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Design Thinking: What it is and Why it Works

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ABSTRACT

"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 more creative thinking and achieving innovation and growth. Yet, it has received scant attention from business scholars, either in the form of empirical research or in the examination of its conceptual legitimacy, linkage to the academic literature on organizational decision processes, or grounding in the psychology of human cognitive processes. This paper aims to address the latter concern, the examination of the theoretical underpinnings and legitimacy of the concept, in order to advance prospects for encouraging attention of the former concern, the pursuit of rigorous empirical study of the concept in practice. We aim to accomplish this by first, examining its definition and origins. Following this, we assess "design thinking" as a concept, for convergent and divergent validity, reviewing its assumptions, principles, and key process tools. Next, we seek to establish its foundation in the literature on human decision-making, drawing on research in several areas, most particularly that of cognitive biases in decision-making. We conclude by advancing a set of research implications and generating testable hypotheses for further research.

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 (Berger, 2009; Brown, 2009; Esslinger, 2009; Fraser, 2012; Kelley & Littman, 2001; 2005; Liedtka & Ogilvie, 2011; Lockwood, 2009; Martin, 2007; 2009; Patnaik & Mortensen, 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 work has appeared in design-focused academic journals like *Design Issues*, the attention accorded to "design thinking" as a problem-solving approach within top-tier academic management publications has been scant. Though anecdotal reports are plentiful, systematic assessment of design thinking and its utility as as a problem-solving approach is limited (Cooper, Juninger & Lockwood, 2009; Johansson, Woodilla & Cetinkaya, 2011; Lindberg, Koppen, Rauth & Meinel, 2012). Is this because design thinking is merely the latest "silver bullet" in the business consulting arsenal, lacking the distinctiveness and conceptual integrity to be considered a robust concept and therefore deserving of scholarly attention? Or is it because design thinking, although conceptually coherent, has not yet been sufficiently grounded in the existing management literature to develop a set of testable hypotheses that would permit scholars too confirm or disconfirm its value to enhancing organizational performance? Our goal in this paper is to examine the origins, practices, and hypothesized value of the design thinking process, and link these to the existing organizational decision-making literature. In doing so, we hope to assess whether the concept is deserving of additional scholarly attention in the future and suggest potentially fruitful approaches for doing so.

Our plan for accomplishing this proceeds in four steps: (1) we will first review the definition, principles, and key process tools that characterize design thinking; (2) drawing from well-respected analyses of such popular management ideas as Total Quality Management (Hackman & Wageman,1995) and Scenario Planning (Schoemaker, 1993), we then assess whether the concept meets the conditions for both convergent and divergent validity, testing for coherence and distinctiveness; (3) we then examine the existing literature in the area of cognitive biases in decision making to set the stage for empirical testing by looking for linkages with the practices and tools of design thinking; (4) finally, we advance hypotheses to facilitate the assessment of its likely utility in relation to the reduction in cognitive bias. Based on these four steps, we conclude with research implications for future scholarly attention.

STEP 1: WHAT IS DESIGN THINKING?

Defining the Concept

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. The nomenclature 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 the term's current meaning as practiced in the business environment. In its current usage, the term is more appropriately attributed to the innovation consulting firm IDEO and its leadership, founder David Kelley (Kelley & Littman, 2001; 2005), and more recently, current CEO Tim Brown (Brown, 2009). IDEO's own strategy as a firm has reflected the evolution of the concept: though originally focused on product development, they have expanded their

practice to include the design of services, strategies, and even educational and other social systems.

Unfortunately, many of the early proponents and prominent practitioners have not offered a detailed definition, often alluding to design thinking as "what designers do," or "bringing designers' principles, approaches, methods, and tools to problem solving" (Brown, 2009). Seidel & Fixson (forthcoming) define it as "the application of design methods by multi-disciplinary teams to a broad range of innovation challenges." Thomas Lockwood, former president of the Design Management Institute, a leading association of design practitioners working in business, has offered perhaps the most 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).

There has been vigorous objection to the nomenclature of design thinking, particularly to the inclusion of the word "thinking." Critics like Collopy (2009) argue that the term is misleading as the design-thinking process involves both affect (rather than mere reasoning) and action (rather than mere reflection). But because no more generally acceptable term has replaced it, "design thinking" remains the popular term in use.

Intellectual Roots in Design Theory

"Design thinking," then, is a relatively new concept in the management literature. As we attempt to determine whether the concept has convergent validity, it is worth assessing what relation it bears to the broader concept of "design" itself. Design is a more established concept, long explored by design theorists in schools of architecture and design. In particular, if our

interest is in design thinking as a problem-solving approach, the literature on design as a verb (to design) - rather than a noun- is of most interest. Design, in the professional realm of its professional practice and training, is frequently associated with the noun, as in extensive discussions of topics such as the relation of form to function. Design thinking, with its process focus, however, is more related to the verb, the process of designing (Liedtka & Mintzberg, 2006). In exploring what design theory has had to say about the design process, we find that discussions of the attributes of designing as described by design theorists reveal a significant degree of both evolution in theory and commonality in approach. We now turn to a brief examination of that literature to see what it might contribute to our task of specifying more precisely what the concept of 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 only began in the mid-20th century, in tandem with developments in the fields of mathematics and systems science (both of which had a major impact on design theory). These early models (Alexander, 1964; Archer, 1963), 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." Acceptance of this orientation was short-lived, however, as it drew immediate criticism for the linearity of its processes and the simplicity of its view of design problems.

