Using the Internet to Support the Patient Treatment Decision Process

Rob Meredith

Decision Support Systems Laboratory, Monash University
PO Box 197
Caulfield East, Victoria 3145
Australia
Rob.Meredith@infotech.monash.edu.au

ABSTRACT: Decision Support Systems tend to be limited to organisational decision making, especially decisions that are easily quantifiable. These systems have had less success in decision situations where information is not quantitative and in a multitude of formats and locations. This article looks at one such decision situation, patient treatment decisions, and outlines an approach that utilises the Internet as an integral part of the technical architecture.

KEY WORDS: DSS, Affect, The Internet, Medical Decision Making, Technical Architecture
1. Introduction

Patient treatment decisions are stressful, highly unstructured problems. The outcomes are truly of life-and-death proportions. In many medical situations, a number of treatment alternatives will have similar medical outcomes. For example, trials may show that surgery for a particular condition has a success rate roughly equal to a regime of drugs. From a medical perspective, the two alternatives are equally viable. From the patient’s perspective, however, the options may have vastly different consequences. For some patients, the prospect of surgery itself is enough for them to prefer the drug option. For others, the side effects of the drug regime may negatively impact on their lifestyle.

This kind of decision problem is indicative of a class of decisions that are poorly supported by model-based decision support systems. The application of classical decision theoretic methods, or the use of an algorithmic model to support the decision-makers is inappropriate, due to the largely emotive, or affective, factors that play a role. Whilst patient treatment decisions are the epitome of this class of decision, there are numerous examples from every domain of life, where affect is an important factor. Indeed, Antonio Damasio (1994) has shown in his book Descartes’ Error: Emotion, Reason and the Human Brain that affect plays a vital, neurological role in all but the most trivial of decisions. This obviously flies in the face of the accepted understanding of normative decision making – that emotions are the antithesis of good, rational decision making.

This article describes the preliminary design of a decision support system intended to support the affective, as well as the logical-empirical aspects of the patient treatment decision, with a view to learning lessons that might be applied to other domains.

2. The Patient-Physician Relationship and Decision Making

Medical decision making has gone through something of a revolution in the last twenty years, with the rise of the patients’ rights movement pushing for greater patient autonomy and active involvement in medical encounters. A number of different studies highlight the importance of active patient involvement (Deadman et al., 2001; Elwyn et al., 1999; Erlen, 1998; Gattellari et al., 2001; Gramlich and Waitzfelder, 1998; Millichap, 1994).

Not all patients, however, seek active participation. Generally, those patients who show an interest in participating are young, well educated and don’t face a life threatening illness (Deber, 1994; Krupat et al., 1999). After all, whilst active participation can be empowering, it comes with a great deal of responsibility. The patients least likely to wish to take this responsibility tend to be older married men with serious illnesses (Deber, 1994).
Even when patients do wish to take an active role, it is generally a limited one. Clinical decision making has two quite distinct parts. The first can be described as “problem solving” (Deber et al., 1996). This involves diagnosis of the illness and the identification of potential treatments, or courses of action. The second is a selection, or treatment choice, where a particular course of action is adopted and followed through. Patients tend to prefer that the physician take responsibility for problem solving (whilst remaining informed), but are more likely to want active participation in the choice of treatment (Deber, 1994; Deber, 1996; Deber et al., 1996). This makes sense if one considers that the diagnosis of a disease is essentially about applying scientific medical information to a set of symptoms. Treatment, on the other hand, has a direct impact on the patient’s life. The desire to retain a certain amount of control over one’s life is understandable.

Patient-physician relationships therefore span a spectrum from the traditional, paternalistic, approach where the physician is the sole decision maker, to informed choice, where the patient is the sole arbiter. Charles et al. (1999) describe four models of treatment decision making:

- **The Paternalistic Approach.** This is the traditional approach, where the physician is considered to be the decision-maker, since he or she has a vast body of medical knowledge to draw upon. Medical information is imparted to the patient only, the minimal amount being that which is legally required. The physician alone, or in consultation with other physicians, makes all decisions.

- **The Physician-As-Agent model.** This approach recognises that medical knowledge as well as knowledge about how different options “resonate” with the patient’s lifestyle etc. are required to make a treatment decision. The patient communicates the latter to the physician, who then puts themselves in the shoes of the patient. The physician then acts as the sole decision-maker but chooses the course of action that they believe the patient would have chosen if the patient were a well informed medical practitioner.

