Behavioral Operations Management

Behavioral Operations Management

Christoph H. Loch

Technology and Operations Management
INSEAD
77305 Fontainebleau
France
christoph.loch@insead.edu

Yaozhong Wu

NUS Business School
National University of Singapore
117592 Singapore
bizwyz@nus.edu.sg

now
the essence of knowledge
Boston – Delft

Foundations and Trends® in Technology, Information and Operations Management

Published, sold and distributed by:
now Publishers Inc.
PO Box 1024
Hanover, MA 02339
USA
Tel. +1-781-985-4510
www.nowpublishers.com
sales@nowpublishers.com

Outside North America:
now Publishers Inc.
PO Box 179
2600 AD Delft
The Netherlands
Tel. +31-6-51115274

The preferred citation for this publication is C. H. Loch and Y. Wu, Behavioral Operations Management, Foundation and Trends® in Technology, Information and Operations Management, vol 1, no 3, pp 121–232, 2005

ISBN: 978-1-60198-094-6

Foundations and Trends® in Technology, Information and Operations Management

Volume 1 Issue 3, 2005

Editorial Board

Editorial Scope

Foundations and Trends® in Technology, Information and Operations Management will publish survey and tutorial articles in the following topics:

- B2B Commerce
- Business Process Engineering and Design
- Business Process Outsourcing
- Capacity Planning
- Competitive Operations
- Contracting in Supply Chains
- E-Commerce and E-Business Models
- Electronic markets, auctions and exchanges
- Enterprise Management Systems
- Facility Location
- Information Chain Structure and Competition
- International Operations
- Marketing/Manufacturing Interfaces
- Multi-location inventory theory
- New Product & Service Design
- Queuing Networks
- Reverse Logistics
- Service Logistics and Product Support
- Supply Chain Management
- Technology Management and Strategy
- Technology, Information and Operations in:
  - Automotive Industries
  - Electronics manufacturing
  - Financial Services
  - Health Care
  - Industrial Equipment
  - Media and Entertainment
  - Process Industries
  - Retailing
  - Telecommunications

Information for Librarians
Foundations and Trends® in Technology, Information and Operations Management, 2005, Volume 1, 4 issues. ISSN paper version 1571-9545. ISSN online version 1571-9553. Also available as a combined paper and online subscription.

Foundations and Trends® in
Technology, Information and Operations Management
Vol. 1, No. 3 (2005) 121–232

DOI: 10.1561/0200000009

Behavioral Operations Management

Christoph H. Loch[1] and Yaozhong Wu[2]

[1] *Technology and Operations Management, INSEAD, 77305 Fontainebleau, France, christoph.loch@insead.edu*
[2] *NUS Business School, National University of Singapore, 117592 Singapore, bizwyz@nus.edu.sg*

Abstract

Behavioral Operations Management investigates new developments around behavioral components — "people issues" — in operations management (OM). While these "people issues" are not new, OM has not dealt with them in a serious or consistent manner until the last 10 years or so. What is new is the emergence of a set of methods and structured areas of study that allow researchers to study these issues *within* the OM paradigm. The authors provide a definition of Behavioral OM and survey a number of relevant behavioral issues and their applications to the existing OM research. Finally, the authors propose that culture studies in OM may represent a promising direction of future behavioral OM research.

Contents

1

Introduction

The field of Operations Management (OM) "encompasses the design and management of the transformation processes in manufacturing and service organizations that create value for society. (. . .) the search for rigorous laws governing the behaviors of physical systems and organizations" [46, p. 8]. This is a broad definition, which leaves open the study of many relevant characteristics of these physical and organizational systems. A broad view is appropriate, especially as the editors of the "Operations and Supply Chain" department of *Management Science* emphasize the "editorial philosophy to focus on senior management issues" (*ibid*, p. 12). The above definition emphasizes the use of "normative mathematical models," as opposed to "positive empirical findings in, e.g., the field of Organizational Behavior (OB)" (*ibid*, p. 13).

And yet, in the process of applying OM methods in managerial practice, members of the field have been left with disappointment and frustration. In the mid-1990s, a well-known Operations Research (OR) scholar remarked to one of the authors, "Of course, everyone knows that people in organizations apply our methods only half of the time; the other 50% of what they do is human foibles." Although the OM

field has always acknowledged social considerations in principle, it has shunned them *de facto*. This has led to calls for more emphasis on "human foibles" in academic literature: "Many of our techniques and theories ignore important characteristics of real systems and therefore are perceived to be difficult to apply in practice. A common factor in this breakdown is people. When it comes to implementation, the success of operations management tools and techniques, and the accuracy of its theories, relies heavily on our understanding of human behavior" [17, p. 737].

Thus, the burst of activity since about the year 2000 on *Behavioral Operations Management* stems from a long observed gap in OM, "people issues" in a wide sense, coupled with the emergence of a set of methods that promise the potential of being able to address such people issues. The recognition of this gap is not new, nor does it represent a "revolution" of the field. The field of OM has been aware of the relevance of people issues, and "danced around them," ever since the 1950s. What is perhaps new is the emergence of a set of methods, and structured areas of study, that may allow us to study people issues *within* the OM paradigm.

Another anecdote is helpful to illustrate this: Around the year 2000, one of the authors discussed a behavioral issue with a colleague from OB. The colleague remarked, "My friend, if you continue this work, you'll end up no longer an OM professor, but an OB professor! Want to join our department?" The answer to this teasing challenge is no, the purpose of Behavioral Operations is not to join the field of OB, its intellectual heritage and set of positivistic empirical methods. There is clearly an overlap in the phenomena studied, but the promise of Behavioral Operations is a continuation of using rigorous mathematical theory and scientific experimental methods to study a set of phenomena that were perceived as too unstructured to be amenable to being captured in models.

To emphasize the continuity of Behavioral Operations with OM, we start with a short overview of the field of OM. Then, we attempt a definition of Behavioral OM, and overview a number of important relevant behavioral issues and their applications in the existing OM

work. Finally, we propose that culture studies in OM may represent a promising direction of future behavioral OM research.

1.1 A Short History of the Discipline of OM

"It is difficult to pinpoint the origins of our field" [46, p. 8]. Its origins certainly go a long way back; some people trace them to Adam Smith's *The Wealth of Nations* [204], where he demonstrated division of labor and productivity with his original pin-making example. Adam Smith's seminal work led to Charles Babbage's *On the Economy of Machinery and Manufactures* (1832), which "catalogued a vast wealth of operational details ... a series of general principles ..." [139]. Many current OM themes, such as planning and control, manufacturing policy, or process technology, have easily identifiable antecedents in Babbage's book. However, applying scientific approaches to OM did not come into existence until the emergence of Frederick W. Taylor's highly influential ideas and techniques embodied in his term "scientific management" [115].

One essential element of Taylor's philosophy was "that scientific laws govern how much a worker could produce per day and that it is the responsibility of management (and staff) to discover and use these laws in carrying out production" [43], where "scientific" meant "based on proven fact (e.g., research and experimentation) rather than on tradition, rule of thumb, guesswork, precedent, personal opinion, or hearsay" [148]. During the early 20th century, Taylor and other pioneers inspired (such as Harrington Emerson, Henry Gantt, and Frank and Lillian Gilbreth) "fostered quantification of management" [106]. This included some early attempts of optimization, for example, in Harris' EOQ model [98].

However, scientific management did not make the step to causal model-based theory. By the mid 20th century, the OM field was generally considered purely descriptive and synonymous with industrial management or factory management [33, 43, 159]. As other functional disciplines that had been considered part of industrial management (finance, marketing, and personnel management) gradually found ways of differentiating themselves and building their own methods and

identities, what was left over for OM was "a nearly empty basket of techniques: time and motion study, plant layout, Gantt's production control boards, the simple EOQ model, and simplistic descriptions of how a production system worked" [33].

Meanwhile, in the 1940s and 1950s, the discipline of OR emerged from World War II and was extensively developed. Mathematical OR techniques were well-suited to the quantitative nature of OM problems and "provided the scientific methodology that allowed us to develop something akin to the 'nature science' or physics of operating systems;" the introduction of these techniques "rescued the field from extinction" [33].

The 1960s and 1970s were hallmarked as the "golden age" of Operations Research/Management Science (OR/MS) with highly influential applications in management, especially in OM [157]. Significant progress was made in the understanding of operations problems such as scheduling, planning, and inventory control. The dominant approach was to structure the problems as system optimizations with a single objective subject to a set of constraints.

The high dependence of OM on OR finally resulted in an "identity crisis" in the 1970s, that is, the definition of the field was challenged. A key reason was that research was narrowly defined relative to management's scope, making the more sophisticated quantitative models difficult for managers to understand, and so they failed to follow the evolution of business practices; models became mathematically more sophisticated, exploring mathematically challenging problems rather than providing pragmatic answers to support real-world decision-making. An additional problem was that some OR/MS application areas successfully moved into other functional fields, such as accounting, finance, and marketing, and were no longer considered as OM [6, 33, 46].