Hoerst Rittel (1972) instead 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. Linear, analytical approaches were unlikely to successfully resolve them; they must be resolved through an experimental approach that explored multiple possible solutions, he asserted. These themes of problem-centeredness,

nonlinearity, 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; therefore, learning has long been highlighted as central to the purpose of design activities (Beckman & Barry, 2007; Senge, 1990).

Rittel's work was followed by on-going and more detailed exploration of the role of the scientific method in the design process. Studies of design processes in the more recent literature almost uniformly suggest a learning-focused hypothesis-driven approach (Schon, 1983), with similarities to the traditional scientific method. Nigel 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 before solution finding.

Other theorists paid attention to the areas in which design and science diverged, namely, designers who dealt with what did not yet exist and scientists who 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 both science and design are hypothesis-driven, the design hypothesis differed from the scientific hypothesis, according the process of abduction a key role. March (1976: 49) stated:

> Science investigates extant forms. Design initiates novel forms. A scientific hypothesis is not the same thing as a design hypothesis…A speculative design cannot be determined logically, because the mode of reasoning involved is essentially abductive.

This acknowledgement of abduction as a mode of reasoning central to invention can be traced back to the pragmatist philosopher Charles Sanders Peirce, who argued that "inference to the best explanation" and "logical leaps of the mind" underlay the production of new ideas (Martin, 2009). Accompanying this emphasis on abduction was significant attention to visualization and an interest in storytelling and such nonverbal mediums as the use of graphics and imagery—not only for communicating design ideas but for generating them as well.

Another fundamental distinction between design and science lies with science's search for generalizable laws and design's interest in the particulars of individual cases. In asserting that there can be no "science" of design, Buchanan (1992) argued that "design is fundamentally concerned with the particular. Out of the specific possibilities of a concrete situation, the designer must conceive a design that will lead to this or that particular product."

A final characteristic of design widely noted by design theorists over the past sixty years is its paradoxical nature as it seeks to find higher-order solutions that accommodate seemingly opposite forces. Findeli (1990) described the designer as seeking "to perceive dualism as dialectic, to transform this antagonism into a constructive dynamic." Buchanan also (1992) situated design as a dialectic that took place at the intersection of constraint, contingency, and possibility. Csikszentmihalyi (1996) in his studies of creative individuals echoed a similar theme, noting that this same ability to accommodate contrasting beliefs lay at the core of what

differentiated these individuals: they were both playful and disciplined, imaginative yet rooted in reality, conservative while iconoclastic, passionate yet objective, and both divergent and convergent in their thinking. These same tensions would later be used to describe the process of design thinking (Owen, 2007).

In summary, looking across the last sixty years of writings in design theory, a strong convergence emerges around the characteristics of the design process: it is problem as well as solution focused, hypothesis-driven, and interested in the particular and the concrete. It relies on abduction and expects to cycle through multiple experiments that test a variety of solutions in an iterative way that actively works a variety of tensions between possibilities and constraints, and is best suited to decision contexts in which uncertainty and ambiguity are high.

There are, however, three significant changes and additions worth noting that represent important elements of design thinking as employed today in business that were not prominent in the writings of design theorists but are critical to design thinking. The first concerns *who* designs. Buchanan (1992) notes that the question of whose values matter and who ought to participate in the design process has changed over time 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, & Tuertscher (2008: 364) argue that the nature of uncertainty in the environment necessitates a kind of "generative engagement" of users:

> In contemporary environments…the distinction between designers and users has blurred, resulting in the formation of a community of co-designers who inscribe

> their own contexts into the emergent design, thereby extending it on an on-going basis in diverse and nonobvious ways.

This orientation toward co-creation 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 (Patnaik & 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. In fact, Verganti (2009) argues that the term "user-driven" is a more apt descriptor for the approach than the popularized "design thinking" term: the "design-driven" strategy he articulates for innovation emphasizes the ingenuity of the designer him or herself as the driver of choice, rather than response to customer needs or requests.

The third addition builds on design's strong emphasis on the concrete and the visual to emphasize specifically the key role of prototyping. Certainly, prototyping has long been a central feature in fields such as architecture and product development, but design thinking's view of prototyping diverges from the kind of sophisticated 3D prototypes and models traditionally seen in these fields. The function of prototyping in design thinking is to drive real world experimentation in service to learning rather than to display, persuade, or sell; these prototypes act as what Schrage (1999) calls "playgrounds" rather than "dress rehearsals."