- **The shared decision making approach.** This is a co-operative effort between the patient and the physician. Information flows in both directions, and includes more than just medical information. The minimal amount communicated is all that is relevant for the decision, not just the minimal legal requirement. Both the physician and the patient together, as well as possible others such as family, friends, nursing staff etc., decide on the course of treatment.

- **The informed-choice approach.** This approach is at the opposite end of the spectrum to the paternalistic approach. In this model, the patient is the sole decision-maker. Information flow is largely one way, with medical facts being imparted by the physician to the patient, but the physician plays no other role in the decision process.

The following table summarises the four different approaches:
Table 1. Treatment Decision Models. Adapted from Charles et al. (1999).

<table>
<thead>
<tr>
<th>Information Exchange</th>
<th>Deliberation and Treatment Choice</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Flow</td>
</tr>
<tr>
<td>Paternalistic</td>
<td>One Way (Physician ⇒ Patient)</td>
</tr>
<tr>
<td>Physician-As-Agent</td>
<td>One Way (Physician ⇐ Patient)</td>
</tr>
<tr>
<td>Shared Decision Making</td>
<td>Two Way (Physician ⇐ Patient)</td>
</tr>
<tr>
<td>Informed</td>
<td>One Way (Physician ⇒ Patient)</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Of these models, the former two minimise the role that patients have to play. As argued above, this is inadequate, as patient involvement is important. The informed model, however, has also been shown to be inadequate. A controlled study of cancer patients and their involvement in treatment decisions showed that shared decision making, as opposed to those models in which the doctor or patient were the sole decision maker, lead to more satisfied patients in terms of consultation, information about treatment and emotional support (Gattellari et al., 2001). It is this model of patient-physician relationship that this project is seeking to support.

2.1. The Shared Decision Making Model

Shared decision making has four requirements (Charles et al., 1997). Firstly, there must be at least two participants – the patient and physician – although more can be involved. This can include other physicians, paramedical staff, or friends and family of the patient. Secondly, all participants must share information. Thirdly, consensus must be sought, and finally, agreement reached, as to the course of action to be taken. If any of these are missing, the shared decision making model falls down.

Towle (1997) suggests that the following steps should be followed:

1. Develop a partnership with the patient
2. Establish or review the patient’s preference for information – for example, amount and format
3. Establish or review the patient’s preferences for role in decision making
4. Ascertain and respond to patient’s ideas, concerns and expectations
5. Identify choices and evaluate the evidence from research in relation to the individual patient
6. Present (or direct to) evidence, taking into account the above steps, and help the patient to reflect on and assess the impact of alternative decisions with regard to his or her values and lifestyle
7. Make or negotiate a decision in partnership, manage conflict
8. Agree on an action plan and complete arrangements for follow up

The two primary and related points are: firstly, an appropriate relationship must be formed between the patient and physician; secondly, communication is essential. For shared decision making, the information given to the patient must be relevant, research based, and in an acceptable format for the patient (Coulter et al., 1999). Coulter goes on to state that current information resources are inadequate, and few of these promote the sort of participation required for shared decision-making to work.

This is, of course, closely tied to the concept of competence. The aim of information sharing is to enable the patient to be a competent decision maker. In the Macarthur Treatment Competence Study (Charland, 1998), a patient is defined as competent if they have an understanding of the information presented to them, an appreciation of the situation they are in (i.e., ill and faced with potentially beneficial courses of action), the ability to manipulate information, and the ability to communicate a choice. Any decision support system designed to support this process must therefore be aimed at supporting the communication process between the patient, the physician, and other relevant information sources.

2.2. Previous Efforts at Supporting Patient Decisions

Medical decision support is not a new area of academic discourse and investigation. However, there is an overwhelming emphasis in the literature that focuses on diagnosis rather than treatment (Kahn et al., 1997). Even when looking at treatment decisions, much of the literature adopts a Rational Choice approach to the area. In attempting to adopt the tools of economists, we see studies which purport to incorporate patient views through such techniques as “Willingness-To-Pay” (Flowers et al., 1997, for example), where the patient is asked how much they would pay to have a certain quality and length of life. Other studies advocate the use of computers and treatment protocols to automatically generate a therapy (Musen et al., 1996). These normative approaches don’t see the need for patient involvement in the decision itself (Groome et al., 1994), adopting, at best, the Physician-As-Agent model. A study of physician decision support showed that physicians preferred ‘passive’ systems that merely provide information, as opposed to ‘active’ systems
that perform the deliberation and recommend an option (de Dombal, 1995). There is no reason to assume that the case would be any different for patients.