Since the late 1970s, modern production and quality systems and philosophies, such as material requirements planning (MRP), total quality management (TQM), and the Toyota production system, particularly just-in-time production (JIT), have been introduced into industries. The ascendancy of these systems not only had a significant impact on business practice, but also "suggested that the locus of

creativity had shifted away from academia" [46, p. 9]. These industry-driven developments prompted OM to approach practice again, trying to explain why, and when, different practices worked. In the early 1980s, the discipline of OM was finally "emerging from the OR/MS phase into a clear recognition of OM as a functional field of management. ... the field is a managerial one" [33]. The research focus increasingly shifted toward practical management concerns, and the importance of managerial implications of OM research was recognized more widely. OR/MS methodologies remained as predominant research tool kits in the field. However, the tactical issues examined by OR/MS started to become building blocks for higher level system-wide problems. In the same direction, operations strategy (earlier known as manufacturing strategy, [202, 203]) became a recognized subfield of OM: operations should not only reactively implement corporate strategy, but should also be actively involved in developing corporate strategy.

In the same trend of moving from tactical implementation problems toward higher-level managerial problems, OM experienced another expansion into a new sub-field in the early 1990s: as businesses evolved from centralized to more decentralized and partner-oriented organizational forms, game-theoretic models of decentralized decision-making and strategic interaction became prominent. An entire sub-area began to focus on supply chain coordination contracts that align local incentives of upstream and downstream parties [46, p. 10].

It is not surprising that an extrapolation of these trends of the field [46, p. 13] led to the prediction of an increasing emphasis on strategic issues (supply chain coordination and operations strategy) and intensifying interfaces and collaborations with other disciplines: Finance, Marketing, Services, R&D, and Organizational Behavior/Human Resource Management (OB/HRM).

The interdisciplinary collaboration with OB, which relates to the "people issues" that are mentioned in the opening paragraphs, is of course intimately related to Behavioral Operations Management. Expanding OM's scope in the direction of people issues is clearly important, worth devoting an entire monograph to, and promising for highly relevant future work. However, this section should make one thing clear: Behavioral Operations Management is not the only promising

expansion of the OM field, it is not a new idea that OM should look at people issues (see, for example, [99, p. 242]), and it will not turn the fundamental premises of the field upside down. It is one of several interesting avenues of expansion.

We conclude this section with one more anecdote: in 1996, the Nobel laureate economist, Gary Becker, was asked about the weakness of economics in acknowledging the psychological roots and complications of decision-making. He replied, "Obviously, economics as a field has neglected psychology, and this needs to change. However, this does not mean throwing out of the window the premises of neoclassical economics; it provides a powerful paradigm of analysis which will be able to incorporate the additional considerations of the psychological system and provide stronger results." The same holds for OM.

1.2 Behavioral Economics and Behavioral Operations

OM and OB studies have been progressing independently for a long period of time, with distinct research questions and methodologies and little interaction, although in real-world management OM and OB are fundamentally intertwined (as every practicing manager knows): "OM policies can only be carried out by people, and OB/HRM policies are effective if they foster people doing organizational-critical tasks" [27]. Consistent with the trends identified in Section 1.1, Boudreau et al. suggest that both OM and HRM studies can be better informed and greatly enriched by incorporating behavioral principles from HRM and operational principles from OM, respectively, and great research opportunities lie in an integrated OM/HRM area.

Until just a few years ago, human behavior had not received as much attention as the connection to other functional fields:

> ... the research in our discipline has remained largely disjointed from the social sciences literature on human resource management and organizational behavior (OB).... Operations management models have historically invoked oversimplified models of motivation, learning, creativity, and other such aspects of human behavior that are vital to the success of management

> policies in practice. Models that can maintain high levels of rigor while incorporating these elements will be richer and more realistic [46, p. 13].

Around the turn of the century, this began to change — human behavior started attracting the attention of OM researchers. Several conferences on behavioral research in OM were held at Harvard and Penn State Universities, special issues appeared on behavioral topics in the OM journals *Decision Sciences* (DS), *Journal of Operations Management* (JOM) and *Manufacturing and Service Operations Management* (MSOM). A new editorial department of Behavioral Operations has been established in the journal *Production and Operations Management* (POM), and the pipeline of research on behavioral operations management is growing fast (discussed in the next section). "Behavioral Operations Management" (Behavioral OM) has become something of a buzzword capturing a potentially emerging field. However, no consensus has (yet) been reached on defining the field; for example, it is not clear what scope the term "behavioral" should denote.

Bendoly et al. [17, p. 3] emphasize people issues (as the opening quote shows), but see behavioral OM, following experimental economics, as focused on experimental studies: "The experimental economics field has seen exponential growth every decade since 1960. Through this evolution, the focus of experiments has expanded to include an emphasis on developing new behavioral theory to explain gaps between established economic theory and experimental results."

The equation of Behavioral OM with experiments seems narrower than the spirit of the attempt to expand OM to incorporate people issues. A broader definition is offered by Gino and Pisano [86]: "*the study of attributes of human behavior and cognition that impact the design, management, and improvement of operating systems, and of the interaction between such attributes and operating systems and process.*"

The pitting of "experimental" versus "behavioral" is not new and reflects a similar conflict in economics. For example, in 2002, Daniel Kahneman co-received the Nobel Prize in Economic Sciences for "for having integrated insights from psychological research into economic science, especially concerning human judgment and decision-making

under uncertainty" (behavioral), while Vernon Smith co-received it for "having established laboratory experiments as a tool in empirical economic analysis, especially in the study of alternative market mechanisms" (experimental).[1]

We believe that, in line with Chopra et al.'s broad definition of OM, we should not restrict Behavioral OM to one methodological approach, we should strive for both modeling (theory) and empirical methods (experimental and others). Both are necessary for the successful development of the field (discussed in Section 1.4). While experimental economics has established laboratory methods in studying human behavior and economic theories, behavioral economics attempts to incorporate psychological considerations into the neo-classic economics paradigm:

> Because economics is the science of how resources are allocated by individuals and by collective institutions like firms and markets, the psychology of individual behavior should underlie and inform economics. However, economists routinely — and proudly — use models that are grossly inconsistent with findings from psychology. A recent approach, "behavioral economics," seeks to use psychology to inform economics, while maintaining the emphases emphasis on mathematical structure and explanation of field data that distinguish economics from other social sciences. In fact, behavioral economics represents a reunification of psychology and economics, rather than a brand new synthesis, because early thinking about economics was shot through with psychological insight. For example, in his *Theory of Moral Sentiments*, Adam Smith described all the ways in which people care about the interests of others [36, p. 10575].

Camerer's explanation of why psychology and economics evolved separately from each other during the 20th century is instructive: "Economists worked hard at formalizing economics mathematically,

[1] See http://nobelprize.org/nobel_prizes/economics/laureates/2002/.

with physics as inspiration. Psychologists were also inspired by natural sciences — by experimental traditions rather than mathematical structure. As a result, to an economist, a theory is a body of mathematical tools and theorems. To a psychologist, a theory is a verbal construct or theme that organizes experimental regularity" (p. 10575).

Behavioral economics challenges and relaxes the neoclassical assumption that people are self-interested rational agents with stable preferences. The "conviction is that increasing the realism of psychological underpinnings of economic analysis will improve economics on its own terms — generating theoretical insights, making better predictions of field phenomena, and suggesting better policy" [37]. Several psychological observations of individual behavior have fundamentally questioned mainstream economic models and, more importantly, provided useful suggestions for modifications of the traditional economic framework, even without inventing methodologies beyond the scope of mainstream economic analysis [181, 182]. Already over the last few decades, behavioral economics has become influential in other fields, such as Marketing and Finance, which leaves OM as perhaps the last field of management studies to embrace behavioral issues.

Although OM has always acknowledged the importance of people in principle, most OM researchers would agree that this has remained lip service — the field has been heavily reliant on oversimplified assumptions essentially requiring that people be deterministic, predictable, and emotionless [27]. Indeed, most OM studies implicitly assume that people can be integrated into manufacturing or service systems like machines. Even when strategic interactions were incorporated into the field in the early 1990s, the core assumptions of neoclassical economics were used: decision-makers act solely to optimize measures of discounted future wealth. In the case of strategic interactions, decision-makers choose their responses to other parties' actions in the same way, driven by discounted future payoffs. Evidence has mounted that a view of man as an aloof trader is distorted in many, if not most, cases [70].

