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Perspective: Linking Design Thinking with Innovation Outcomes through Cognitive Bias Reduction

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"Design thinking" has generated significant attention in the business press and has been heralded as a novel problem-solving methodology well suited to the often-cited challenges business organizations face in encouraging innovation and growth. Yet the specific mechanisms through which the use of design, approached as a thought process, might improve innovation outcomes have not received significant attention from business scholars. In particular, its utility has only rarely been linked to the academic literature on individual cognition and decision-making. This perspective piece advocates addressing this omission by examining "design thinking" as a practice potentially valuable for improving innovation outcomes by helping decision-makers reduce their individual level cognitive biases. In this essay, I first review the assumptions, principles, and key process tools associated with design thinking. I then establish its foundation in the decision-making literature, drawing on an extensive body of research on cognitive biases and their impact. The essay concludes by advancing a set of propositions and research implications, aiming to demonstrate one particular path that future research might take in assessing the utility of design thinking as a method for improving organizational outcomes related to innovation. In doing so, it seeks to address the challenge of conducting academic research on a practice that is obviously popular in management circles but appears resistant to rigorous empirical inquiry because of the multifaceted nature of its "basket" of tools and processes and the complexity of measuring the outcomes it produces.

Introduction

The quantity of practitioner writing on the topic of "design thinking" has grown voluminously over the past five years, both in terms of popular management books explicitly focusing on the subject (e.g., Brown, 2009; Kelley and Littman, 2005; Liedtka and Ogilvie, 2011; Martin, 2009; Pink, 2005; Verganti, 2009) and in articles of note appearing in major business practitioner publications such as *The Economist*, *Harvard Business Review*, *Business Week*, *The Wall Street Journal*, and *The New York Times*. While significant scholarly attention to product design has emerged over the past decade (for instance, see *JPIM*'s special May 2011 issue on product design research and practice, edited by Luchs and Swan) and theoretical work has appeared in design-focused academic journals like *Design Issues*, attention to the specific mechanisms through which "design thinking" as a problem-solving approach improves business outcomes has been scant. Although anecdotal reports are plentiful, systematic assessment of design thinking's utility is limited (Cooper, Juninger, and Lockwood, 2009; Johansson, Woodilla, and Cetinkaya, 2011; Lindberg, Koppen, Rauth, and Meinel, 2012). The goal of this essay is to lay out one approach for more systematic study of a set of concrete and measurable outcomes that design thinking might be hypothesized to produce relative to innovation success. I propose to do this by first examining the origins, practices, and hypothesized value of the design-thinking process, and then linking these to existing research on organizational decision-making, specifically cognitive bias. In focusing on the well-researched area of the cognitive limitations of decision-makers, I hope to identify the theoretical contribution design thinking might make to addressing specific limitations already well identified in the literature on cognition and decision-making processes and lay out a path to future empirical work.

My plan for accomplishing this proceeds in three steps: (1) review the definition, principles, and key process tools that characterize the practice of design thinking; (2) examine the literature in the area of cognitive biases in decision-making and explore potential linkages with the practices and tools of design thinking; and (3) advance propositions to facilitate the assessment of its likely utility in relation to the impact on cognitive bias. Based on these three steps, this essay concludes with research implications for future scholarly attention.

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Defining Design Thinking

A generally accepted definition of design thinking has yet to emerge, and even the term itself is a subject of controversy among its practitioners and advocates. This is not surprising, given that even the well-established topic of *product* design, with a much longer history in the innovation and marketing literature (Veryzer and Borja de Mozota, 2005), still suffers from confusion introduced by the use of varied definitions (Luchs and Swan, 2011). The nomenclature of "design thinking" first appears prominently in a book of that title authored by Peter Rowe (1987), a professor of architecture and urban planning at Harvard's School of Design. A review of that publication's contents, however, reveals usage of the term primarily oriented to architectural design that does not capture its current meaning as practiced in the business environment. In its current usage, as a thought process, the nomenclature is more appropriately attributed to the innovation consulting firm IDEO and its leadership, founder David Kelley (Kelley and Littman, 2005), and more recently, current chief executive officer Tim Brown (Brown, 2009). IDEO's own strategy as a firm has reflected the evolution of design thinking itself: although originally focused on product development, it has expanded to include the design of services, strategies, and even educational and other social systems. Brown has defined *design thinking* as "bringing designers' principles, approaches, methods, and tools to problem solving." Thomas Lockwood, former president of the Design Management Institute, a leading association of design practitioners working in business, has offered a more detailed definition of design thinking: "a human-centered innovation process that emphasizes observation, collaboration, fast learning, visualization of ideas, rapid concept prototyping, and concurrent business analysis" (Lockwood, 2009).

BIOGRAPHICAL SKETCH

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Intellectual Roots in Design Theory

While "design thinking" is a relatively new addition to the management literature, product design has been of keen interest to business researchers for more than a decade (Bloch, 2011), and the design process has long been explored by theorists in schools of architecture and design. Let us turn to a brief examination of the design theory literature to see what it might contribute to our task of defining more precisely what the term "design thinking" might include.

Vladimir Bazjanac (1974), a Berkeley architecture professor and early leader in design theory, argued that serious attention to the design process began in the mid-20th century, in tandem with developments in the fields of mathematics and systems science. Early models, he notes, "all view the design process as a sequence of well-defined activities and are based on the assumption that the ideas and principles of the scientific method can be applied to it." Hoerst Rittel (1972) first called attention to the "wicked" nature of many design problems. These problems, he argued, lacked both definitive formulations and solutions and were characterized by conditions of high uncertainty—thus, linear analytical approaches were unlikely to successfully resolve them. Instead, they benefitted from an experimental approach that explored multiple possible solutions, he asserted. These themes of problem centeredness, nonlinearity, optionality, and the presence of uncertainty and ambiguity as defining conditions calling for a design approach all remain central to subsequent work in design theory. Reflecting on the centrality of its fittedness for dealing with uncertainty as core to the value that design brings, Owen (2007) would later argue that design thinking, in contrast to traditional management approaches, actively avoids making choices for as long as possible in order to maximize learning as an uncertainty reduction strategy; learning has long been highlighted as central to the purpose of design (Beckman and Barry, 2007).

Rittel's work was followed by ongoing and more detailed explorations of the role of the scientific method in the design process. Studies of design processes in more recent literature almost uniformly suggest a learning-focused, hypothesis-driven approach (Schon, 1982), with similarities to the traditional scientific method. Cross (1995), in reviewing a wide range of studies of design processes in action, noted, "It becomes clear from these studies that architects, engineers, and other designers adopt a problem-solving strategy based on generating and testing potential solutions." Like Rittel, Cross emphasized design's intense focus on problem exploration as an

antecedent to solution finding. Other theorists paid attention to the areas in which design and science diverged, namely that designers dealt with what did not yet exist and scientists dealt with explaining what did. "That scientists *discover* the laws that govern today's reality, while designers *invent* a different future is a common theme," Liedtka (2000) noted in her review of this literature. Thus, while science and design are both hypothesis driven, the design hypothesis differs from the scientific hypothesis, according the process of abduction a key role. March (1976) stated that "Science investigates extant forms. Design initiates novel forms . . . a speculative design cannot be determined logically, because the mode of reasoning involved is essentially abductive." A final characteristic of design widely noted by design theorists over the past 60 years is its paradoxical nature as it seeks to find higher-order solutions that accommodate seemingly opposite forces. Buchanan (1992) situated design as a dialectic that took place at the intersection of constraint, contingency, and possibility.