In any case, the normative / active decision support approach is inadequate for a shared decision making model. Shared decision making requires active participation on the part of the patient in deliberation and choice, and relies not just on objective facts and measures, but also on values and emotions (Charland, 1998; Erlen, 1998; Kahn et al., 1997; Redelmeier et al., 1993). Patient treatment decision support therefore requires a tool that is capable of the communication of affective, as well as cognitive information. A number of such tools have been developed, dealing with diseases like prostatic hyperplasia (Kasper et al., 1992; Millichap, 1994), lower back pain (Millichap, 1994), hypertension (Millichap, 1994), hormone replacement therapy (Robinson, 1997), breast cancer (Gramlich and Waitzfelder, 1998; Millichap, 1994) and ischemic heart disease (Liao et al., 1996).

Development of patient decision support systems requires that multi-disciplinary teams should be involved (Coulter et al., 1999). This ensures that appropriate medical facts are presented to the patient – physicians ensure accuracy, whilst patients ensure that this is information that they want. Patients can also ensure that the system is usable. Technologists and systems analysts can ensure that proposed features are technically feasible. A good quality patient decision support system should ensure the following (Entwistle et al., 2001):

- The full range of options is presented
- The nature and amount of information is appropriate
- Patients gain understanding
- Patients have opportunities to ask questions and express opinions
- The practitioner is aware of patient feelings, preferences and opinions
- Patients understand and agree with any treatment recommendation
- Patients feel that their choices would be respected, even if they chose a different treatment option.

3. ‘Well-Balanced’ Decision Support Systems

It is clear that in the domain of treatment decisions, a number of highly subjective factors are at play, such as emotions and values. Whilst objective information, such as medical facts, are incredibly important, a shared decision making approach acknowledges the importance of such things as patient concerns, life-style choices, hopes and aspirations.

These things are difficult to support with technology. The traditional strength of decision support systems has been in areas where the information is simple to quantify and manipulate for analysis, such as logistics or financial planning.
However, the importance of the subjective in most areas of decision making has been shown to be paramount. Antonio Damasio (1994) has shown in his book “Descartes' Error”, that without affect (the psychological term for feelings, emotions and values), people become very poor decision makers. He makes the point that we need to be balanced in our decision-making – too much emotion is undoubtedly a bad thing, but so is too little. As decision makers, we need to strike a balance. It follows that decision support tools should help decision makers, or at least not hinder them, in striking that balance. We need ‘well-balanced’ decision support systems.

Decision Support Systems, therefore, should aim to strike a balance between dealing with those factors that are traditionally considered rational, such as reason, logic, facts, and cognitively based information on the one hand, with values, emotions and affectively based information on the other. Perhaps due to its operations research roots, decision support systems development has generally been oriented towards supporting the former, rather than the latter. Model based decision support systems in particular have focussed on algorithmic approaches to solving decision problems, with a concentration on numerical data and its manipulation and presentation. However, even data-oriented decision support systems, such as those based on data-warehouses, focus on algorithmic analysis, trends and forecasts and so on.

An argument can be made that information technology is inherently geared towards supporting the logic and reasoning aspect of decision making since computers are essentially logic-machines. Computers cannot, at the current state of the art, experience emotions or hold values. Surely, in developing decision support systems, it should be left to the technology to deal with those aspects of decision making that they can handle best, leaving the ‘human’ aspects of the process to the user, should we not?

This argument, however, misses the central point of decision support systems: these systems are decision support systems, not decision making systems. It is not necessary for a computer to experience emotions or possess a value system to support the consideration of these factors by decision makers, anymore than it is necessary for a computer to understand the logic or reasoning behind a decision to provide meaningful support. Just as it is useful to support these logical-empirical aspects of decision making, it seems just as important to support the normative-affective aspect as well.