Camerer's diagnosis of incompleteness of economics and both its complementarity with and separatedness from psychology closely

parallels the history of OM and OB [36]. Camerer's definition holds useful insights for a conceptualization of behavioral OM that complements and broadens the definitions above. Camerer even provided additional mathematical structures for how insights from psychology might be translated into parsimonious modifications of economic utilities:

1. Reference-point-dependent utility (prospect theory) and loss aversion extend expected utility. People evaluate payoffs from the *status quo* and view gains differently from losses.
2. Hyperbolic discounting, or a preference for immediacy, extends consistent exponential discounting. People react more strongly to salient and immediate events than to events in the future, thus causing time reversal of preference inconsistencies and myopic behavior.
3. The consideration of equilibria in the theory of strategic interaction (game theory) is extended by transient analysis, informed by reinforcement learning (simple rules of updating information rather than full Bayesian updating).
4. Social utility, or the consideration of the effect of one's actions on others, extends self-interested payoff maximization.

In other words, Camerer proposes that the key extension of neoclassical behavior lies in systematic individual "decision biases," or deviations from normative decision theory (in particular, loss aversion and immediacy) and in social preferences that prompt people to intrinsically care about what happens to other people (independent of effects on the self); in addition, the path of a group toward equilibrium matters, not only the equilibrium itself (which may never be reached). Note that these extensions represent important extensions of the definitions by Bendoly et al. [17] and by Gino and Pisano [86], both of which focus on individual decision biases (not social utility), and the first two definitions are also restricted to empirical or experimental work rather than on the combination of data with mathematical theory. With these insights, we can now attempt to propose a definition of behavioral operations.

1.3 Behavioral Operations: An Attempt of a Definition

We have seen that some approaches to the emerging field of Behavioral Operations stress an "experimental" emphasis, proposing, "let's add experimental investigations to our OM models to see whether they are realistic." This seems insufficient — it should be no more than good scientific practice to attempt empirical tests of mathematical theory, and it falls squarely within the broad definition of OM, as laid out by Chopra et al. [46].

Several definitions emphasize the "individual decision biases" extension of OM [17, 86]. However, when we recall that the purpose of behavioral operations is to "bring people issues back into the discipline" and provide an interface to Organizational Behavior and Human Resource Management, we should encompass *both* individual decision psychology (and the associated deviations from normative decision theory) and the influence of group dynamics, emotions, and culture on interactions among actors in processes.

The efforts of reunifying psychology and economics [36, 181, 182] give us a good start to define behavioral operations. However, we need to first find appropriate application areas for behavioral studies in OM, and then acknowledge that the vision of "bringing people issues into OM" requires including not only human psychology, but also human culture.

Let's first recall that OM is about the "design and management of the transformation processes in manufacturing and service organizations that create value for society" [46], and therefore requires more operational and actionable studies (just as OM models have always been detail-richer than economics models). Second, human behavior that goes beyond maximizing payoffs can be classified into three different categories: individual decision biases due to cognitive limitations, individual other-regarding behaviors in the context of social interactions driven by social goals that are rooted in psychology, and finally collective behaviors in a population as an outcome of culture transmission and evolution. All three behavior categories have been examined with mathematical models as well as experimental studies.

The first category of OM-relevant behavior has been studied in literature on heuristics and biases in judgment and decision-making. People deviate from normative decision theory not only because they are loss-averse and like immediacy (overly discount the future), but also because they are boundedly rational (they overlook information when they are occupied, they intuitively linearize complex causal connections and extrapolate even when it is not justified), they are overconfident (overestimate their ability of control in areas in which they feel confident, and underestimate intervals of decision outcomes), they shun ambiguity (unknown outcomes with unknown probabilities) and complexity, and they are easily anchored and conformist (their estimates are biased by previous information and by peer pressure).

The second behavior category is concerned with social interactions in OM. The social utility aspect of behavioral operations reflects not only psychology, but even more importantly, social psychology, evolutionary psychology, and anthropology. Social preferences have a clear structure that helps people to intuitively navigate the complexities of social interactions based on emotional "heuristic" cues: people everywhere intrinsically value status and respect, relationships, fairness in the relationships, and identify with a group that possesses a positive image. We will overview the work that has established these social preferences in Section 3; we can already state here that these preferences have a great impact on the performance and motivation of workers in the context of an operational process. The social preferences are, in our opinion, an even more important part of behavioral operations than cognitive biases — any operations manager who fails to be aware that people do *not* care only for incentives and payoffs, and that they deeply care about other aspects of social interactions as well, will not succeed as a manager.

A third area that we think needs to be incorporated in the new behavioral operations field in the future is culture, the knowledge and skills that are acquired and transmitted through individual learning and social learning in a given population. Culture consists of rules that reflect the experience of a group over time, and has been "automated," accepted without question by the group's members. Clearly, cultural assumptions are relevant for decisions in operational processes. Culture

has been "off limits" for operations management in the past, partially because it is so difficult to make operational. However, it turns out that mathematical theories of culture have been developed in anthropology and sociology [28, 29, 156] that are amenable to OM-style models and empirical tests of process design and performance. This research area clearly represents an overlap with the field of OB. But that is precisely what "interfaces" between disciplines are about: the possibility of studying OB "territory" with OM-style mathematical theory and empirics or experiments, offers an opportunity of complementarities with OB researchers and exciting new insights. We will discuss this further in the last section.

In summary, we finally arrive at our proposal of a definition of Behavioral Operations Management.

> OM is concerned with the study of the design and management of transformation processes in manufacturing and service organizations, building mathematical theory of the phenomena of interest and testing the theory with field data (derived from surveys, databases, experiments, comparative case studies, ethnographic observations, etc.). Behavioral Operations Management is a multi-disciplinary branch of OM that explicitly considers the effects of human behavior in process performance, influenced by cognitive biases, social preferences, and cultural norms.

1.4 On the Complementary Roles of Modeling and Experiments

We have already alluded to the debate between advocates of experiments and empirical work, and modelers. As one member of the "empirical camp" commented, "the emergence of behavioral operations should not be viewed as an opportunity to further complicate 'toy models,' but rather an opportunity to truly reflect upon some of the long held assumptions on which much of operations research models have been founded, and move forward from there. I don't see real progress taking place in this area if a predominance of modelers jumping on the

behavioral operations bandwagon are averse to conducting real-world observations of behavior." In this section, we argue for a *combination* of theory and empirical approaches, only the combination adds up to science.

In a 1995 study, Thomas Powell empirically examined whether TQM methods represented a strategic resource of the firm [178]. He found that of 12 TQM factors, the 9 formal process ones (adoption and communication of TQM, customer relationships, supplier relationships, benchmarking, training, zero-defects mentality, flexible manufacturing, process improvement, and measurement) were not significantly associated with company performance, while the three "intangible" factors of committed leadership, open organization and employee empowerment, were significant performance drivers. Powell concluded that "rather than merely imitating TQM procedures, firms should focus their efforts on creating a culture within which these procedures can thrive. (...) Perhaps TQM's highest purpose, and its real contribution to American business, is in providing a framework that helps firms understand and acquire these resources as part of an integrated change program" [178, pp. 29 and 31].

This study holds lessons for OM scholars on two dimensions. First, it is part of mounting evidence that formal processes and optimization of explicit goals, the traditional domains of OM, are insufficient to explain organizational success. Complaints have long accumulated that formal methods have had unsatisfactory impact in practice (e.g., [49, 146], but the field of OM largely ignored the explanatory gap until recently. The emerging sub-field of Behavioral OM is precisely about identifying additional factors (besides optimization and incentives) that influence behavior, such as decision biases, emotions, and culture, which constitute the main focus of this article.

Second, Powell's study demonstrates the limits of empirical research. The study's results point to "intangible" factors, which replaces one mystery (the insufficiency of formal methods) with another — why would an "open" non-hierarchical organization, management commitment and empowerment explain the success of TQM methods better than the processes? Is it because empowered decision-making brings better information (at the front line) to bear? Is it

because committed management is more flexible in dealing with uncertainty? If the reasons are really better decision-making, why is that "intangible" and not measurable as part of the processes? If the "culture" leads to more motivated employees who try harder, why can one not measure and incentivize how hard employees try?

The problem lies not in the empirical (or experimental) approach *per se* — the need for empirical testing of theory is plain and clear for all to see. The problem lies in the fact that in the social sciences, empirical work is predominantly based on verbal theory, or the qualitative description of phenomena with prose. As the term "behavioral" in Behavioral OM seems to be often seen as synonymous with "experimental," which almost looks like an "anti-modeling" stance, we must discuss this limitation in some more detail.

Verbal theory is limited simply because it is incapable of precisely describing complex systems — emergent system-level phenomena that require descriptions of the system elements as well as of interactions require description with symbols. Prose simply cannot "keep all the balls in the air" to allow sufficient precision; only mathematical characterizations can quantitatively describe system behavior. Without quantitative description, we cannot measure and achieve progress.

In the words of Richerson and Boyd [185, p. 248], "models of modestly general applicability and empirical generalizations of modest scope are extremely valuable for two reasons. First, individuals are quite stupid compared to the complexity of the problems we aspire to solve. An isolated individual thinker has no chance against a problem of any complexity. Well-studied models and well-tested empirical generalizations embody the collective of one's fellow scientists. (...) Second, most concrete cases are so complex that no one investigator can hope to study in detail every dimension of the problem; it is necessarily simplified, often drastically. (...) Theories help to make this simplification transparent."