This convergence around the characteristics of the design process provides a theoretical foundation for describing the design-thinking process as advocated in business today: it is a hypothesis-driven process that is problem, as well as solution, focused. It relies on abduction and experimentation involving multiple alternative solutions that actively mediate a variety of tensions between possibilities and constraints, and is best suited to decision contexts in which uncertainty and ambiguity are high. Iteration, based on learning through experimentation, is seen as a central task.

There are, however, three significant changes and additions worth noting that represent critical elements of business design thinking that were not prominent in these earlier writings of design theorists. The first concerns *who* designs (Moreau, 2011). Buchanan (1992) notes that the question of whose values matter and who ought to participate in the design process has changed evolving from 1950s' beliefs about the "ability of experts to engineer socially acceptable results" toward a view of audiences as "active participants in reaching conclusions." After studying new organizational forms such as Wikipedia and Linux, Garud, Jain, and Tuertscher (2008) argue that the nature of uncertainty in the environment necessitates a kind of "generative engagement" of users in which "the distinction between designers and users has blurred, resulting in the formation of a community of co-designers." This orientation toward cocreation introduces a distinctly social focus, and emphasis on collaboration that earlier theories lacked. The second essential element in today's views of design thinking relates to the role of empathy (Leonard and Rayport, 1997; Patnaik and Mortensen, 2009), a topic almost wholly absent from earlier theories. Empathy goes beyond mere recognition of the subjectivity of the design domain; virtually all current descriptions of the process emphasize design thinking as human centered and user driven as a core value. The third addition builds on design's strong emphasis on the concrete and the visual to highlight the key role of visualization and prototyping. Certainly, prototyping has long been a central feature in fields such as architecture and product development, but design thinking's view of prototyping is somewhat different: the function of prototyping in design thinking is to drive real world experimentation in service to learning rather than to display, persuade, or test; these prototypes act as what Schrage (1999) calls "playgrounds" for conversation rather than "dress rehearsals" for new products.

Examining Design as Practiced

Thus, a significant theoretical literature base suggests convergence around the fundamental meaning of design thinking. But what about in practice? Significant divergence has often been found between theory and practice related to other management concepts, for example with total quality management (Hackman and Wageman, 1995). Examining the state-of-the-art practice in this area is not difficult—leading consultants in the design space like IDEO and Continuum, and educators like Stanford Design School, the Rotman School at the University of Toronto, and the Darden School at the University of Virginia offer extensive website descriptions of their views of the process and tools used to practice design thinking. A review of these reveals a widely shared view of the design-thinking process, despite each using different terminology (Table 1).

It specifies an initial exploratory phase focused on data gathering to identify user needs and define the problem, followed by a second stage of idea generation, followed by a final phase of prototyping and testing that correspond closely to what Seidel and Fixson (2013) describe in their review of the literature as "need finding, brainstorming, and prototyping." All descriptions of the process emphasize iterative cycles of exploration using deep user research to develop insights and design criteria, followed by the generation of multiple ideas and concepts and then prototyping and experimentation to select the best ones—usually performed by functionally diverse groups working closely with users.

Table 1. Models of Design-thinking Process in Practice

Stage	IDEO	Continuum	Stanford Design School	Rotman Business School	Darden Business School
Stage I data gathering about user needs	Discovery and interpretation	Discover deep insights	Empathize and define	Empathy	What is?
Stage II idea generation	Ideation	Create	Ideation	Ideation	What if?
Stage III testing	Experimentation and evolution	Make it real: prototype, test, and deploy	Prototype and test	Prototyping and experimentation	What wows? What works?

Sources:
IDEO.com. 2014. Available at http://designthinkingforeducators.com/.
Continuum.com. 2014. Available at http://continuuminnovation.com/whatwedo/.
Stanford Design School. 2014. Available at http://dschool.stanford.edu/use-our-methods/.
University of Toronto Rotman School DesignWorks. 2014. Available at http://www.rotman.utoronto.ca/FacultyAndResearch/EducationCentres/DesignWorks/About.aspx
University of Virginia's Darden Business School Design at Darden. 2014. Available at http://batten.squarespace.com/.

A wide variety of tools are described to support the process. Table 2 summarizes the more prominently discussed of these.

The first stage of need finding includes a variety of ethnographic research techniques, such as participant observation, job to be done, and journey mapping. The second stage of ideation includes sense-making tools (e.g., mind mapping and other forms of cluster analysis) and ideation tools to support brainstorming and concept development. Prototyping and testing approaches to support experimentation (assumption testing and field experiments) are part of the third phase of testing. Other tools, such as visualization and cocreation, are used throughout the process. The emphasis is on teams, and collaboration across diversity in the form of functions, perspectives, and experience bases is core to the approach. In fact, Seidel and Fixson (2013) place collaboration at the center of design thinking, defining it as "the application of design methods by multi-disciplinary teams to a broad range of innovation challenges."

There is clearly overlap between the design-thinking process and tool kit and that of other management approaches. The emphasis on learning is strongly reminiscent of Senge's (1990) seminal work on learning organizations. The need-finding phase, and accompanying tools, can be linked with the marketing literature; consumer research has long recognized the value of a deep understanding of customer needs. Ethnographic research techniques, a staple in qualitative academic research, are finding increased usage and support in marketing practice (Elliott and Jankel-Elliott, 2003; Leonard and Rayport, 1997; Mariampolski, 1999). Problem finding has been

Table 2. Common Design-thinking Tools

1	Visualization involves the use of *imagery*, either visual or narrative. In addition to traditional charts and graphs, it can take the form of *storytelling* and the use of *metaphor* and *analogies*, or capturing individual ideas on post-it notes and whiteboards so they can be shared and developed jointly.
2	Ethnography encompasses a variety of qualitative research methods that focus on developing a deep understanding of users by observing and interacting with them in their native habitat. Techniques here would include *participant observation*, *interviewing*, *journey mapping*, and *job-to-be-done analysis.*
3	Structured collaborative sense-making techniques like *mind mapping* facilitate team-based processes for drawing insights from ethnographic data and create a "common mind" across team members. Collaborative ideation, using *brainstorming* and *concept development* techniques, assists in generating hypotheses about potential opportunities. These tools leverage difference by encouraging a set of behaviors around withholding judgment, avoiding debates, and paying particular attention to the tensions difference creates in the process of seeking higher-order thinking and creating more innovative solutions.
4	*Assumption surfacing* focuses on identifying assumptions around value creation, execution, scalability, and defensibility that underlie the attractiveness of a new idea.
5	*Prototyping* techniques facilitate making abstract ideas tangible. These include approaches such as storyboarding, user scenarios, metaphor, experience journeys, and business concept illustrations. Prototypes aim to enhance the accuracy of feedback conversations by providing a mechanism to allow decision-makers to create more vivid manifestations of the future.
6	*Cocreation* incorporates techniques that engage users in generating, developing, and testing new ideas.
7	*Field experiments* are designed to test the key underlying and value-generating assumptions of a hypothesis in the field. Conducting these experiments involves field testing the identified assumptions using prototypes with external stakeholders, with attention to disconfirming data.

discussed in the strategy literature (Leavitt, 1986). The focus on possibilities in the ideation stage is consistent with Scharmer's (2007) work on "Theory U," and specific techniques for brainstorming are widely discussed in the creativity field (e.g., Paulus, Larey, and Dzindolet, 2001). The final hypothesis-testing stage of the design-thinking process echoes themes similar to currently popular ideas such as effectuation (Sarasvathy, 2001) and lean startup (Reis, 2011). In short, many elements in both the process and toolkit are visible elsewhere in management theory and practice. Thus, it would be hard to argue that design thinking offers a new or distinctive concept or theory of management.

