconscious works; and, by and large, “rational” as used above refers to processes following classic deductive logics. We suggest a different hypothesis (to be verified in further research): that the behaviour outlined above by Tversky is in fact due to us “switching modules” in our mind. The Modular Mind concepts imply that people have a variety of domain-specific rationalities, for example from “technical” to “social”⁵ contexts. Rather than focusing on irrationality, we suggest focusing on differing rationalities. Complexity in the decision making process can thus be looked at from the perspective of different individuals ‘coming from’ differing rationalities.

Team situations

Building on the work of Brehmer and others, Philips⁶ describes one social dimension of decision making: how team contributors influence team leader decisions in a hierarchical team, with distributed expertise. Her findings with undergraduates in a simulation show that the team leader relies both on records of past performance (how accurate the advice from team members has been) and also on how much confidence the team members have in their own judgement. She demonstrates the dysfunctional decision making that occurs when team leaders rely on the “confidence” factor (or others such as personal friendship) rather than the “past accuracy” factor.

We contrast this with the fact that in Silicon Valley, venture capitalists’ two key criteria for investing or otherwise in a company are: whether they know and trust the person presenting the case⁷, and whether that person has done the venture capitalist a good turn recently.⁸ Behavioural psychologists appear to be saying one thing, while business appears to be saying the opposite. This may be partly explained by the experience factor (Kobus et al⁹ have demonstrated the difference in behaviour between high-experience and low-experience groups when making decisions under uncertainty) but clearly, more research is needed in this area, which complexity theory could inform.

Different Kinds of Teams

There are also several kinds of teams and hence several kinds of decision dynamics. Hierarchical technical teams will have different internal dynamics to non-hierarchical technical teams, who will again have different internal dynamics to hierarchical or non-hierarchical customer service teams.

What Complexity Theory can Bring

Complexity theory should bring greater understanding of the complex dynamic decision making process. Autocatalytic theory and notions of phase transition can shed light on the way dynamic decision making unfolds, both with respect to a dynamic context and with respect to group dynamics in the decision-making team. It can also help those guiding the decision process to “throttle” the dynamics of the decision process, either to increase it by increasing interconnectedness or stabilize it by decreasing interconnectedness. Patching, as advocated by Kauffman in the context of solving the problem of endemic misspecification, can be used to “decentralize” portions of the decision, and then bring them together dynamically. And of course, the notions of ecosystems and co-evolution provide an intuitive metaphor, and possibly even an analogy for the “ecosystem” of the decision team and its environment. These are but a few of the possibilities: the domain of investigation is rich in promise.

Application to Investment in Technological Innovation

The area of investment in technological innovation is a classic dynamic decision situation, since it is in fact a chain of decisions which depend both on each other and on the changing outside environment that determines the specific context of each individual decision (“a competitor has just announced product X”, or “we’re in March, and have overspent/underspent our budget”).

Those involved in investing in new technology may have to deal with technologists whose life’s meaning is intricately tied up in a decision to either promote or cut a project. Here the dialectic may end up being, not on the strictly rational level (or “mode of mind”) but between the rational mode and a social mode inspired by empathy with the person who has consecrated him or herself to developing this innovation, sometimes at great personal sacrifice. Or the mode may be purely personal, as in Silicon Valley, where the personality of the presenter of the request for funding for a technology project is more important than the content of the project itself.

In a social situation (and most technology investment decisions are taken by a board of decision makers), the chairperson of the board who may have final say may, concur with a decision against his or her own judgment, because a majority on the board feel passionately about the project.

Looking at boards of decision makers for technology investment projects as Complex Adaptive Systems, or Complex Responsive Processes (if one follows Stacey) holds out much promise for further research.

Initial Conclusions

Complexity occurs both in the decision itself, and also in decision-making individuals and teams. Notions from complexity theory, taken together with the substantial body of research on the psychology of decision making, may be able to help us better understand complex decision making and possibly discover new modes of decision making.

A few tentative principles are beginning to emerge from our research.

- ❑ Decisions are rarely what we perceive them to be, either because we ourselves misrepresent them, or because others, trying to influence us, are framing them in a particular way. Though prevalent social norms require that a decision be justified on rational grounds, even if the real reason is political or personal, we should look at defining acceptable bases for decisions which are other than technically “rational”.
- ❑ Emotion is an intrinsic part of the way we decide as human beings. A decision framework which bans emotion is doomed to failure.
- ❑ In an environment where complexity and emergence can radically transform landscapes in a short space of time, the power of a decision lies in its inherent adaptability, not the accuracy of its predictions. As humans, we need to find ways of coming to terms with our predisposition of “always wanting to be right”, and find a “mode of mind” where we can be comfortable with seeking out errors in decisions we have made, in order to adapt them.
- ❑ Reflexivity (consciousness of the environment and one’s reaction to it) is a key factor of success for individual and team decision making.
- ❑ Group dynamics are a key factor in determining the outcome of a decision. They can either have a positive (e.g. strength of a coalition) or negative (game-playing, pretending to agree, etc.) impact on the decision process.

As this research progresses, we hope to discover further principles, and to develop a formal framework that can be used as a practical tool for informing our decision making in the unsettling yet exciting complexity of the outer environment of the technology industry and the inner environment of our own humanity, both individual and social.

References

- ¹ “Dynamic Decision Making and Human control”, Brehmer B., *Acta Psychologica* 1992, 81: 211-241
- ² The first three are taken from Edwards, W. 1962. *Dynamic Decision theory and probabilistic information processing*. *Human Factors* 4, 59-73.
- ³ *Feedback complexity, bounded rationality & market dynamics*, 1998, Sterman, J. and Kampmann, C.
- ⁴ Tversky, A, 1977 “On the elicitation of Preferences: Descriptive and Prescriptive Considerations” in Bell, D. Kenney, R., and Raiffa H., eds “*Conflicting Objectives in Decisions*”, Wiley, New York.
- ⁵ The “modularity of the mind” hypothesis is described in: Fodor “*The modularity of the mind*”, 1983, MIT Press, and taken further by Mithen “*The prehistory of the mind*”, 1996, Thames and Hudson; Karmiloff-Smith, A; “*Beyond Modularity: A Developmental Perspective on Gognitive Science*”, 1992; and others.
- ⁶ Philips, J., *Antecedents of Leader utilization of Staff Input in Decision-making Teams - Organizational Behaviour and Human Decision processes*. Vol 77, No 3, March pp 215-242, 1999.
- ⁷ Weinberger makes a similar point in “*Garbage in, Great Stuff out*”, *Harvard Business Review*, September 2001. The key for him is “*Evaluate your resources, and decide which to trust*”.
- ⁸ Interview with Jean-Marc Frangos, Head of BT Corporate Venturing, based in Silicon Valley.
- ⁹ Kobusa, D, Proctor, S., Holste, S., *Effects of experience and uncertainty during dynamic decision making*, *International Journal of Industrial Ergonomics* 28 (2001) 275–290.