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Editorial

Human centered processes: Toward a naturalistic decision making paradigm

The articles in this special issue originate in a mini-EURO conference, "Distributed Decision Making and Man-Machine Cooperation," under the Human Centered Processes (HCP) umbrella in Luxembourg in May, 2003; a conference that in turn built on the work of two earlier HCP conferences in Luxembourg (1994) and Brest, France (1999), respectively. We wish to begin this article and the introduction to this special issue by first briefly looking at where we have been. In the 1994 Luxembourg meeting, the general focus was placed on the natural cognition; on the notion that important decisions exist as parts of integrated complex systems. This emphasis (cf. Barthélemy et al., 1994) constituted a contrast to the prevailing cognitive science focus on relatively abstract and highly structured tasks. The 1994 ambition was to utilize the full cognitive science core—psychology, philosophy, and computer science—in operational research (OR), and to tackle the problem of understanding and modelling human expertise in industrial settings. This emphasis constituted an early response to criticism of traditional OR practises as inattentive to cognitive issues; notably the notion that the knowledge and expertise that human agents have acquired over time has not received due attention. Traditional OR models sometimes have not been seen as relevant for practise, as builders of strong models have a tendency to try to fit reality to the models, not the models to reality. Also, expertise is not very well covered, as the models tend to be timeless. As a response, in the 1994 meeting an attempt was made to address issues related to the mastering and reduction of complexity by experts. Similarly, numerous presentations in the 1999 meeting focused on the reuse of knowledge, the recycling of expertise, and the documenting of knowledge and expertise. At this time, there was also a sense of the need to scale back estimates of the usefulness of expert systems and frameworks based on the 'general problem solver' (Newell and simon, 1963) as universal remedies. Natural human cognitive capacities in many ways were more robust than the artificial intelligence literature suggested. Human cognition certainly has limits (cf. the vast literature on biases and fallacies, e.g. Kahneman et al., 1982), yet knowledgeable humans frequently have been shown to be hugely capable (cf. Gigerenzer, Todd, and the ABC Research Group, 1999).

Following up on the foundation laid in the 1994 meeting, the 1999 Brest conference was oriented toward knowledge and information processing and expertise; toward knowledge engineering in industry, including discovery of rules, updating and maintenance of rules, and rule-based systems. Multi-attribute models designed to aid complex human decision-making constituted another important component of the meeting (cf. Lenca, 1999; Bathélemy et al., 2002). These models maintained a clearly normative element, countering a noticeable drift toward process description and process modelling in cognition in general and decision making in particular. Key arguments in this

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important emphasis shift during the Brest meeting are exemplified by presentations by Shanteau (cf. Shanteau et al., 2002) on defining and measuring expertise, by Montgomery on operationalizing decision processes (cf. Montgomery, 1983), and in papers focused on Barthélemy and Mullet's (1986) moving basis heuristic. Gradually, and as a result of the heuristic nature of the methods, the emphasis also began to shift toward a stronger recognition of the importance of ecological validation. Also, the linking of cognition and decision theory had progressed to a point where we were able to start to build a home for human expertise.

The 2003 Luxembourg meeting in a sense completed a cycle, focusing on decision psychology and process descriptive frameworks, not any longer on decision theory per se, and on complex (often distributed) decision-making and human–machine cooperation in naturalistic settings (Bisdorff, 2003). Importantly, in the human–machine track, the focus was on the naturalization of machines, not on the machinization of humans. Equally importantly, several presentations again focused on ecological validation. This emphasis was strongly supported in two practitioner/academic panels on critical decision-making: one on human–machine cooperation in aviation, one on military and critical systems. We believe that a focus on critical decision making helps make the underlying decision processes both more salient and explicit.

The evolution of thought and the contrast to our preceding conferences are clearly evident in the three keynote addresses delivered by Todd, Slovic, and Svenson. Todd's presentation concentrated on the notion of 'simple heuristics that make us smart' and on ecological rationality, Slovic's presentation addressed the importance of understanding affect in decision making and reasoning, whereas Svenson's presentation spanned both operational decision processes and key aspect measuring issues. Svenson also tested decision theoretic predictions in naturalistic settings, thus reconnecting to our earlier emphases. In general, the 2003 HCP conference was characterized by the strongest yet focus on process descriptive frameworks.

Looking forward, it is important to explore when and under what circumstances particular decision models, processes, and procedures apply, and to which extent the cognition, reasoning, and decision making of experts differ from those of domain novices, and, equally importantly, from the processes involved when people make everyday decisions. For example, it has been argued that generalized decision heuristics are at work when people make everyday decisions (often of rather little consequence), and when people make decisions in more complex environments where they lack experience, but that experts make decisions at least in part based on specialized (domain specific) procedures. It is also increasingly important to explore how and when experts can be aided with decision support systems (cf. Lundberg, in press).