However, when individual elements of design thinking are combined and viewed together as an end-to-end system for problem solving, design thinking does emerge as a distinctive *practice*, a bundle of attitudes, tools, and approaches. Orilkowski (2010) has documented the increasing interest of management scholars in the notion of practice. Viewed as a practice, design thinking provides an integrating framework that brings together both creative and analytic modes of reasoning, accompanied by a process and set of tools and techniques. There exists a coherent set of shared assumptions underlying the practice. These include beliefs related to need finding: that treating the problem, not just its solution, as a hypothesis ultimately will yield more innovative and value-added solutions; and that the risk of innovation failure will be minimized by the use of the early-stage discovery processes that attend to users' emotions as well as their functional needs. Translating these needs into design criteria provides the underpinning for the ideation stage and its belief that users' unarticulated needs and desires are the foundation of differentiated value propositions. Thus, conducting research to inspire better hypotheses, rather than merely to test them, will result in improved outcomes. There are also assumptions behind the third stage that, in an environment of uncertainty, experimentation will be superior to analytics as a decision-making approach; that continued learning and the iteration of hypotheses will reduce risk and improve success rates in the innovation process; and that the use of low fidelity prototypes will increase the accuracy of feedback from potential customers when used in conjunction with small marketplace experiments.

Researching the Practice of Design Thinking

Despite this consensus on the core processes and tools involved in design thinking, the task of bringing rigorous empirical testing to assess the outcomes produced by a practice comprised multiple and diverse stages and tools, and establishing causality with complex multidimensional outcomes like innovation performance is a challenging one. Recently, systematic fieldwork has begun to emerge that seeks to explore the use of design-thinking methodologies in practice as used by nondesigners. For instance, Seidel and Fixson (2013) review the performance of design methodologies as practiced by 14 novice multidisciplinary product development teams, finding that combined methods and attention to more reflective practices are key to producing more innovative outcomes. Wattanasupachoke (2012) studied Thai businesses, exploring the self-reported relationship between the use of design methodologies and firm performance, finding that usage increased the firms' innovativeness scores but did not relate directly to firm performance. Carlgren (2013) and her colleagues Elmquist and Rauth studied the implementation of design thinking across an array of firms and explored it in depth in a health-care delivery organization, examining the link between organizational culture and the implementation of design thinking, and finding evidence of performance improvements beyond the innovativeness of the solutions the method produced.

As we explore how to expand this research, we can look to a larger body of work available on the study of other practices. Orilkowski (2010) has argued that a practice may be studied from three perspectives: with an emphasis on the phenomenon of practice, or on the perspective of practice, or on its philosophy and ontology. All three are possibly fruitful avenues for the study of design thinking. In the remainder of this essay, I will focus on the phenomenon of practice lens. Within this, design thinking can be studied in multiple ways: it might be compared with other problem-solving approaches, with an eye toward identification of the specific environmental and organizational conditions under which it yields superior outcomes, or conversely, its integration with other organizational approaches could be examined. Even at this level, researchers must make choices in how to frame their focus: do they want to examine design thinking as a unified concept, including its philosophy and inclusive of an end-to-end process and a complete toolkit; or, instead, to examine particular tools or elements of the process? A diversity of levels could be addressed as well: the practice could be examined at the level of the individual, the team, or the organization. For instance, how does design thinking impact organizational or team sense making? Or facilitate different organizational or team learning outcomes? At the individual level, questions related to its impact on affect or on

Table 3. Flaws in Cognitive Processing and Their Consequences for Innovative Problem Solving

Cognitive Bias	Description	Innovation Consequences
Projection bias	Projection of past into future	Failure to generate novel ideas
Egocentric empathy gap	Projection of own preferences onto others	Failure to generate value-creating ideas
Focusing illusion	Overemphasis on particular elements	Failure to generate a broad range of ideas
Hot/cold gap	Current state colors assessment of future state	Undervaluing or overvaluing ideas
Say/do gap	Inability to accurately describe own preferences	Inability to accurately articulate and assess future wants and needs
Planning fallacy	Overoptimism	Overcommitment to inferior ideas
Hypothesis confirmation bias	Look for confirmation of hypothesis	Disconfirming data missed
Endowment effect	Attachment to first solutions	Reduction in options considered
Availability bias	Preference for what can be easily imagined	Undervaluing of more novel ideas

psychological safety or on risk-taking behavior could be scrutinized, among many others. In fact, bringing rigorous empirical scrutiny to the design-thinking process could itself be construed as a "wicked" problem: the "problem" can be defined in many different ways (dependent upon the perspective taken by the stakeholder in question) and is situated in an environment of sufficient complexity that definitive arguments for any one "best" approach would clearly be foolish—a case can be made for any of these research approaches.

Because my aim in this essay is to accelerate the scholarly conversation around research possibilities, I offer here a path that design thinking itself would advocate: pick a place to start that looks promising and go deep to see what you find. My "solution" (incomplete and somewhat arbitrary as I acknowledge it to be) is to look for opportunities to relate design thinking to clearly identified problems in a field with a deep empirical literature base.

My initial explorations suggest that the literature on cognitive bias offers a good place to start. It provides a well-researched body of work over more than five decades delineating the flaws of human beings as information processors. Many of design thinking's tools and processes, I will argue, ameliorate some of these human shortcomings. By grounding the practice of design thinking in the literature on humans as cognitive processors and their limitations, my aim is to use the theoretical relationships uncovered to lay the groundwork for the development of a set of propositions for further testing.

Examining the Psychological Underpinning of Design Thinking in Relationship to the Cognitive Bias Literature

In reviewing the cognitive biases literature through the lens of design-thinking practices, I have identified nine prominent and well-documented cognitive biases worth exploring more deeply: the projection bias, the egocentric empathy gap, the hot/cold gap, the focusing illusion, the say/do gap, the planning fallacy, the hypothesis confirmation bias, the endowment effect, and the availability bias. In the next section, I briefly review each of these and describe their negative consequences for decision-making when innovation is the goal. Table 3 summarizes these:

1. Projection Bias: A "projection bias" is evidenced in a tendency to project the present into the future (Loewenstein and Angner, 2003). Such "naive realism" results in predictions that are too regressive and too biased toward the present. Gilbert, Gill, and Wilson (2002) describe a similar behavior that they term *presentism*, which they define as a "tendency to over-estimate the extent to which their future experience of an event will resemble their current experience of an event." This projection of a decision-maker's past into attempts to imagine a new future impedes the development of novel ideas as well as accurate assessment of their likelihood of success.
2. Egocentric Empathy Gap: Other researchers (Van Boven, Dunning, and Loewenstein, 2000) document what they call an "egocentric empathy gap," which causes decision-makers to consistently overestimate the similarity between what they value and what others value. In fact, Van Boven and Loewenstein (2003) argue that "a venerable tradition in social psychology has documented people's tendency to project their own thoughts, preferences, and behaviors onto other people." In the literature on motivated information processing, Nickerson (1998) has noted the "pervasive human tendency to selectively perceive, encode, and retain information that is congruent with one's desires" and linked it with both problematic idea generation and testing. This results in the creation of new ideas that the creators find valuable, but that those

they seek to serve do not, and also makes assessment of the likelihood of success problematic.