The main thrust of the argument here is to develop systems that strike a balance between explicit, cognitively based information, with the often tacit values and feelings embodied in affectively based information. Whilst the traditional, model based approach may suffice for some decisions, such as logistical or financial decisions, and so on, they do not suffice for human-oriented decisions such as patient treatment decisions. Not surprisingly, it is in supporting the former types of
decisions that DSS has seen most of its success, whilst there has been very little success in supporting the latter.

So what does such a well balanced decision support system look like? A prescriptive decision support system is probably inappropriate – one cannot dictate to a user the particular emotions or value systems they should adhere to in the same way that you can prescribe an approach to reason and logic. This would suggest a passive approach to decision support that allows the decision maker to explore an information space that includes logical-empirical and normative-affective information at will. Such an approach is outlined in two previous papers that examined adopting knowledge-management as a means of providing decision support: the first outlining a view of knowledge that recognises the non-cognitive aspects of knowledge (Meredith et al., 2000), whilst the second argues that a knowledge management approach should be strongly concerned with the facilitation of communication (Meredith and Burstein, 2000).

This leads to the view that a decision support system that balances the normative-affective with the logical-empirical should be concerned with facilitating communication flows between the decision maker(s) and information or knowledge sources. These sources may be traditional information repositories such as books, computers, the internet, or a data-warehouse, or they may be people, audio-visual materials and so on. Given the different information sources, it follows that the decision support system needs to cater for multiple media as well. Given that individual decision makers will have their own preferences on how to access these information sources, including which ones they access and in what order, the decision support system must also cater for a variety of usage styles. A decision support system that balances the normative-affective with the logical-empirical needs to therefore support multiple information sources, delivered via multiple media and accessed in a multitude of ways. The Internet offers a platform that could allow a decision support system to meet these three key needs.

4. Design of a Patient Treatment Decision Support System

To explore these ideas, a decision support system for cardiac patients is being developed. At the time of writing, the project is in the very early stages of participant recruitment within a large Australian teaching hospital with a strong record of research in cardiology and a number of practitioners interested in clinical decision making. The project has received clearance from the hospital ethics committee and a number of cardiologists have agreed to participate. The cardiologists have a commitment to bettering clinical practice and to the shared decision making approach described above. The project is about to enter the requirements specification phase, and the system design outlined below forms the baseline for discussion in a focus group session to elicit a concrete set of requirements for the systems development process.
It is important to recognise that the technology being developed is a relatively small part of the patient-physician encounter. Of the eight steps in Towle’s shared decision making approach (Towle, 1997), the decision support tool specifically addresses the sixth step: helping the patient to “reflect on and assess the impact of alternative decisions with regard to his or her values and lifestyle”. It also helps to address, to a lesser extent, the next step of actually making the decision. The practitioner and other hospital staff are responsible for ensuring that the other steps take place effectively.

4.1. Project Team

As stated above, it is important that a multi-disciplinary team is assembled to develop any patient decision support system (Coulter et al., 1999), and this is the case with this project. First and foremost is the involvement of medical practitioners. Practitioners are the primary source of medical information, providing details of relevant conditions and their treatment options. They are also able to provide, or at least point to, scientific data describing the efficacy of different treatment options. They can also provide information about side effects and other considerations, such as which scenarios call for one treatment option over another. Finally, practitioners can also vet other information sources such as internet sites and brochures.

It is also important to include other hospital staff involved in the patient care process. Included in this project are the patient care co-ordinator and the head of outpatient services. These two people are on the front line in dealing with patient concerns as they progress through the diagnosis and treatment process. Organisationally, they liaise with the practitioners, the patients, and other hospital staff responsible for administering various procedures and tests. Both these people are trained as nurses, although the roles they play in the clinic are not nursing roles. They are able to provide an alternative perspective on how patients are cared for and relate to the hospital, in a way that is significantly different to a practitioner perspective.

Another significantly different perspective on the information requirements for the system can be obtained from past patients. These people have an understanding of what it is like to be faced with a life threatening disease and the associated and often significant lifestyle changes. Their understanding of patient needs is important in developing a tool that adequately supports current patients’ concerns, fears, and desires.

The last two roles required are that of the systems analyst and systems developer. As with many small system development projects, the analyst and developer roles have been combined in this project and will be fulfilled by the author. The analyst’s role is to ensure that all of the requirements are elicited from the various groups and, in conjunction with each of the stakeholders, that these requirements are turned into
a coherent system design. The developer then provides the technical expertise to turn this design into a delivered system.