"When used properly, mathematics schools our intuition in ways no other technique can. (...) Good models produce diamond-clear deductive insights into the logic of evolutionary processes [and complex systems, more generally]. (...) When it comes to subject areas like evolution [or complex systems, more generally], one cannot think

straight without them. You don't have to be a modeler to appreciate models. Much like in any other art form, educated connoisseurs can get a lot out of them. However, in the end, data are the ultimate arbiter." [185, pp. 256–257].

The large conceptual breakthroughs in theoretical biology on the question of altruism (rather than raw selfishness) of animals, starting from the 1960s, were made with simple conceptual models, to name a few important ones: [95] (altruism for relatives) and [96] (group selection), [224] (reciprocal altruism), and recent models on the safeguarding of cooperation in groups through punishment [167], and finally, Boyd and Richerson's methods of modeling cultural evolution have been extended to explain many empirically observed aspects of culture [28]. The same holds in Behavioral OM: well chosen collections of simple models of decision biases as well as social preferences hold the promise of sharpening the experimental work [25, 42, 73, 108, 180, 197].

Simple models of partial phenomena that are modular and sufficiently significant to explain important aspects of real phenomena (not to be confused with "reality") can then be used to put more complex system, after the components have been understood, and to test specific implications quantitatively with more precision than verbal theory allows.

In light of its fast growth in the last few years, we are convinced that behavioral OM will bring tremendous research opportunities for OM. OM is a field that is familiar with mathematical models and understands their use, both as simple models and as "complete" decision support models in well-understood situations with ample data availability. Thus, it seems surprising that there is even any discussion about Behavioral OM shunning modeling. With appropriate extensions of traditional rational choice and game theory models to incorporate decision biases, emotional or social preferences, and cultural norms, mathematical models can guide empirical testing in behavioral OM just as well as in OM at large.

First, math models will produce OM theories and hypotheses for experimental studies. Many traditional OM problems have been well structured and analyzed in mathematical models, for example, the

newsvendor problem, the bullwhip effect, and supply chain contracting and coordination, all of which have elegant models that have been experimentally tested. The models provide not only testable hypotheses, but also simplified system structures that can be easily recreated in the corresponding experiment designs. Attesting the need for behavioral OM as an expansion of the field, empirical tests have clearly shown that the traditional OM models are incomplete.

By now, a sufficient number of models has been published which show that models of operations problems can be extended to include decision biases, emotions and social preferences, and cultural norms. Mathematical models of fundamental human behaviors ranging from individual level to population were first developed in other fields, such as economics and sociology. For example, reference-dependence and time-preference have been formally modeled to capture the empirical regularities that individual's preference can be reversed by reference point and time, respectively. Social preference models capture that human behavior can be biased by social interactions, and that people have a concern for others in addition to being self-interested. Finally, cultural evolution models are used to study how social behaviors evolve and are transmitted in a population. The modeling techniques are well established and similar to methods already used in OM, and thus readily adaptable.

The ability of models to analyze behavior of complex systems is highly relevant for behavioral OM — most modern OM problems involve complex decision-making in decentralized systems, and they can quickly become too hard to study without the help of models. There are simply too many interacting variables to control. Once the models have produced predictions of emergent system behavior, we can go back to experiments, or empirical studies, with a few controls. Of course, the arbiter is data — we are not proposing that behavioral OM should only be model driven; it should be model driven and experimental or empirical. Models can guide experiments to test emergent behavior that cannot be predicted otherwise.

References

[1] D. Abreu and A. Rubinstein, "The structure of Nash equilibrium in repeated games with finite automata," *Econometrica*, vol. 56, no. 6, pp. 1259–1282, 1988.

[2] P. Aghion and J. Tirole, "Formal and real authority in organizations," *The Journal of Political Economy*, vol. 105, no. 1, pp. 1–29, 1997.

[3] G. Ainslie, "A behavioral theory of impulsiveness and impulse control," *Psychological Bulletin*, vol. 82, pp. 463–496, 1975.

[4] T. J. Allen, *Managing the Flow of Technology*. Boston: MIT Press, 1977.

[5] T. J. Allen and G. Henn, "Architecture and communication among product development engineers," in *The Organization and Architecture of Innovation: Managing the Flow of Technology*, (T. J. Allen and G. Henn, eds.), Butterworth Heinemann Elsevier, 2006.

[6] C. G. Andrew and G. A. Johnson, "The crucial importance of production and operations management," *Academy of Management Review*, vol. 7, pp. 143–147, 1982.

[7] W. E. Baker, *Achieving Success Through Social Capital*. San Francisco: Jossey Bass, 2000.

[8] R. F. Bales, "The equilibrium problem in small groups," in *Working Papers in the Theory of Action*, (T. Parsons, R. F. Bales, and E. A. Shils, eds.), pp. 111–161, Glecoe: Free Press, 1953.

[9] J. H. Barkow, *Darwin, Sex and Status*. Toronto: Toronto University Press, 1989.

[10] J. H. Barkow, "Beneath new culture is old psychology: Gossip and social stratification," in *The Adapted Mind*, (J. H. Barkow, L. Cosmides, and J. Tooby, eds.), pp. 627–638, Oxford: Oxford University Press, 1992.

[11] T. Bastick, *Intuition: How We Think and Act*. New York: Wiley, 1982.
[12] C. D. Batson, S. Pate, H. Lawless, P. Sparkman, S. Lambers, and B. Worman, "Helping under conditions of common threat: Increased 'we-feeling' or ensuring reciprocity," *Social Psychology Quarterly*, vol. 42, no. 4, pp. 410–414, 1979.
[13] J. N. Bearden, R. O. Murphy, and A. Rapoport, "Decision biases in revenue management: Some behavioral evidence," Forthcoming, *Manufacturing & Service Operations Management*, 2007.
[14] J. N. Bearden, A. Rapoport, and R. O. Murphy, "Sequential observation and selection with rank-dependent payoffs: An experimental test," *Management Science*, vol. 52, pp. 1437–1449, 2006.
[15] D. Bell, "Regret in decision making under uncertainty," *Operations Research*, vol. 30, no. 5, pp. 961–981, 1982.
[16] D. Bell, "Disappointment in decision making under uncertainty," *Operations Research*, vol. 33, no. 1, pp. 1–27, 1985.
[17] E. Bendoly, K. Donohue, and K. L. Schultz, "Behavior in operations management: Assessing recent findings and revisiting old assumptions," *Journal of Operations Management*, vol. 24, no. 6, pp. 737–752, 2006.
[18] S. J. Blackmore, *The Meme Machine*. Oxford: Oxford University Press, 1999.
[19] P. M. Blau, "Cooperation and competition in a bureaucracy," *The American Journal of Sociology*, vol. 59, no. 6, pp. 530–535, 1954.
[20] P. M. Blau, *Exchange and Power in Social Life*. New York: Wiley, 1964.
[21] G. E. Bolton, "A comparative model of bargaining: Theory and evidence," *American Economic Review*, vol. 81, no. 5, pp. 1096–1136, 1991.
[22] G. E. Bolton, J. Brandts, and A. Ockenfels, "Fair procedures: Evidence from games involving lotteries," *The Economic Journal*, vol. 115, pp. 1054–1076, 2005.
[23] G. E. Bolton and E. Katok, "Learning-by-doing in the newsvendor problem: A laboratory investigation," Forthcoming, *Manufacturing & Service Operations Management*, 2006.
[24] G. E. Bolton, E. Katok, and A. Ockenfels, "How effective are online reputation mechanisms? An experimental study," *Management Science*, vol. 50, no. 11, pp. 1587–1602, 2004.
[25] G. E. Bolton and A. Ockenfels, "ERC – a theory of equity, reciprocity and competition," *American Economic Review*, vol. 90, pp. 166–193, 2000.
[26] A. Booth, G. Shelley, A. Mazur, G. Tharp, and R. Kittok, "Testosterone, and winning and losing in human competition," *Hormones and Behaviour*, vol. 33, pp. 556–571, 1989.
[27] J. Boudreau, W. Hopp, J. O. McClain, and L. J. Thomas, "On the interface between operations and human resources management," *Manufacturing & Service Operations Management*, vol. 5, no. 3, pp. 179–202, 2003.
[28] R. Boyd and P. J. Richerson, *Culture and the Evolutionary Process*. Chicago: Chicago University Press, 1985.
[29] R. Boyd and P. J. Richerson, *The Origin and Evolution of Cultures*. Oxford: Oxford University Press, 1999.

[30] R. Boyd and P. J. Richerson, "Solving the puzzle of human cooperation," in *Evolution and Culture*, (S. Levinson, ed.), pp. 105–132, Cambridge: MIT Press, 2005.