3. Hot/Cold Gap: Decision-makers' state at the time of the prediction, whether emotion-laden (hot) or not (cold), unduly influences their assessment of the potential value of an idea, leading them to either under- or overvalue ideas (Loewenstein and Angner, 2003). For example, decision-makers' current enthusiasm over an idea can impede the accuracy of their prediction of how others will react (or even how they themselves will react) in the future when their state is likely to be less "hot."
4. Focusing Illusion: Another dysfunction that Loewenstein and Angner (2003) describe is a "focusing illusion," in which decision-makers tend to overestimate the effect of one factor at the expense of others, overreacting to specific stimuli, and ignoring others. This can impact either hypothesis generation or testing, and results in a narrowed, and potentially less attractive, set of ideas.
5. Say/Do Gap: Innovators have long sought to compensate for these prediction problems by *asking* users what they want. Unfortunately, this, too, has proven to be problematic in a phenomenon that some call the "say/do" gap. Consumers are frequently unable to accurately describe their own current behavior, much less make reliable predictions (Fellmann, 1999). Morwitz, Steckel, and Gupta (1997) perform a meta-analysis of over 100 studies and conclude that consumers were not reliable predictors of their own purchase behavior for any type of goods studied. Even focus groups, the gold standard in marketing research for decades, have a high error rate and routinely fail to perform satisfactorily.
6. The Planning Fallacy: Even when decision-makers succeed at creating new ideas, they are overly optimistic about how well-received these ideas will be because of what Kahneman and Tversky (1979) term the "planning fallacy." This tendency toward a rosy view of the future is well documented. In multiple studies, people routinely describe their pasts as balanced and consisting of both positive and negative events, yet predict their futures as consisting of overwhelmingly positive events (Armor and Taylor, 1998). These views only rarely include considerations of failures, except in the cases of clinically depressed subjects (Newby-Clark and Ross, 2003). This same overconfidence and unfounded optimism has been found to extend to organizational planning processes (Larwood and Whittaker, 1977).
7. Hypothesis Confirmation Bias: In the well-recognized "hypothesis confirmation bias" (Snyder and Swan, 1978), decision-makers seek explanations that coincide with their preferred alternative. They search for facts, as Gilbert (2006) notes, which *allow* them to build faith in favored solutions, whereas they must be *compelled* by data to believe that which points to a less favored one. Similarly, Ditto and Lopez (1992) demonstrate that decision-makers use different levels of intensity in processing information consistent with their preferences versus that which contradicts their preconceived perceptions. Information challenging any perception is more likely to be heavily scrutinized than information agreeing with the preferred solution, and alternative explanations that allow decision-makers to ignore this disconfirming data are often pursued. They summarize: "People are less critical consumers of preference-consistent than preference-inconsistent information." Even when decision-makers' bias is revealed to them, they often fail to correct it, as Gilbert and Jones (1986) conclude after a series of experiments: "We do indeed subscribe to the social realities we construct, even when we are well aware that we have constructed them."
8. The Endowment Effect: In a similar vein, Kahneman, Knetsch, and Thaler (1991) identify an "endowment effect" in which decision-makers' attachment to what they already have causes a loss aversion that makes giving something up (e.g., the solution in hand) more painful than the pleasure of getting something new, in this case a new and improved solution (Kahneman, 2011).
9. The Availability Bias: Kahneman and Tversky (1979) also identify an "availability bias" in which decision-makers undervalue options that are harder for them to imagine. Because the familiarity of an idea is likely to be inversely related to its novelty, this leads to a preference for more incremental solutions.

Thus, would-be innovators seeking to produce and assess more novel, value-creating, and differentiated ideas face significant challenges from different sources of cognitive bias.

Linking Design Thinking to Cognitive Bias Reduction

Fortunately, researchers have also documented myriad strategies for mitigating these dysfunctions—and many of these remedies overlap dramatically with the processes and tools emphasized in a design-thinking approach.

Table 4. Biases, Remedies, and Design-thinking Process and Tools

Biases	Remedies	Need Finding	Ideation	Experimentation
Category 1 bias (projection, egocentric empathy, focusing, and hot/cold gap)	1. Collect deep data on others	Perspective-taking ethnography (journey mapping and job-to-be-done analysis)		
	2. Improve ability to imagine experiences of others	Visualization (storytelling and metaphor)		
	3. Work in teams	Sense-making tools	Collaborative ideation tools	Disconfirming data focus
Category 2 bias (say/do gap)	1. Improve users' ability to identify and assess their own needs	Journey mapping Projective techniques		
	2. Use methods that do not rely on users imagining their needs and solutions	Participant observation		
Category 3 bias (planning fallacy, confirmation, endowment, and availability)	1. Help decision-makers become better testers	Perspective-taking ethnography		Assumption testing and prototyping to create "preexperience"
	2. Work with multiple options		Creating multiple options	Testing multiple options
	3. Conduct reflection on results of real experiments			Field experiments act as after-event review (AER)

Consequently, I want to advance a set of propositions about the ways in which design thinking, when understood in detail at the practice level, provides a series of mechanisms well suited to ameliorating negative outcomes introduced by the aforementioned cognitive biases of decision-makers. In doing so, I assert, it is likely to improve the novelty, value, and breadth of ideas generated, plus the quality of their evaluation. In this next section, I lay out this argument in detail and cite the supporting literature. Table 4 summarizes my thesis, describing the cognitive biases, suggested remedies, and the specific design processes and tools that address them.

How Design Thinking Reduces Cognitive Bias

In order to simplify the discussion of the specifics of how and why design thinking plays a role in increasing positive innovation outcomes by reducing bias, I begin by sorting the nine biases into three discrete categories: the first category of biases relate to decision-makers' inability to see beyond themselves and escape their own pasts (projection bias), current state (hot/cold gap), personal preferences (egocentric empathy gap), and tendency to be unduly influenced by specific factors (focusing illusion). A second category of bias relates not to decision-makers themselves, but to the inability of their users or customers to articulate future needs and provide accurate feedback on new ideas, making it difficult to develop value-creating ideas for them (say/do gap). Finally, a third category of biases relates to flaws in decision-makers' ability to test the hypotheses they have developed. They are unimaginative (availability bias), overly optimistic (planning fallacy), and wedded to initial (endowment effect) and preferred (hypothesis confirmation bias) solutions. Based on these categories, I can now discuss remedies suggested by cognitive bias researchers and relate these to design-thinking processes and tools in order to arrive at a set of propositions.

Mitigating Biases in Idea Generation

Category 1 biases relate to the proclivity of decision-makers to become trapped in their own world view—whether the source be their past (as in the projection bias), their personal preferences (egocentric empathy gap), their emotional state (hot/cold gap), or their particular perspective (focusing illusion). Design thinking mitigates the impact of these biases as follows:

> *Proposition 1: By insisting on the collection of deep data on customers' concerns and perspectives as central in*

the need finding stage, design thinking mitigates the effects of the projection, egocentric empathy, focusing, and hot/cold biases.