Whilst it is acknowledged that the preferred development approach for decision support systems is evolutionary (Courbon, 1996; Courbon et al., 1978; Keen, 1980), there are a number of difficulties in adopting a truly evolutionary approach in this case. The major reason for this is the involvement of cardiologists, whose time is in extremely short supply (more so than typical managers or executives). Having ready access to the practitioner user group on an ad hoc basis is simply not possible. Further compounding this is the fact that the patient user group do not belong to the organisation as would be found in a more typical project, making it difficult to have ready access to them on an on-going basis. As such, the approach adopted here is a pseudo-evolutionary approach. The system design outlined here will take the place of an initial prototype. The various project groups will meet together for an initial discussion looking at this design and suggesting changes and improvements. A prototype will then be developed and a single further evolutionary cycle will take place leading to the final system. This will hopefully maintain a number of the major benefits of an evolutionary approach whilst dealing with the organisational issues facing the project.

4.2. Initial Information Requirements

Whilst a formal requirements elicitation process has not yet been undertaken, the following describes an initial pass at some of the requirements of the system to be developed. This initial pass forms the basis for discussion for the more formal process, much like a prototype, although no physical prototype system will be developed initially.

Given the organisational constraints outlined above, it is felt that the most appropriate approach to gathering information requirements for the project is to adopt a method that sees as many of the stakeholders involved, in the same room at the same time. Similar to a JAD session, focus group sessions will be conducted with the participants described above in section 4.1. This will maximise the generation of ideas and creative thinking, as the process will allow participants to bounce ideas off each other.

A total of two sessions will be conducted to allow for some refinement of design ideas and concepts. As stated, the requirements set out below will form the basis of discussion for the initial session. After the initial focus group session, a mock-prototype will be developed incorporating the ideas generated. This will then form the basis of discussion in the subsequent focus group session. It is recognised that this approach has its limitations, in that these initial requirements may cloud, or bias, the focus group’s approach to the problem. Further, it is not truly an evolutionary development process. However, given the limited access and time, this approach is
seen to be the best balance between adopting an evolutionary approach, and maximising the use of a number of participants’ time.

The information requirements can be broken down into two major areas: medical information consisting of scientific information, treatment options and background about the patient’s disease or condition; and non-medical information consisting of information about how the different treatment options impacted the lifestyles of previous patients.

The medical information can be derived from a number of different sources. Internet sites are becoming more and more popular, and one of the benefits perceived by practitioners in the development of the decision support system is that they will be able to exercise a certain amount of control or influence over the sites that patients visit. Information available via the internet is of varying quality, ranging from excellent, well-researched and reviewed sites to less reputable sites with questionable information. Currently it is up to the patients to work out which sites are of high quality, and this causes problems when the information they receive from their doctor differs from, or contradicts, information they obtained from a web site.

Another source of medical information is patient information leaflets or brochures. These are developed by the hospital for the majority of conditions that they treat, but due to the effort required to compile and edit them, they are often out of date with current research and medical practice. Another perceived benefit, therefore, is to move the leaflets on-line with the decision support system so that they can be easily edited, updated, and printed off by the patient on an as-needs basis. In addition to internet sites and patient leaflets, some patients even go to the extreme of reading relevant articles in academic journals. However, in most cases, the primary source of medical information for the patient is the physician. For shared decision making, communication is vital, and so the system needs to facilitate and enhance communication between the patient and physician. The system is not a replacement for face to face interaction or the usual patient consultation, but should be in addition to the current means of maintaining the patient-physician relationship.

Finally, non-medical information can come from a number of sources. This information pertains to the value judgements that the patient is going to have to make, that is, the decisions about what aspects of their current lifestyle are most important. This may include religious values, as in the case of Jehovah’s Witnesses and blood transfusions, or it may simply be a preference to maintain the ability to perform a sporting or social activity post-treatment, or even a fear or worry about a certain type of treatment such as surgery. Relevant information could come from family and friends and other acquaintances, as well as past patients, the practitioner, and to a lesser extent the other information sources described for medical information. Whilst the system scope is unlikely to extend to addressing communication with family and friends (although the possible use of email may
touch on this), it can help to make information from past patients available for consideration.