[31] L. Brenner, D. J. Koehler, V. Liberman, and A. Tversky, "Overconfidence in probability and frequency judgments: A critical examination," *Organizational Behavior and Human Decision Processes*, vol. 65, no. 3, pp. 212–219, 1996.

[32] J. Brockner, "Why it's so hard to be fair," *Harvard Business Review*, vol. 84, no. 3, pp. 122–129, 2006.

[33] E. S. Buffa, "Research in operations management," *Journal of Operations Management*, vol. 1, no. 1, pp. 1–8, 1980.

[34] R. S. Burt, "The network structure of social capital," *Research in Organizational Behaviour*, vol. 22, pp. 345–423, 2000.

[35] D. M. Buss, *Evolutionary Psychology*. Boston: Pearson Education, 2004.

[36] C. Camerer, "Behavioral economics: Reunifying psychology and economics," *Proceedings of the National Academy of Science USA*, vol. 96, pp. 10575–10577, 1999.

[37] C. Camerer and G. Loewenstein, "Behavioral economics: Past, present, future," in *Advances in Behavioral Economics*, (C. Camerer, G. Loewenstein, and M. Rabin, eds.), Princeton: Princeton University Press, 2003.

[38] C. Camerer and M. Weber, "Recent developments in modeling preferences: Uncertainty and ambiguity," *Journal of Risk and Uncertainty*, vol. 5, pp. 325–370, 1992.

[39] L. L. Cavalli-Sforza and M. W. Feldman, *Cultural Transmission and Evolution: A Quantitative Approach*. Princeton: Princeton University Press, 1981.

[40] B. Chapais, "Primates and the origins of aggression, power and politics among humans," in *Understanding Behaviour*, (J. D. Loy and C. B. Peters, eds.), pp. 190–228, Oxford: Oxford University Press, 1991.

[41] G. Charness and D. Levin, "When optimal choices feel wrong: A laboratory study of Bayesian updating, complexity, and affect," *American Economic Review*, vol. 95, pp. 1300–1309, 2005.

[42] G. Charness and M. Rabin, "Understanding social preferences with simple tests," *Quarterly Journal of Economics*, vol. 117, no. 3, pp. 817–869, 2002.

[43] R. B. Chase and E. L. Prentis, "Operations management: A field rediscovered," *Journal of Management*, vol. 13, no. 2, pp. 351–366, 1987.

[44] A. Chateauneuf, J. Eichberger, and S. Grant, "Choice under uncertainty with the best and worst on mind: Neo-additive capacities," *Journal of Economic Theory*, vol. 137, no. 1, pp. 538–567, 2007.

[45] J. A. Chatman, J. T. Polzer, S. G. Barsade, and M. A. Neale, "Being different yet feeling similar," *Administrative Science Quarterly*, vol. 43, pp. 749–780, 1998.

[46] S. Chopra, W. Lovejoy, and C. Yano, "Five decades of operations management and the prospects ahead," *Management Science*, vol. 50, no. 1, pp. 8–14, 2004.

[47] Y. Cohen-Charash and P. E. Spector, "The role of justice in organizations: A meta-analysis," *Organizational Behavior and Human Decision Processes*, vol. 86, no. 2, pp. 278–321, 2001.

[48] J. A. Colquitt, D. E. Conlon, M. K. Wesson, C. O. L. H. Porter, and K. Y. Ng, "Justice at the millennium: A meta-analytic review of 25 years of

organizational justice research," *Journal of Applied Psychology*, vol. 86, no. 3, pp. 425–445, 2001.

[49] C. J. Corbett and L. N. Van Wassenhove, "The natural drift: What happened to Operations Research?," *Operations Research*, vol. 41, pp. 625–640, 1993.

[50] L. Cosmides and J. Tooby, "Evolutionary psychology and the generation of culture," *Ethology and Sociobiology*, vol. 10, pp. 51–97, 1989.

[51] L. Cosmides and J. Tooby, "Cognitive adaptations for social exchange," in *The Adapted Mind*, (J. H. Barkow, L. Cosmides, and J. Tooby, eds.), pp. 163–228, Oxford: Oxford University Press, 1992.

[52] L. Cosmides and J. Tooby, "Evolutionary psychology and the emotions," in *Handbook of Emotions*, (M. Lewis and J. M. Haviland-Jones, eds.), pp. 91–115, New York: Guilford, 2000.

[53] R. P. Crease and C. C. Mann, *The Second Creation*. New York: MacMillan, 1986.

[54] R. Croson and K. Donohue, "Behavioral causes of the bullwhip effect and observed value of inventory information," *Management Science*, vol. 52, no. 3, pp. 323–336, 2006.

[55] R. Croson, K. Donohue, E. Katok, and J. Sterman, "Order stability in supply chains: Coordination risk and the role of coordination stock," Working Paper, Penn State University, 2007.

[56] A. Damasio, *Descartes' Error*. New York: Putnam, 1994.

[57] A. Damasio, *The Feeling of What Happens*. New York: Harcourt Brace, 1999.

[58] G. F. Davis and H. R. Greve, "Corporate elite networks and governance changes in the 1980s," *The American Journal of Sociology*, vol. 103, pp. 1–37, 1997.

[59] F. De Waal, *Good Natured: The Origins of Right and Wrong in Humans and Other Animals*. Cambridge: Harvard University Press, 1996.

[60] S. Della Vigna and U. Malmendier, "Contract design and self-control: Theory and evidence," *Quarterly Journal of Economics*, vol. 119, no. 2, pp. 353–402, 2004.

[61] T. Devos, L. A. Silver, D. M. Mackie, and E. R. Smith, "Experiencing Intergroup emotions," in *From Prejudice to Intergroup Emotions: Differential Reactions to Social Groups*, (D. M. Mackie and E. R. Smith, eds.), Philadelphia: Psychology Press, 2002.

[62] R. I. M. Dunbar, "Determinants of group size in primates: A general model," *Proceedings of the British Academy*, vol. 88, pp. 33–57, 1996.

[63] R. I. M. Dunbar, *Grooming, Gossip and the Evolution of Language*. Cambridge, MA: Harvard University Press, 1996.

[64] J. Eichberger, D. Kelsey, and B. C. Schipper, "Ambiguity and social interactions," Working Paper, University of California, Davis, 2007.

[65] H. Einhorn and R. M. Hogarth, "Decision making under ambiguity," *Journal of Business*, vol. 59, no. 4, pp. 225–250, 1986.

[66] D. Ellsberg, "Risk, ambiguity, and the savage axioms," *Quarterly Journal of Economics*, vol. 75, pp. 643–669, 1961.

[67] R. M. Emerson, "Power-dependence relations," *American Sociology Review*, vol. 27, pp. 31–40, 1962.

[68] R. Engelbrecht-Wiggans and E. Katok, "Regret and feedback information in first-price sealed-bid auctions," forthcoming, *Management Science*, 2007.
[69] J. R. Evans and W. M. Lindsay, *The Management and Control of Quality*. Minneapolis: West, 3rd ed., 2003.
[70] E. Fehr and U. Fischbacher, "The nature of human altruism," *Nature*, vol. 425, pp. 785–791, 2003.
[71] E. Fehr and S. Gächter, "Altruistic punishment in humans," *Nature*, vol. 415, no. 10, pp. 137–140, 2002.
[72] E. Fehr, A. Klein, and K. M. Schmidt, "Fairness and contract design," *Econometrica*, vol. 75, no. 1, pp. 121–154, 2007.
[73] E. Fehr and K. M. Schmidt, "A theory of fairness, competition, and cooperation," *Quarterly Journal of Economics*, vol. 114, no. 3, pp. 817–868, 1999.
[74] A. P. Fiske, "The four elementary forms of sociality: A framework for a unified theory of social relations," *Psychological Review*, vol. 99, pp. 689–723, 1992.
[75] P. A. Fiske, *Structures of Social Life: The Four Elementary Forms of Human Relations*. New York: Free Press, 1991.
[76] L. Fleming, "Lone inventors as sources of breakthroughs: Myth or reality?," Working Paper, Harvard Business School, 2006.
[77] L. Fleming and O. Sorenson, "Science as a map in technological search," *Strategic Management Journal*, vol. 25, pp. 909–928, 2004.
[78] R. H. Frank, "Interdependent preferences and the competitive wage structure," *RAND Journal of Economics*, vol. 15, pp. 510–520, 1984.
[79] R. H. Frank, *Choosing the Right Pond*. Oxford: Oxford University Press, 1985.
[80] S. Frederick, G. Loewenstein, and T. O'Donoghue, "Time discounting and time preference: A critical review," *Journal of Economic Literature*, vol. 40, no. 2, pp. 351–401, 2002.
[81] B. S. Frey, M. Benz, and A. Stutzer, "Introducing procedural utility: Not only what, but also how matters," *Journal of Institutional and Theoretical Economics*, vol. 160, pp. 377–401, 2004.
[82] F. Fukuyama, "Women and the evolution of world politics," *Foreign Affairs*, vol. 77, pp. 24–40, 1998.
[83] N. Gans, G. Knox, and R. Croson, "Simple models of discrete choice and their performance in Bandit experiments," *Manufacturing & Service and Operations Management*, vol. 9, no. 4, pp. 383–408, 2007.
[84] G. Gigerenzer and K. Hug, "Domain-specific reasoning: Social contracts, cheating and perspective change," *Cognition*, vol. 43, pp. 127–171, 1992.
[85] I. Gilboa and D. Schmeidler, "Maxmin expected utility with a non-unique prior," *Journal of Mathematical Economics*, vol. 18, pp. 141–153, 1989.
[86] F. Gino and G. Pisano, "Behavioral operations," Working Paper, Harvard Business School, 2006.
[87] F. Gino and G. Pisano, "Do managers' heuristics affect R&D performance volatility? A simulation informed by the pharmaceutical industy," Working Paper, Harvard Business School, 2006.
[88] R. Goffee and G. Jones, "What holds the modern company together?," *Harvard Business Review*, pp. 133–148, 1996.
[89] D. Goleman, *Emotional Intelligence*. London: Bloomsbury, 1995.