The development of perspective-taking skills (understanding and adopting the viewpoints of others) is offered by cognitive researchers as one remedy for category 1 biases. Researchers have demonstrated that this has a positive effect on the generation of new ideas (Galinsky, Maddux, Gilin, and White, 2008), particularly along the usefulness versus novelty dimension (Mohrman, Gibson, and Mohrman, 2001). Grant and Berry (2011) go further in their research to establish perspective taking as a mediating factor that determines whether intrinsic motivation is likely to produce only novel ideas versus those that are both novel and useful. They argue for the benefits of "prosocial" motivation, in which the decision-maker is oriented toward solving the needs of others, as distinct and as more valuable for improving innovation outcomes than intrinsic motivation that is self-motivated. Ethnography, a core need-finding tool in the design-thinking process, is a research practice aimed at understanding the perspective of others. Where decision-makers have difficulty seeing novel solutions and figuring out what users will value, researchers have repeatedly identified ethnography as a potential remedy (Mariampolski, 1999). Krippendorff (2011) argues that innovators need a "second-order understanding" that "assumes that others' understanding is potentially different from one's own." Ethnography has been revived in marketing circles, Mariampolski asserts, as a way to compensate for the failure of focus groups and quantitative methodologies, and is especially valuable when innovative insights are desired. By immersing decision-makers in collecting data about the experience of someone other than themselves, by developing first hand a deep and visceral understanding of others' past, preferences, perspectives, and emotional state, decision-makers' reliance on themselves as the prime source of information is reduced. Through ethnographic approaches like journey mapping, participant observation, and job-to-be-done analyses, decision-makers develop a deep understanding of users' current situation and needs before moving to the creation of solutions. This emphasis mitigates the following biases:

- The projection bias because by immersing themselves in the user's experience, decision-makers are less likely to look exclusively to their own past experiences as the source of new ideas, thus producing more novel ideas.
- The egocentric empathy gap by providing data that helps decision-makers recognize that users' preferences differ from their own, fostering the creation of more valuable ideas.
- The focusing illusion by encouraging a broader perspective that mitigates the narrowed attention focus, thus introducing a broader array of alternatives.

Proposition 2: By improving decision-makers' ability to better imagine the experiences of others in the need-finding stage, design thinking mitigates the effects of the projection, egocentric empathy, focusing, and hot/cold biases.

A second remedy for category 1 biases is improving decision-makers' ability to *imagine* the experience of those other than themselves, even in the absence of first-hand data gathering. The use of storytelling and metaphor, two key design tools, enhances decision-makers' imaginative abilities. The increased use of stories—rather than merely presenting data—has been cited by researchers as a remedy for cognitive bias because it encourages decision-makers to attend to and make sense of data that would otherwise be missed. Kahneman (2011) notes that the coherence and concreteness of stories—stories about "agents who have personalities, habits, and abilities"—attracts people. Pennington and Hastie (1986) also advocate for the power of narrative. In design thinking, visualization methods like storytelling boost decision-makers' ability to envision experiences outside of their own. Storytelling, often partnered with ethnography, improves the novelty and value of the ideas generated by helping decision-makers take in and hold onto the rich details of the lives of those for whom they seek to create value.

Metaphor, another visualization technique, is helpful as well. Lakoff and Johnson (1985) argue that "on the basis of linguistic evidence, we have found that most of our ordinary conceptual system is metaphorical in nature." Imagining and creating metaphors, they argue, plays a major role in helping humans make sense of their experiences, understand past experiences, and act as a guide to future ones. They describe metaphors as acts of "imaginative rationality." Metaphor is another one of design thinking's frequently used visualization tools; it stimulates decision-makers' imaginations, thereby reducing reliance on the past (the projection bias), broadening their field of vision (avoiding the focusing illusion), and acknowledging different preferences (the egocentric empathy gap) to produce more novel and valuable ideas.

Proposition 3: By insisting that innovation tasks be carried out by diverse, multifunctional teams, design

thinking mitigates the effects of the projection, egocentric empathy, focusing, and hot/cold biases.

A third alternative in the decision-making literature to reduce reliance on self is to work in teams—preferably diverse multidisciplinary ones. By exposing decision-makers to the perspectives and preferences of their colleagues, it allows them to contrast their own perspectives with those of other decision-makers. Madjar, Oldham, and Pratt (2002) demonstrate that interactions with others from diverse backgrounds improves the creativity of individual responses. The team learning literature makes a similar point (Boland and Tenkasi, 1995; Somech and Drach-Zahavy, 2013). Throughout design-thinking processes, collaboration across diversity is central and tools are provided to facilitate it. Visualization captures individual ideas on post-it notes and whiteboards so they can be shared and developed jointly. Cocreation invites others into the processes of both idea generation and testing. Structured sense making and brainstorming tools facilitate team-based processes for drawing insights from ethnographic data. In addition, design values like withholding judgment, avoiding debates, and paying particular attention to disconfirming data and the tensions difference creates encourage more innovative team solutions.

In summary, design thinking, with its emphasis on need finding as a preliminary to decision-making; its array of tools for ethnography, visualization, and the use of metaphor; and its toolkit for collaboration across diverse teams, lessens the effects of the projection, egocentric empathy, and focusing illusion biases, leading to more novel, valuable, and a broader array of solutions.

Mitigating Biases Introduced by Customers

In *category 2*, the source of the bias lies with the user or customer, rather than the decision-maker, and derives from the customer's inability to accurately describe his or her needs and assess whether any particular approach succeeds in meeting them. Design thinking mitigates the impact of these biases as follows:

Proposition 4: By using qualitative methodologies and prototyping tools, design thinking improves customers' ability to identify and assess their own needs, mitigating the effects of the say/do bias.

Design thinking's use of qualitative research methodologies that focus on questioning customers about *behaviors*, rather than preferences and desires, helps them identify their own needs more successfully and assess them more accurately (Mariampolski, 1999). Academic researchers have long relied on the insight that people "know more than they can say" and have used talk-aloud protocols to elicit deeper insights (Van Someren, Barnard, and Sandberg, 1994). In design thinking's need-finding stage, tools like journey mapping and job-to-be-done analyses ask customers what they sought to accomplish in a relevant situation and request that they recount an actual experience, describing their thoughts, reactions, and satisfaction at each step. This facilitates identification of needs that customers cannot easily articulate. Projective tools like collages are used in design research to accomplish similar goals.

Another approach to eliciting more accurate feedback is to activate more vivid mental images of the new future that help customers "preexperience" something novel. Thus, the reaction of decision-makers to mental images of the future can be an effective proxy for the real thing, improving the accuracy of their forecasting. Atance and O'Niell (2001) contend that motivating an individual "to pre-experience the unfolding of a future plan of events from a personal perspective" results in more accurate assessment and note that new evidence emerging out of neuropsychological research that planning for a personal future involves different parts of the brain. Gilbert et al. (2002) agree, citing multiple sources that decision-makers' assessments of their reaction to imaginary events activate many of the same neurological pathways and thus can stand in for the events themselves. They note that "just as mental images are proxies for actual events, so our reactions to these mental images may serve as proxies for our actual reactions to the events themselves." The effects can be even more powerful than improved assessment, as Johnson and Sherman (1990) note: "Specifying a particular future for people to think about not only increases judgments of the likelihood of such a future but affects actual subsequent behavior as well." Increased motivation to achieve the future seems to be at work. Subjects asked to explicitly state their expectations beforehand actually performed better on experimental tasks (Sherman, Skov, Hervitz, and Stock, 1981). In design thinking, providing prototypes aids preexperiencing by providing a concrete and tangible artifact that allows decision-makers to create more vivid manifestations of the future. Whether in the form of storyboards, journey maps, user scenarios, or business concept illustrations, low-fidelity and often two-dimensional prototypes offer specific tools to make new ideas tangible and, hence, solicit more accurate feedback.