The following figure shows the various information sources and communication flows that the system will need to support:

![Image](image_url)

**Figure 1. Information Sources and Communication Flows**

### 4.3. Technical Architecture

The implementation of this system presents a number of technical challenges. Firstly, supporting communication with a number of information sources requires the ability to support a number of different media. Secondly, the technology used needs to be as basic and as standard as possible. Finally, the system needs to be accessible from a number of different physical computers, whether at the hospital or at the patient’s home.

This leads to the idea of using a web browser as the main interface to the system. Much of the information could be internet based, such as patient leaflets, scientific medical information and consultation with the physician outside face-to-face consultations. It is envisaged, however, that information from past patients would be in video format, as this provides richer context and sub-textual information than simple text. The delivery of this information presents a challenge since standard internet connections severely limit the quality of video resulting in some loss of this extra, sub-textual information. A hybrid internet-CDROM based approach is therefore posited. A web browser could be used to seamlessly (to the user) provide access to information both on the CDROM and the internet, launching an
appropriate viewer for the video material such as Microsoft’s Windows Media Player or Apple’s Quicktime player.

It is envisaged that patient-physician communication will be facilitated through the use of an on-line diary and email system. This allows the physician to view the thoughts of the patient as he or she goes through the process of thinking and deliberating, as well as the patient to clarify their thoughts and concerns for their self. A means of storing this material on-line, but securely, so that both the patient and physician (but only the patient and physician) can access it is required. This can be achieved through the use of a database and web-scripting language such as ASP. Email can also be used, again facilitated through the use of a database and a scripting language.

This design maximises the quality of high-bandwidth material in an environment which doesn’t guarantee a high-speed internet connection whilst maintaining the communication benefits of an internet based system. The following represents this possible technical architecture:

![Figure 2. Technical Architecture](image)

5. Closing Comments

The development of this system hopes to achieve a number of objectives. It is hoped that the hospital and patients will derive benefit through the support of the
decision making process. The project hopes to explore, also, a number of research themes related to this kind of decision support systems development.

The first is that of differentiation with today’s decision support systems. Specifically, differences in terms of the complexity of the decision problem supported, the degree to which normative-affective factors were supported, impact on stakeholder involvement, and the nature of the tool developed.

The second theme looks at development issues that arose during the project. Whilst it is not intended that this research be generalisable, the project will hopefully raise social and technical issues that need to be addressed by developers of such systems.

Finally, the third theme focuses on how the system is used and how this impacts on the patient-physician relationship, patient learning, outcomes of the decision process and user views on the balance between normative-affective factors and logical-empirical factors.

The project adopts a kind of pre / post test approach to the evaluation of the project. By talking to patients and physicians prior to developing the system, it will be possible to evaluate the impact that the system has on the decision process and the patient-hospital relationship (ie. practitioners and other staff). Whilst user satisfaction is specifically not being measured, due to a number of difficulties with that concept and the fact that most patients are already satisfied with the outcomes of the current process, it is important to understand the nature of the intervention being proposed. It is therefore hoped that these three research themes will point to a new type of decision support system oriented towards supporting human centred decisions, not just in the medical arena, but also in a number of other domains.

The author would like to thank Professor David Arnott, participants of the IFIP Working Group 8.3 DSIAge 2002 Conference in Cork, Ireland, Professeur Jean-Claude Courbon, and the various anonymous reviewers for their insightful comments that have lead to a number of improvements to this article. Any shortcomings in the paper are, of course, attributable only to the author.

6. References


De Dombal, F. T. "Computer Aided Diagnosis and Medical Decision Support are not Synonymous". Methods of Information in Medicine, vol. 34 no. 4. 1995, pp. 369-370


Gattellari, M., Butow, P. N., & Tattersall, M. H. N. "Sharing Decisions in Cancer Care". *Social Science & Medicine*, vol. 52 no. 2001, pp. 1865-1878


Rob Meredith is a lecturer and PhD student with the Decision Support Systems Laboratory, which is part of the School of Information Management & Systems at Monash University. He has been a consultant with business systems consultancy Simsion Bowles & Associates (now known as Tier Consulting), and is a part time consultant with internet consultancy Sunesis Interactive. His research interests include the philosophies of rationality and decision making, and exploration of the role of emotions and feelings in decision making, with the ultimate view of developing better decision support systems.