We divide the contributions to this special HCP issue into four categories: *Decision Making Processes*; *Organizations*, *Distributed Systems*, *and Human–Machine Interfaces*; *Preference Modeling*; and *Human Factors*. Under the *Decision Making Processes* umbrella, Todd presents four classes of simple heuristics that use limited information—recognition-based heuristics, one-reason decision mechanisms, multiple-cue elimination strategies, and quick sequential search mechanisms—applied to environments from stock market investment to judging intentions of other organisms, to choosing a mate. The findings that ecological rationality can be achieved with limited information are also used to indicate how our mind's design, relying on decision mechanisms tuned to specific environments, should be taken into account in our technology's design, creating environments that can enable better decisions.

The paper by Slovic, Finucane, Peters, and MacGregor introduces a theoretical framework that describes the importance of affect in guiding judgments and decisions. Affective responses occur rapidly and automatically. Slovic and his co-authors argue that reliance on such feelings can be characterized as "the affect heuristic". Some important practical implications resulting from ways in which this heuristic impacts our daily lives are also discussed.

Svenson and Salo present two studies investigating how decision makers characterize alterna-

tives in important real-life decisions (that the participants have had experience with) with a very high degree of personal involvement (to leave a partner, choose an education, and choose a home). As predicted by decision theory, consequence, probability, and value constitute important aspects. Svenson and Salo also include positive and negative affects, finding that value and emotion are uncorrelated. Principal component analyses revealed the existence of one factor for positive affect/emotions and another factor for negative affect/emotions, providing evidence against the use of bipolar scales.

Lundberg explores key components of the multiple constraint satisfaction framework in a series of experiments set in complex and ambiguous domains. All cases show the prevalence and importance of purposeful information structuring. The participants gradually generate coherence, even in cases without increasing information, as evidenced in increasing differentiation of alternatives and simplified knowledge structures.

In the *Organizations*, *Distributed Systems*, *and Human–Machine Interfaces* cluster, Fioretti argues that no procedure is available to predict the extent to which and the pace at which the production time will decrease with the total number of units produced, i.e. one consequence of organizational learning. This article links the parameters of the only available disaggregate model of the learning curve to measurable features of the component units of an organization.

The Antunes, Melo, and Costa paper presents the argumentation and data structuring models of a collaborative computational tool. The system assists between-participant discussions and those with a coordinator. The *Collaboration Studio* differs from other collaboration tools in that it aims at preserving a trace of the knowledge development path.

Papamichail and Papamichail describe a clustering algorithm that, combined with a spatial data structure, provides an effective implementation of distributed interactive decision aids in e-commerce. The tool helps the consumer explore preferences, search for and aggregate product information, and thus improve the purchase decision.

The Michalowski, Kersten, Wilk, and Slovinski paper presents an operational mobile, hand-held clinical child patient triage support system, aiding physicians in a Hospital's Emergency Department. The interface design and the interaction between triage expert and system are discussed.

In the *Preference Modeling* section, Renaud, Thibault, Lanouette, Kiss, Zaras, and Fonteix compare two multicriteria analysis methods, the Rough Set Method (RSM) and the Net Flow Method (NFM), applied to paper manufacturing. Importantly, both methods use domain expert knowledge in the form of decision rules and thresholds, respectively.

de Smet introduces a formal framework for modelling multicriteria auctions in the context of limited comparability of bids, a situation common in e-procurement and e-commerce.

The Choquet integral and its associated capacities allow the modeler to take into account realistic interactions between criteria, but their effective use suffers from a notorious complexity problem. Marichal proposes an instrument, the k-intolerant capacities, for overcoming these computational problems.

Joseph, Chan, Hiroux, and Weil propose a new soft preference constraint, global consistency constraints based on customizable level consistency, and an algorithm for generating quality solutions for multicriteria optimization problems.

Finally, two papers address *Human Factors*. Annualizing work plans and schedules requires taking into account not only relaxed optimization constraints but also more realistic and human centered constraints. In this setting, Corominas, Lusa, and Pastor propose a model providing essential quantitative information for establishing the trade-off between weekly flexibility and economic or working-time reduction compensation.

Zamiska, Jaber, and Kher investigate worker learning and forgetting phenomena in a dual resource constrained system setting. In this model it is assumed that a work task has separate cognitive and motor requirements. The authors show that the task-type affects the performance of training and deployment policies in such systems.

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