Proposition 5: By using methods that do not rely on users' ability to diagnose their own preferences, design thinking mitigates the effects of the say/do gap.

A second approach offered by cognitive researchers to mitigate the effects of the say/do gap seems obvious—use methods that do not rely solely on customers' ability to articulate present needs or imagine the ability of a solution to meet them (Mariampolski, 1999). Because it does not rely on what users say and instead includes tools like participant observation, design thinking mitigates the negative impact of the say/do gap, producing ideas likely to be more value creating.

Thus, design thinking, with its emphasis on research methods like journey mapping and tools like prototyping, assists customers/users to more accurately describe their experiences, which helps to surface unarticulated needs. Other tools like participant observation reduce the reliance on self-reports. All mitigate the say/do gap, leading to the creation of more valuable ideas and more accurate feedback.

Mitigating Biases in Testing

Category 3 bias relates to flaws in decision-makers' hypothesis testing abilities. These may relate to overoptimism (the planning fallacy), inability to see disconfirming data (hypothesis confirmation bias), attachment to early solutions (endowment effect), or preference for the easily imagined (availability bias). Design thinking mitigates the impact of these biases as follows:

> *Proposition 6: By teaching decision-makers how to be better hypothesis testers, design thinking mitigates the effects of the planning fallacy, confirmation, endowment, and availability biases. It does this by insisting that they prototype, surface unarticulated assumptions, and actively seek disconfirming data.*

One way the accuracy of testers' assessment can be improved is by creating the same kind of vivid "preexperience" that improves users' feedback, thereby reducing the availability bias by helping innovators themselves (as well as their customers) to imagine novel ideas more easily. In creating this "preexperience," details and specificity matter greatly. Committing not just to the *goal* of taking needed medication daily, but also to the *specifics* of when and where the pills would be swallowed produce more consistent pill taking (Sheeran and Orbell, 1999). The same researchers studied the impact of defining hypothetical success and failure, with and without expectancies. They found that respondents who explained hypothetical successes succeeded more often than those who explained failures, but those who explained failure and yet were not fully committed to a set of expectancies performed best of all. Johnson and Sherman (1990) describe a similar phenomenon: "It is as though the accessible possibility of failure motivated them to avoid such an outcome by putting more effort into the task. Small doses of potential future failure may act to inoculate people against such a future by preparing them to behave in ways so as to avoid the outcome." Such mental planning—cognitive rehearsal—is capable of changing behavior. Hypothesis-testing methodologies in design thinking provide such cognitive rehearsals. Surfacing explicit assumptions forces testers to describe in detail their expectancies and then to describe what data that supported or nullified these assumptions might look like, reducing overoptimism (the planning fallacy) and assisting in the search for disconfirming data (the hypothesis confirmation bias). Thus, design's hypothesis-driven approach emphasizing assumption surfacing improves the accuracy of testing. Articulating in detail the individual assumptions underlying any new idea, so they can be tested as well as identifying what disconfirming data would look like, acts to mitigate category 3 cognitive bias.

> *Proposition 7: By insisting that decision-makers work with multiple options, design thinking mitigates the effects of the planning fallacy, the hypothesis confirmation bias, and the endowment effect.*

Getting decision-makers to consider—and explain—a range of possible outcomes improves the accuracy of their predictions. Considering multiple predictions of the future, rather than a single one, has been demonstrated to mitigate overoptimism (planning fallacy). When subjects in experiments conducted by Griffin, Dunning, and Ross (1990) were asked to create multiple construals of potential future situations, they were significantly less likely to exhibit the overconfidence that characterized other subjects. In a similar vein, Anderson (1982) demonstrated that the hypothesis confirmation bias effect is also greatly reduced when respondents are asked to perform counterexplanation tasks. Klein (1998) calls this a "premortem." This also mitigates the endowment effect, as *despite* attachments to first solutions, testers are forced to move multiple solutions into active testing. Thus, the idea of optionality, a core element of a design-thinking approach, with its insistence on generating and evaluating multiple hypotheses, provides a positive mechanism for lessening the effects of the planning fallacy, the hypothesis confirmation bias, and the endowment effect.

> *Proposition 8: By insisting that decision-makers conduct and reflect on the results of marketplace experiments, design thinking mitigates the effects of category 3 biases.*

Conducting and then reflecting on experimental results simulates a kind of "after-event review" (AER), which researchers have proven improves future performance. Ellis and Davidi (2005) demonstrate that reviewing both successes and failures is beneficial when understanding *why* events happen as they do is important (which is, of course, the underlying logic of assumption testing). Ellis and Davidi define learning as the "process of formulating and updating mental models" of "noticing new variables that are relevant to explaining and predicting various social phenomena or, in other words, the process of hypothesis generation and validation." They concur with Sitkin (1992) that learning from success happens less naturally and requires more motivation and effort to replicate than learning from failure. Finally, researchers report that knowing the *general* cause of any outcome is less useful in improving future performance than knowing a *specific* cause, hence the importance of reflecting on detailed and explicit assumptions, rather than general ones. One of the important by-products of AERs is the nature of feedback received and its specificity to the process of task performance. Ansell, Lievens, and Schollaert (2009) demonstrate that "effortful" reflection, in conjunction with external feedback, accelerates performance. Reflection without external feedback does not, and the depth and focus involved in the reflection process matters to performance improvement.

Design thinking conducts field experiments to test clearly identified assumptions, presenting prototypes to external users, ideally in real market contexts, which fulfills the function of AERs. The emphasis on testing with actual customers, rather than in artificial environments like traditional focus groups, provides specific external feedback that aids decision-makers in their reflection processes. These experiments provide a particularly vivid form of "action" that creates the input for after-action reviews. Making specific assumptions testable introduces additional rigor. Design thinking's field experiments are not pilots in which revenues (or their lack) are the only outcomes evaluated. They are true field experiments in which specific assumptions concerning value creation, execution, defensibility, and scalability are evaluated (Liedtka and Ogilvie, 2011). Because the outcomes of the assumption tests reflect on and are used to reject or improve the hypothesized idea for the next round of testing, "effortful" after-action reviews are embedded in the design approach. Finally, the prescriptions offered earlier to address biases in idea generation also mitigate the effects of testing bias: perspective taking, and its related ethnographic methods, has been demonstrated to address confirmation bias as well (Nickerson, 1998).

Thus, design thinking, with its emphasis on prototyping to create more vivid "preexperiences," and the explicit identification of detailed assumptions mitigates the effects of category 3 testing biases. In addition, the gathering of market feedback through field experiments to stimulate AERs, and the insistence on reflection in order to iterate toward improved solutions, should produce a similar effect. Coupled with ethnographic methods, they lessen the effects of the planning fallacy, hypothesis confirmation bias, endowment effect, and availability bias, increasing the array of options considered and reducing the undervaluing of more novel alternatives.