[90] J. Goodall, *The Chimpanzee, the Living Link Between Man and Beast*. The Third Edinburgh Medal Address, pp. 14–17, 1994.
[91] J. Greenberg, "Organizational justice: Yesterday, today and tomorrow," *Journal of Management*, vol. 16, no. 2, pp. 399–432, 1990.
[92] P. Griffiths, *What Emotions Really Are*. Chicago: University of Chicago Press, 1997.
[93] F. Gul, "A theory of disappointment aversion," *Econometrica*, vol. 59, no. 3, pp. 667–686, 1991.
[94] W. Güth, R. Schmittberger, and B. Schwarze, "An experimental analysis of ultimatum bargaining," *Journal of Economic Behavior and Organization*, vol. 3, pp. 367–388, 1982.
[95] W. D. Hamilton, "The genetic evolution of social behavior," *Journal of Theoretical Biology*, vol. 7, pp. 1–52, 1964.
[96] W. D. Hamilton, "Innate social aptitudes of man: An approach from evolutionary genetics," in *Biosocial Anthropology*, (R. Fax, ed.), pp. 133–155, New York: Wiley, 1975.
[97] M. T. Hannan and J. H. Freeman, *Organizational Ecology*. Cambridge: Harvard University Press, 1989.
[98] F. W. Harris, "What quantity to make at once," *The Library of Factory Management Vol. V, Operation and Costs*, pp. 47–52, Chicago: Shaw Company, 1915.
[99] R. Hayes, S. Wheelwright, and K. B. Clark, *Dynamic Manufacturing*. New York, NY: The Free Press, 1988.
[100] C. Heath, C. Bell, and E. Sternberg, "Emotional selection in memes: The case of urban legends," *Journal of Personality and Social Psychology*, vol. 81, pp. 1028–1041, 2001.
[101] C. Heath and A. Tversky, "Preference and belief: Ambiguity and competence in choice under uncertainty," *Journal of Risk and Uncertainty*, vol. 4, no. 1, pp. 5–28, 1991.
[102] J. Henrich, R. Boyd, S. Bowles, C. Camerer, E. Fehr, and H. Gintis, *Foundations of Human Society: Economic Experiments and Ethnographic Evidence from Fifteen Small-Scale Societies*. Oxford University Press, 2004.
[103] T.-H. Ho and K. Weigelt, "Trust building among strangers," *Management Science*, vol. 51, no. 4, pp. 1–12, 2005.
[104] T.-H. Ho and J. Zhang, "Designing price contracts for boundedly rational customers: Does the framing of the fixed fee matter?," forthcoming, *Management Science*, 2007.
[105] R. Hogarth, *Educating Intuition*. Chicago: Chicago University Press, 2001.
[106] W. J. Hopp and L. Spearman, *Factory Physics: Foundations of Manufacturing Management*. New York: McGraw-Hill, 2nd ed., 2000.
[107] D. L. Horowitz, *The Deadly Ethnic Riot*. Berkeley: University of California Press, 2001.
[108] B. A. Huberman, C. H. Loch, and A. Önçüler, "Status as a valued resource," *Social Psychology Quarterly*, vol. 67, pp. 103–114, 2004.
[109] S. Huck and G. Weizsacker, "Risk, complexity, and deviations from expected-value maximization: Results of a lottery choice experiment," *Journal of Economic Psychology*, vol. 20, no. 6, pp. 699–715, 1999.

[110] I. L. Janis, *Victims of Groupthink*. Boston: Houghton Mifflin, 1971.
[111] D. Kahneman, "Maps of bounded rationality: Psychology of behavioral economics," *American Economic Review*, vol. 93, no. 5, pp. 1449–1495, 2003.
[112] D. Kahneman, J. L. Knetsch, and R. Thaler, "Fairness as a constraint on profit seeking: Entitlement in markets," *American Economic Review*, vol. 76, no. 4, pp. 728–741, 1986.
[113] D. Kahneman, J. L. Knetsch, and R. Thaler, "Anomalies: The endowment effect, loss aversion, and status quo bias," *Journal of Economic Perspectives*, vol. 5, no. 1, pp. 193–206, 1991.
[114] D. Kahneman and A. Tversky, "Prospect theory: An analysis of decision under risk," *Econometrica*, vol. 47, no. 2, pp. 263–292, 1979.
[115] R. Kanigel, *The One Best Way: Frederick Winslow Taylor and the Enigma of Efficiency*. New York, NY: Viking Penguin, 1997.
[116] U. Karmarkar, "Subjectively weighted utility: A descriptive extension of the expected utility model," *Organizational Behavior and Human Performance*, vol. 21, pp. 61–72, 1978.
[117] U. Karmarkar, "Subjectively weighted utility and the Allais paradox," *Organizational Behavior and Human Performance*, vol. 24, pp. 67–72, 1979.
[118] E. Katok and D. Wu, "Contracting in supply chains: A laboratory investigation," Working Paper, Penn State University Smeal School, 2006.
[119] R. Katz and T. J. Allen, "Investigating the Not Invented Here (NIH) syndrome: A look at the performance, tenure and communication patterns of 50 R&D project groups," *R&D Management*, vol. 12, no. 1, pp. 7–19, 1982.
[120] R. Kelly, *The Nuer Conquest: The Structure and Content of an Expansionist System*. Ann Arbor: University of Michigan Press, 1985.
[121] T. D. Kemper and R. Collins, "Dimensions of microinteraction," *American Journal of Sociology*, vol. 96, pp. 32–68, 1990.
[122] W. C. Kim and R. A. Mauborgne, "Implementing global strategies: The role of procedural justice," *Strategic Management Journal*, vol. 12, pp. 125–143, 1991.
[123] W. C. Kim and R. A. Mauborgne, "Fair process: Managing in the knowledge economy," *Harvard Business Review*, vol. 75, no. 4, pp. 65–75, 1997.
[124] J. Knetsch and S. John, "Willingness to pay and compensation demanded: Experimental evidence of an unexpected disparity in measures of value," *Quarterly Journal of Economics*, vol. 99, no. 3, pp. 507–521, 1984.
[125] F. H. Knight, *Risk, Uncertainty, and Profit*. New York: Houghton Mifflin, 1921.
[126] V. Kobberling and P. Wakker, "An index of loss aversion," *Journal of Economic Theory*, vol. 122, no. 1, pp. 119–131, 2005.
[127] K. A. Konrad and K. E. Lommerud, "Relative standing comparisons, risk taking, and safety regulations," *Journal of Public Economics*, vol. 51, pp. 345–358, 1993.
[128] B. Köszegi and M. Rabin, "A model of reference dependent preferences," *Quarterly Journal of Economics*, vol. 121, no. 4, pp. 1133–1166, 2006.
[129] R. M. Kramer, "Intergroup relations and organizational dilemmas: The role of categorization processes," *Research in Organizational Behaviour*, vol. 13, pp. 191–228, 1991.

[130] D. M. Kreps, "A representation theorem for 'preference for flexibility'," *Econometrica*, vol. 47, pp. 565–577, 1979.
[131] D. M. Kreps, *A Course in Microeconomic Theory*. Princeton University Press, 1990.
[132] R. Kurzban, J. Tooby, and L. Cosmides, "Can race be erased? Coalitional computation and social categorization," *Proceedings of the National Academy of Sciences 98*, vol. 18, pp. 15387–15392, 2001.
[133] D. Laibson, "Golden eggs and hyperbolic discounting," *Quarterly Journal of Economics*, vol. 112, pp. 443–477, 1997.
[134] D. Laibson, "Life-cycle consumption and hyperbolic discount functions," *European Economic Review*, vol. 42, pp. 861–871, 1998.
[135] J. LeDoux, *The Emotional Brain*. London: Orion Books, 1998.
[136] H. Lee, P. Padmanabhan, and S. Whang, "Information distortion in a supply chain: The bullwhip effect," *Management Science*, vol. 43, pp. 546–558, 1997.
[137] G. S. Leventhal, "What should be done with equity theory," in *Social Exchange: Advances in Theory and Research*, (K. Gergen, M. Greenberg, and R. Willis, eds.), pp. 25–75, New York: Plenum Press, 1980.
[138] P. F. Levy, "The Nut Island effect: When good teams go wrong," *Harvard Business Review*, vol. 79, no. 3, pp. 51–59, 2001.
[139] M. A. Lewis, "Babbage and the beginning of OM: Reappraising on the economy of machinery and manufactures," in *Operations Management: Critical Perspectives on Business and Management*, (M. A. Lewis and N. Slack, eds.), Routledge London, 2003.
[140] N. Lim and T.-H. Ho, "Designing contracts for boundedly rational customers: Does the number of blocks matter," *Marketing Science*, vol. 26, no. 3, pp. 312–326, 2007.
[141] N. Lin, "Social resources and social mobility: A structural theory of status attainment," in *Social Mobility and Social Structure*, (R. L. Breiger, ed.), pp. 247–271, Cambridge: Cambridge University Press, 1990.
[142] E. A. Lind and T. R. Tyler, *The Social Psychology of Procedural Justice*. New York: Plenum Press, 1988.
[143] C. H. Loch, S. Chick, and A. Huchzermeier, "Can European manufacturing companies compete?," *European Management Journal*, vol. 25, no. 4, pp. 251–265, 2007.
[144] C. H. Loch, D. C. Galunic, and S. Schneider, "Balancing cooperation and competition in human groups: The role of emotional algorithms and evolution," *Managerial and Decision Economics*, vol. 27, pp. 217–233, 2006.
[145] C. H. Loch, B. A. Huberman, and S. T. Stout, "Status competition and performance in work groups," *Journal of Economic Behavior & Organization*, vol. 43, pp. 35–55, 2000.
[146] C. H. Loch, M. T. Pich, C. Terwiesch, and M. Urbschat, "Selecting R&D projects at BMW: A case study of adopting mathematical programming methods," *IEEE Transactions on Engineering Management*, vol. 48, no. 1, pp. 70–80, 2001.
[147] C. H. Loch and Y. Wu, "Social preferences and supply chain performance: An experimental study," Working Paper, INSEAD, 2007.

[148] E. A. Locke, "The ideas of Frederick W. Taylor: An evaluation," *Academy of Management Review*, vol. 7, no. 1, pp. 14–24, 1987.
[149] G. Looms and R. Sugden, "Regret theory: An alternative theory of rational choice under uncertainty," *Economic Journal*, vol. 92, pp. 805–824, 1982.
[150] G. Looms and R. Sugden, "Testing for regret and disappointment in choice under uncertainty," *Economic Journal*, vol. 97, pp. 118–129, 1987.
[151] C. Lumsden and E. O. Wilson, *Genes, Mind and Culture*. Cambridge: Harvard University Press, 1981.
[152] G. Mador, D. Donsino, and U. Benzion, "On complexity and lotteries' evaluation – three experimental observations," *Journal of Economic Psychology*, vol. 21, no. 6, pp. 625–637, 2000.
[153] D. S. Massey, "A brief history of human society: The origin and role of emotion in social life," *American Sociological Review*, vol. 67, pp. 1–29, 2002.
[154] M. Mauss, *The Gift*. New York: WW Norton, 1950.
[155] J. Maynard Smith, "Group selection and kin selection," *Nature*, vol. 201, pp. 1145–1146, 1964.
[156] R. McElreath and R. Boyd, *Mathematical Models of Social Evolution*. Chicago: The University of Chicago Press, 2007.
[157] J. R. Meredith, "Hopes for the future of operations management," *Journal of Operations Management*, vol. 19, no. 4, pp. 397–402, 2001.
[158] J. Mokyr, *The Lever of Riches*. Oxford: Oxford University Press, 1990.
[159] A. Neely, "Production/operations management: Research process and content during 1980s," *International Journal of Operations & Production Management*, vol. 13, no. 1, pp. 5–18, 1993.
[160] R. R. Nelson and S. G. Winter, *An Evolutionary Theory of Economic Change*. Cambridge: Belknap Harvard, 1982.
[161] N. Nicholson, *Executive Instinct*. New York: Crown, 2000.
[162] M. A. Nowak, K. M. Page, and K. Sigmund, "Fairness versus reason in the ultimatum game," *Science*, vol. 289, no. 5485, pp. 1773–1775, 2000.
[163] K. Oatley and P. N. Johnson-Laird, "Towards a cognitive theory of emotions," *Cognition and Emotion*, vol. 1, pp. 29–50, 1987.
[164] T. O'Donoghue and M. Rabin, "Doing it now or later," *American Economic Review*, vol. 89, no. 1, pp. 103–124, 1999.
[165] T. O'Donoghue and M. Rabin, "Incentives for procrastinators," *Quarterly Journal of Economics*, vol. 114, no. 3, pp. 769–816, 1999.
[166] T. O'Donoghue and M. Rabin, "Choice and procrastinators," *Quarterly Journal of Economics*, vol. 116, no. 1, pp. 121–160, 2001.
[167] K. Panchanathan and R. Boyd, "Indirect reciprocity can stabilize cooperation without the second-order free-rider problem," *Nature*, vol. 432, pp. 499–502, 2004.
[168] J. W. Payne, "Task complexity and contingent processing in decision making: An information search and protocol analysis," *Organizational Behavior and Human Performance*, vol. 16, pp. 366–387, 1976.
[169] G. Perakis and G. Roels, "Regret in the newsvendor model with partial information," forthcoming, *Operations Research*, 2007.
[170] J. Pfeffer, *Managing with Power*. Cambridge: Harvard Business School Press, 1992.

[171] E. Phelps and R. A. Pollak, "On second-best national saving and game-equilibrium growth," *Review of Economic Studies*, vol. 35, no. 2, pp. 185–199, 1968.

[172] M. T. Pich, L. C. H, and A. De Meyer, "On uncertainty, ambiguity and complexity in project management," *Management Science*, vol. 48, no. 8, pp. 1008–1023, 2002.

[173] H. Plotkin, *Darwin Machines and the Nature of Knowledge*. Cambridge: Harvard University Press, 1993.

[174] C. R. Plott and K. Zeiler, "The willingness to pay-willingness to accept gap, the 'Endowment Effect,' subject misconceptions, and experimental procedures for eliciting valuations," *American Economic Review*, vol. 95, no. 3, pp. 530–545, 2005.

[175] C. R. Plott and K. Zeiler, "Exchange asymmetries incorrectly interpreted as evidence of endowment effect theory and prospect theory?," *American Economic Review*, vol. 97, no. 4, pp. 1449–1466, 2007.

[176] J. M. Podolny, "A status-based model of market competition," *American Journal of Sociology*, vol. 98, pp. 829–872, 1997.

[177] I. Popescu and Y. Wu, "Dynamic pricing strategies with reference effects," *Operations Research*, vol. 55, no. 3, pp. 413–429, 2007.

[178] T. C. Powell, "Total quality management as competitive advantage: A review and empirical study," *Strategic Management Journal*, vol. 16, pp. 15–37, 1995.

[179] T. C. Powell, "How much does industry matter? An alternative empirical test," *Strategic Management Journal*, vol. 17, pp. 323–334, 1996.

[180] M. Rabin, "Incorporating fairness into game theory and economics," *American Economic Review*, vol. 83, no. 5, pp. 1281–1302, 1993.

[181] M. Rabin, "Psychology and economics," *Journal of Economic Literature*, vol. 36, no. 1, pp. 11–46, 1998.

[182] M. Rabin, "A perspective on psychology and economics," *European Economic Review*, vol. 46, pp. 657–685, 2002.

[183] A. Rapoport, "A study of human control in a stochastic multistage decision task," *Behavioral Sciences*, vol. 11, pp. 18–32, 1966.

[184] A. Rapoport, "Variables affecting decisions in a multistage inventory task," *Behavioral Sciences*, vol. 12, pp. 194–204, 1967.

[185] P. J. Richerson and R. Boyd, *Not by Genes Alone: How Culture Transformed Human Evolution*. Chicago University Press, 2005.

[186] C. Ridgeway and H. A. Walker, "Status structures," in *Sociological Perspectives on Social Psychology*, (K. Cook, G. Fine, and J. House, eds.), pp. 281–310, Allyn and Bacon, 1995.

[187] C. Rode, L. Cosmides, W. Hell, and J. Tooby, "When and why do people avoid unknown probabilities in decisions under uncertainty? Testing some predictions from optimal foraging theory," *Cognition*, vol. 72, pp. 269–304, 1999.