Discussion and Limitations

The propositions offered here are mere starting points. The possible negative effects design-thinking approaches may produce, for instance, have not been addressed. Phenomena like "groupthink" in which groups adopt practices that enhance rather than reduce bias must be considered. How can design thinking avoid this? Similarly, research demonstrates that too much information reduces the quality of decisions—what might be the effect of the torrent of data produced by ethnographic methods? Seidel and Fixson (2013) demonstrate that individual tools like brainstorming, in the absence of reflection, fail to improve innovation quality. Clearly, research studies are needed that can rigorously assess whether, in fact, these benefits I hypothesize bear out in practice and whether unanticipated negative outcomes increase. Grounding design-thinking research in the well-respected cognitive bias framework, however, provides future researchers a clearly specified and well-documented place to begin. Such work offers a set of well-tested research methodologies as well as accepted metrics for calibrating variables.

The approach I advocate here represents one route for meeting the "wicked" challenges of conducting academic research on a practice like design thinking, one that is obviously popular in management circles but appears resistant to rigorous empirical inquiry because of the multifaceted nature of its "basket" of tools and processes, and the complexity of measuring the outcomes it produces.

Conclusion

A review of the literature on design thinking suggests that it is a management practice deserving of increased atten-

tion from scholars. An examination of both theoretical work and actual management practice reveals a process that is both internally consistent and coherent and that constitutes a distinctive practice.

In a related sphere, a review of the decision-making literature surrounding cognitive bias suggests that design-thinking practices carry the potential for improving innovation outcomes by mitigating a well-known set of cognitive flaws: humans often project their own world view onto others, limit the options considered, and ignore disconfirming data. They tend toward overconfidence in their predictions, regularly terminate the search process prematurely, and become overinvested in their early solutions—all of which impair the quality of hypothesis generation and testing.

A design-thinking methodology, I have suggested, may help decision-makers address many of these inadequacies. As researchers intent on improving practice, we have an obligation to explore whether these assertions bear out in reality so that, as educators, we can help managers more effectively address what is clearly one of the great challenges organizations face today: the imperative to improve the value of the innovations they bring to market.

In keeping with the "wicked" nature of the problem I explore, I have pursued an agenda focused on the impact of design thinking in relation to cognitive bias, but I believe that other literatures—team learning and positive affect, for instance—hold similar promise for hypothesizing why design thinking works. My aim in this essay has been twofold: first, to suggest one initial direction that may prove fruitful and, more importantly, to demonstrate that this is work worth undertaking.

References

Anderson, C. A. 1982. Inoculation and counter-explanation: Debiasing techniques in the perseverance of social theories. *Social Cognition* 1: 126–39.

Ansell, F., F. Lievens, and E. Schollaert. 2009. Reflection as a strategy to enhance task performance after feedback. *Organizational Behavior and Human Decision Processes* 110: 23–35.

Armor, D. A., and S. E. Taylor. 1998. Situated optimism: Specific outcome expectancies and self-regulation. In *Advances in experimental social psychology*, ed. M. P. Zanna, 30, 309–79. New York: Academic Press.

Atance, C. M., and D. K. O'Niell. 2001. Episodic future thinking. *Trends in Cognitive Sciences* 5 (12): 533–39.

Bazjanac, V. 1974. Architectural design theory: Models of the design process. In *Basic questions of design theory*, ed. W. Spillers, 3–20. New York: American Elsevier.

Beckman, S., and M. Barry. 2007. Innovation as a learning process: Embedding design thinking. *California Management Review* 50 (1): 25–56.

Bloch, P. 2011. Product design and marketing: Reflections after fifteen years. *Journal of Product Innovation Management* 28: 378–80.

Boland, R. J., and R. V. Tenkasi. 1995. Perspective making and perspective taking in communities of knowing. *Organization Science* 6 (4): 350–72.

Brown, T. 2009. *Change by design: How design thinking transforms organizations and inspires innovation*. New York: Harper-Collins.

Buchanan, R. 1992. Wicked problems in design thinking. *Design Issues* 8 (2): 5–21.

Carlgren, L. 2013. Design thinking as an enabler of innovation: Exploring the concept and its relation to building innovation capabilities. PhD thesis, Chalmers University of Technology.

Cooper, R., S. Juninger, and T. Lockwood. 2009. Design thinking and design management: A research and practice perspective. In *Design thinking: Integrating innovation, customer experience, and brand value* (3rd ed.), ed. T. Lockwood, 57–64. New York: Allworth Press.

Cross, N. 1995. Discovering design ability. In *Discovering design*, ed. R. Buchanan and V. Margolin, 105–20. Chicago, IL: University of Chicago Press.

Ditto, P. H., and D. F. Lopez. 1992. Motivated skepticism: Use of differential decision criteria for preferred and nonpreferred conclusions. *Journal of Personality and Social Psychology* 63 (4): 568–84.

Elliott, R., and N. Jankel-Elliott. 2003. Using ethnography in strategic consumer research. *Qualitative Market Research* 6 (4): 215–23.

Ellis, S., and I. Davidi. 2005. After-event reviews: Drawing lessons from successful and failed experience. *Journal of Applied Psychology* 90 (5): 857–71.

Fellmann, M. 1999. Breaking tradition. *Marketing Research* 11 (3): 20–25.

Galinsky, A., W. Maddux, D. Gilin, and J. B. White. 2008. Why it pays to get inside the head of your opponent the differential effects of perspective taking and empathy in negotiations. *Psychological Science* 19 (4): 378–84.

Garud, R., S. Jain, and P. Tuertscher. 2008. Designing for incompleteness; incompleteness by design. *Organization Studies* 29 (3): 351–71.

Gilbert, D. 2006. *Stumbling on happiness*. New York: Alfred Knopf.

Gilbert, D. T., and E. E. Jones. 1986. Perceiver-induced constraint: Interpretations of self-generated reality. *Journal of Personality and Social Psychology* 50 (2): 269–80.

Gilbert, D. T., J. J. Gill, and T. D. Wilson. 2002. The future is now: Temporal correction in affective forecasting. *Organizational Behavior and Human Decision Processes* 88 (1): 430–44.

Grant, A., and J. Berry. 2011. The necessity of others is the mother of invention: Intrinsic and prosocial motivations, perspective taking, and creativity. *Academy of Management Journal* 54 (1): 73–96.

Griffin, D. W., D. Dunning, and L. Ross. 1990. The role of construal processes in overconfident predictions about the self and others. *Journal of Personality and Social Psychology* 59 (6): 1128–39.

Hackman, J., and R. Wageman. 1995. Total quality management: Empirical, conceptual, and practical issues. *Administrative Science Quarterly* 40 (2): 309–42.

Johansson, U., J. Woodilla, and M. Cetinkaya. 2011. The emperor's new clothes or the magic wand? The past, present and future of design thinking. *Proceedings of the 1st Cambridge Academic Design Management Conference*, Cambridge, UK.

Johnson, M. K., and S. J. Sherman. 1990. Constructing and reconstructing the past and the future in the present. In *Handbook of motivation and cognition: Foundations of social behavior*, ed. E. T. Higgins and R. M. Sorrention, 2, 482–526. New York: The Guilford Press.

Kahneman, D. 2011. *Thinking, fast and slow*. New York: Farrar, Straus and Giroux.

Kahneman, D., and A. Tversky. 1979. Intuitive prediction: Biases and corrective procedures. *Management Science* 12: 313–27.

Kahneman, D., J. L. Knetsch, and R. Thaler. 1991. Anomalies: The endowment effect, loss aversion, and status quo bias. *Journal of Economic Perspectives* 5: 193–206.