[188] A. Rubinstein, "Finite automata player the repeated prisoner's dilemma," *Journal of Economic Theory*, vol. 38, pp. 63–77, 1986.

[189] W. G. Runciman, "The selectionist paradigm and its implications," *Sociology*, vol. 32, pp. 163–188, 1998.

[190] J. E. Russo, P. J. Schoemaker, and M. Hittleman, *Winning Decisions: Getting it Right the First Time*. New York: DoubleDay/Piatkus, 2002.

[191] P. Samuelson, "A note on measurement of utility," *Review of Economic Studies*, vol. 4, pp. 155–161, 1937.
[192] L. J. Savage, *Foundations of Statistics*. New York: Wiley, 1954.
[193] E. H. Schein, *Organizational Culture and Leadership*. San Francisco: Jossey Bass, 1992.
[194] K. R. Scherer, "Emotion," in *Introduction to Social Psychology: A European perspective*, (M. Hewstone and W. Stroebe, eds.), pp. 151–191, Blackwell: Oxford, 2000.
[195] K. R. Scherer and V. Tran, "Effects of emotion on the process of organisational learning," in *Handbook of Organizational Learning and Knowledge*, (A. Berthoin Antal, J. Child, M. Dierkes, and I. Nonaka, eds.), pp. 369–392, Oxford University Press, 2001.
[196] D. Schmeidler, "Subjective probability and expected utility without additivity," *Econometrica*, vol. 57, pp. 571–587, 1989.
[197] M. Schweitzer and G. Cachon, "Decision bias in the newsvendor problem with a known demand distribution: Experimental evidence," *Management Science*, vol. 46, no. 3, pp. 406–420, 2000.
[198] M. Sherif, *In Common Predicament*. Boston: Houghton Mifflin, 1966.
[199] K. Sigmund, E. Fehr, and M. A. Nowak, "The economics of fair play," *Scientific American*, vol. 286, no. 1, pp. 82–87, 2002.
[200] H. A. Simon, "A behavioral model of rational choice," *Quarterly Journal of Economics*, vol. LXIX, pp. 99–118, 1955.
[201] H. A. Simon, "Rational decision making in business organizations," *American Economic Review*, vol. 69, no. 4, pp. 493–513, 1979.
[202] W. Skinner, "Manufacturing — Missing link in corporate strategy," *Harvard Business Review*, vol. 47, no. 3, pp. 136–145, 1969.
[203] W. Skinner, "The focused factory," *Harvard Business Review*, vol. 52, no. 3, pp. 113–121, 1974.
[204] A. Smith, *The Wealth of Nations*. 1776. (Reprinted by A. Knopf, Toronto, 1991).
[205] J. Sobel, "Interdependent preferences and reciprocity," *Journal of Economic Literature*, vol. XLIII, pp. 392–436, 2005.
[206] E. Sober and D. S. Wilson, *Unto Others*. Cambridge: Harvard University Press, 1998.
[207] S. C. Sommer and C. H. Loch, "Mastering unforeseeable uncertainty and complexity in startup companies: En empirical study," Working Paper, INSEAD, 2007.
[208] D. Sonsino, U. Benzion, and G. Mador, "The complexity effects on choice with uncertainty — experimental evidence," *Economic Journal*, vol. 112, pp. 936–965, 2002.
[209] D. Sonsino and M. Mandelbaum, "On preference for flexibility and complexity aversion: Experimental evidence," *Theory and Decision*, vol. 51, no. 2–4, pp. 197–276, 2001.
[210] M. Sosa, S. D. Eppinger, M. T. Pich, D. G. McKendrick, and S. K. Stout, "Factors that influence technical communication in distributed product development," *IEEE Transactions on Engineering Management*, vol. 49, no. 1, pp. 45–58, 2002.

[211] G. Stalk Jr. and T. M. Hout, *Competing Against Time*. New York: Free Press, 1990.

[212] K. E. Stanovich, *Who is Rational?: Studies of Individual Differences in Reasoning*. Lawrence Erlbaum Associates, 1999.

[213] K. E. Stanovich, "The fundamental computational biases of human cognition: Heuristics that (sometimes) impair decision making and problem solving," in *The Psychology of Problem Solving*, (J. E. Davidson and R. J. Sternberg, eds.), pp. 291–342, New York: Cambridge University Press, 2003.

[214] K. E. Stanovich and R. F. West, "Individual differences in reasoning: Implications for the rationality debate?," *Behavioral and Brain Science*, vol. 23, no. 5, pp. 645–655, 2000.

[215] K. E. Stanovich and R. F. West, "Individual differences in reasoning: Implications for the rationality debate," in *Heuristics and Biases*, (T. Gilovich, D. Griffin, and D. Kahneman, eds.), pp. 421–440, Cambridge: Cambridge University Press, 2002.

[216] J. D. Sterman, "Modeling managerial behavior: Misperceptions of feedback in a dynamic decision making experiment," *Management Science*, vol. 35, pp. 321–339, 1989.

[217] X. Su, "A model of consumer inertia with applications to dynamic pricing," Working Paper, University of California Berkeley, 2006.

[218] X. Su, "Bounded rationality in newsvendor models," forthcoming, *Manufacturing and Service Operations Management*, 2007.

[219] H. Tajfel, "Experiments in intergroup discrimination," *Scientific American*, vol. 223, pp. 96–102, 1970.

[220] H. Tajfel, "Social psychology of intergroup relations," *Annual Review of Psychology*, vol. 33, pp. 1–39, 1982.

[221] R. Thaler, "Toward a positive theory of consumer choice," *Journal of Economic Behavior and Organization*, vol. 1, pp. 39–60, 1980.

[222] J. W. Thibault and L. Walker, *Procedural Justice: A Psychological Analysis*. New Jersey: Hillsdale, 1975.

[223] T.-H. THo, N. Lim, and C. F. Camerer, "Modeling the psychology of consumer and firm behavior with behavioral economics," *Journal of Marketing Research*, vol. XLIII, pp. 307–331, 2006.

[224] R. L. Trivers, "The evolution of reciprocal altruism," *Quarterly Review of Biology*, vol. 46, pp. 35–57, 1971.

[225] R. L. Trivers, *Social Evolution*. Menlo Park, CA: Benjamin/Cummings, 1985.

[226] B. W. Tuckman and M. A. C. Jensen, "Stages of small-group development revisited," *Group and Organization Management*, vol. 2, no. 4, pp. 419–427, 1977.

[227] A. Tversky, "Elimination by aspects: A theory of choice," *Psychological Review*, vol. 79, pp. 281–299, 1972.

[228] A. Tversky and D. Kahneman, "Judgment under uncertainty: Heuristics and biases," *Science*, vol. 185, no. 4157, pp. 1124–1131, 1974.

[229] A. Tversky and D. Kahneman, "The framing of decisions and psychology of choice," *Science*, vol. 211, no. 4481, pp. 453–458, 1981.

[230] J. Urda and C. H. Loch, "Social goals and cognitive appraisal: How social context influences emotions," Working Paper, INSEAD, 2007.
[231] B. Uzzi, "Social structure and competition in interfirm networks: The paradox of embeddedness," *Administrative Science Quarterly*, vol. 42, pp. 35–67, 1997.
[232] L. Van der Heyden, "Why fairness matters," Working paper, INSEAD, 2007.
[233] L. Van der Heyden, C. Blondel, and R. S. Carlock, "Fair process: Striving for justice in family business," *Family Business Review*, vol. XVIII, no. 1, pp. 1–21, 2005.
[234] L. Van der Heyden and T. Limberg, "Fair process in operations: Measurement, validation, and innovation performance," Working Paper, INSEAD, 2007.
[235] T. Veblen, *The Theory of the Leisure Class*. New York: MacMillan, 1899.
[236] C. X. Wang and S. Webster, "The loss-averse newsvendor problem," *OMEGA*, doi: 10.1016/j.omega.2006.08.003, 2006.
[237] M. Weber, *The Theory of Social and Economic Organization*. New York: The Free Press (translation of *Wirtschaft und Gesellschaft*), 1964.
[238] J. Weeks, *Unpopular Culture. The Ritual of Complaint in a British Bank*. Chicago: Chicago University Press, 2004.
[239] J. Weeks and C. Galunic, "A theory of the cultural evolution of the firm: The intra-organizational ecology of memes," *Organization Studies*, vol. 24, no. 8, pp. 1309–1352, 2003.
[240] G. C. Williams, *Adaptation and Natural Selection: A Critique of Some Current Evolutionary Thought*. Princeton: Princeton University Press, 1966.
[241] R. W. Woodman, J. E. Sawyer, and R. W. Griffin, "Toward a theory of organizational creativity," *Academy of Management Review*, vol. 18, no. 2, pp. 293–321, 1993.
[242] Y. Wu, C. H. Loch, and L. Van der Heyden, "A model of fair process and its limits," Forthcoming, *Manufacturing and Service Operations Management*, 2007.