Kelley, T., and J. Littman. 2005. *The ten faces of innovation: IDEO's strategies for beating the devil's advocate and driving creativity throughout your organization*. New York: Doubleday.

Klein, G. 1998. *How people makes decisions*. Boston, MA: MIT Press.

Krippendorff, C. 2011. Principles of design and a trajectory of artificiality. *Journal of Product Innovation Management* 28: 411–18.

Lakoff, G., and M. Johnson. 1985. *Metaphors we live by*. Chicago, IL: University of Chicago Press.

Larwood, L., and W. Whittaker. 1977. Managerial myopia: Self-serving biases in organizational planning. *Journal of Applied Psychology* 62 (2): 194–98.

Leavitt, H. 1986. *Corporate pathfinders*. Homewood, IL: Dow Jones-Irwin.

Leonard, D., and J. Rayport. 1997. Spark innovation through empathic design. *Harvard Business Review* 75 (6): 102–13.

Liedtka, J. 2000. In defense of strategy as design. *California Management Review* 42 (3): 8–30.

Liedtka, J., and T. Ogilvie. 2011. *Designing for growth*. New York: Columbia Business Press.

Lindberg, T., E. Koppen, I. Rauth, and C. Meinel. 2012. On the perception, adoption and implementation of design thinking in the IT. In *Design thinking research*, ed. H. Plattner, C. Meinel, and L. Leifer, 229–40. Heidelberg, Germany: Industry Springer Berlin Heidelberg.

Lockwood, T., ed. 2009. *Design thinking: Integrating innovation, customer experience, and brand value* (3rd ed.). New York: Allworth Press.

Loewenstein, G., and E. Angner. 2003. Predicting and indulging changing preferences. In *Time and decision: Economic and psychological perspectives on intertemporal choice*, ed. G. Loewenstein, D. Read, and R. Baumeister, 12, 351–91. New York: Russell Sage Foundation.

Luchs, M., and K. Swan. 2011. Perspective: The emergence of product design as a field of marketing inquiry. *Journal of Product Innovation Management* 28: 327–45.

Madjar, N., G. Oldham, and M. Pratt. 2002. There's no place like home? The contributions of work and nonwork creativity support to employees' creative performance. *Academy of Management Journal* 45 (4): 757–67.

March, L. 1976. *The architecture of form*. Cambridge, U.K.: Cambridge University Press.

Mariampolski, H. 1999. The power of ethnography. *Journal of the Market Research Society* 41 (1): 75–85.

Martin, R. 2009. *The design of business: Why design thinking is the next competitive advantage*. Boston, MA: Harvard Business Press.

Mohrman, S., C. Gibson, and A. Mohrman. 2001. Doing research that is useful to practice: A model and empirical exploration. *Academy of Management Journal* 44: 1085–100.

Moreau, G. 2011. Inviting the amateurs into the studio. *Journal of Product Innovation Management* 28: 409–10.

Morwitz, V., J. Steckel, and A. Gupta. 1997. *When do purchase intentions predict sales?* Cambridge, MA: The Marketing Science Institute.

Newby-Clark, I. R., and M. Ross. 2003. Conceiving the past and future. *Personality and Social Psychology Bulletin* 29 (7): 807–18.

Nickerson, R. 1998. Confirmation bias: A ubiquitous phenomenon in many guises. *Review of General Psychology* 2: 175–220.

Orilkowski, W. 2010. Engaging practice in research. In *The Cambridge handbook on strategy as practice*, ed. D. Golsorkhi, L. Rouleau, D. Seidl, and E. Varra, 23–33. Cambridge, U.K.: Cambridge University Press.

Owen, C. 2007. Design thinking: Notes on its nature and use. *Research Quarterly* 2 (1): 16–27.

Patnaik, C., and P. Mortensen. 2009. *Wired to care: How companies prosper when they create widespread empathy*. Upper Saddle River, NJ: FT Press.

Paulus, P., T. Larey, and M. Dzindolet. 2001. Creativity in groups and teams. In *Groups at work: Advances in theory and research*, ed. M. Turner, 319–38. Mahwah, NJ: Erlbaum.

Pennington, N., and R. Hastie. 1986. Evidence evaluation in complex decision-making. *Journal of Personality and Social Psychology* 51 (2): 242–58.

Pink, D. 2005. *A whole new mind: Why right-brainers will rule the future*. New York: Riverhead Books, Penguin Group.

Reis, E. 2011. *The lean startup: How today's entrepreneurs use continuous innovation to create radically successful businesses*. New York: Crown Business.

Rittel, H. 1972. On the planning crisis: Systems analysis of the first and second generations. *Institute of Urban and Regional Development* 8: 390–96.

Rowe, P. 1987. *Design thinking*. Cambridge, MA: The MIT Press.

Sarasvathy, S. 2001. Causation and effectuation. *Academy of Management Review* 26 (2): 243–65.

Scharmer, O. 2007. *Theory U leading from the future as it emerges*. Cambridge, MA: The Society for Organizational Learning.

Schon, D. 1982. *The reflective practitioner: How professionals think in action*. New York: Basic Books.

Schrage, M. 1999. *Serious play*. Boston, MA: Harvard Business School Press.

Seidel, V., and S. Fixson. 2013. Adopting "design thinking" in novice multidisciplinary teams: The application and limits of design methods and reflexive practices. *Journal of Product Innovation Management* 30 (S1): 19–33.

Senge, P. 1990. *The fifth discipline: The art and practice of the learning organization*. New York: Doubleday.

Sheeran, P., and S. Orbell. 1999. Implementation intentions and repeated behaviors. *European Journal of Social Psychology* 29: 349–69.

Sherman, S. J., R. B. Skov, E. F. Hervitz, and C. B. Stock. 1981. The effects of explaining hypothetical future events. *Journal of Experimental Social Psychology* 17: 142–58.

Sitkin, S. B. 1992. Learning through failure: The strategy of small losses. *Research in Organizational Behavior* 14: 231.

Snyder, M., and W. B. Swan. 1978. Hypotheses testing processes in social interaction. *The Journal of Personality and Social Psychology* 36: 1202–12.

Somech, A., and A. Drach-Zahavy. 2013. Translating team creativity to innovation implementation: The role of team composition and climate for innovation. *Journal of Management* 39 (3): 684–708.

Van Boven, L., and G. Loewenstein. 2003. Social projection of transient drive states. *Personality and Social Psychology Bulletin* 29 (9): 1159–68.

Van Boven, L., D. Dunning, and G. Loewenstein. 2000. Egocentric empathy gaps between owners and buyers: Misperceptions of the endowment effect. *Journal of Personality and Social Psychology* 79 (1): 66–76.

Van Someren, M. W., Y. F. Barnard, and J. A. Sandberg. 1994. *The think aloud method: A practical guide to modeling cognitive processes*. London: Academic Press.

Verganti, R. 2009. *Design-driven innovation: Changing the rules of competition by radically innovating what things mean*. Boston, MA: Harvard Business Press.

Veryzer, R., and B. Borja de Mozota. 2005. The impact of user-oriented design on new product development: An examination of fundamental relationships. *The Journal of Product Innovation Management* 22: 128–43.

Wattanasupachoke, T. 2012. Design thinking, innovativeness and performance: An empirical examination. *International Journal of Management and Innovation* 4 (1): 1–14.