Design and Business Theory

But to imply that design as a process has been explored only by design theorists in architecture and design schools and ignored in business would be misleading. The idea of

designing specific objects such as new products, software, or structures (including organizational structures) has been well attended to in the management literature and a review of these would make this paper's already lengthy reference list considerably longer (Brown & Eisenhardt, 1995; Romme, 2003; Veryzer & Borja de Mozota, 2005). Herbert Simon famously declared in 1969 that, because business was fundamentally concerned "not with how things are, but with how they might be," that design should be at the core of all professional training. Yet Simon's strong advocacy for design appears to have had little effect on the work of management scholars in terms of either research or teaching about design as a problem-solving methodology in the ensuing forty plus years. This, however, appears to be changing. Roger Martin (2007) has gained a wide management audience with his argument for the importance of integrative thinking - the ability to work the tensions between opposing ideas and search for a higher order solution - as critical to long-term business success, arguing that balancing the desire for validity and reliability is key. He also made a strong case (2009) for design thinking's potential as a core source of competitive advantage, asserting that design's strength lies in its ability to move between intuitive and analytic modes, due to its emphasis on abductive reasoning. Liedtka (2000) has asserted that the strategy process could itself be seen as one of designing, given their shared qualities: a focus on synthesis rather than merely analysis, attention to possibilities as well as constraints, and its hypothesis-driven nature. The idea of problems in strategy as "wicked" has also been discussed (Borja de Mozata, 2003; Mason & Mitroff, 1981).

Practitioner writing on the subject has offered extensive case-based, anecdotal examples of design thinking's benefits in practice. More recently, systematic field work has begun to emerge that seeks to explore the use of design thinking methodologies in practice as used by non-designers. Lindberg, Koppen, Rauth, & Meinel (2012), at the Plattner Institute of the

University of Potsdam have begun a multi-phase project to examine how design thinking is being incorporated into the development process within the IT industry. They report on an initial 30 expert interviews conducted within the German and US Information Technology industries, finding a diverse array of views and perspectives. Seidel and Fixson (forthcoming) have reviewed the performance of design methodologies as practiced by fourteen novice multi-disciplinary product development teams , finding that combined methods and attention to more reflective practices are key to producing more innovative outcomes. Wattanasupachoke (2012) studied 114 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.

Attention has also been paid to contrasting design thinking with traditional analytic methods and assessing the relative utility of each, arguing for design's superiority when data from the past is limited in its predictive value. Boland & Collopy (2004) have advocated for the value of a "design attitude," characterized by a problem-centered focus and the recognition that alternative solutions must be invented as preferable to a "decision attitude" in which alternatives are treated as already known, and choices are rational. Owen (2007) asserts that design thinking is both the "obverse" and the "complement" to business thinking. Liedtka & Ogilvie (2011: 10) argue that design thinking's values and assumptions present a significant—and valuable—challenge to the analytical approaches that form the core of business education today:

> The differences are as basic as the core assumptions and decision drivers underlying each approach. Business thinking is predicated on assumptions of economic rationality and objectivity. Its decision driver is *logic*. Design thinking assumes the primacy of personal experience. Reality, for designers, is always

socially constructed. Decisions in this world are seen as driven by *emotion* more than logic; desire as a far more powerful motivator than goals.

In summary, although specific terms in usage vary, significant convergence does exist around both the fundamental meaning of design thinking in a management context, as well as when to use it. For our purposes here, based on our synthesis of the literature reviewed, we will use as a starting point a definition of design as a systematic approach to problem solving, especially well-suited to a class of problems where the nature of the problem is people-centered, rather than technology or process centered, and uncertainty is high. It is hypothesis-driven, incorporating both generative and analytical thinking modes, and characterized by an emphasis on discovery of deep needs, collaborative work, optionality, iteration, and experimentation in practice.

STEP 2: IS THE CONCEPT VALID?

Examining Design Practices and Tools

We now turn to the question of concept validity, whether convergence exists about the actual practices used to operationalize it - that is, how uniform are the processes and tools? Fortunately, information on design thinking as actually practiced is not difficult to unearth, as it is written about extensively in the public domain. Many of the leading consultants in the space, such as IDEO and Jump have websites offering extensive descriptions of their views of the process and "toolkits" for those interested in trying to practice design thinking on their own. Educators such as the Stanford Design School, who publishes a free and downloadable "Bootleg" detailing processes and tools with an accompanying field guide, offer detailed information. Companies, like Whirlpool and Intuit, that have embraced the concept write extensively about the specifics of their practices. Run a Google search on a design tool like

"customer journey map" and you will get millions of results (11 million at last attempt). This is a topic that thrives through on-line communications in blog posts and websites: information is freely shared by consultants, educators, and business practicing it, making an evaluation of convergent validity straight-forward using these public sources.

Even a cursory review of these many sources suggests significant uniformity across the processes and tools advocated. Not surprisingly, given the multiple facets of design thinking as an approach, there exists a significant number and variety of tools described. These include a variety of ethnographic research techniques (e.g., observation and journey mapping), sense-making tools (e.g., mind mapping and other forms of cluster analysis), visualization tools (e.g., imagery, storytelling, and metaphor) ideation tools (e.g., brainstorming and concept development methodologies), and prototyping approaches (e.g., business concept illustrations and storyboarding). The emphasis is team-based, and collaboration across diversity in the form of functions, perspectives and experience bases is core to the approach. The nature of many design tools and processes, such as structured group processes for insight generation and ideation, are naturally supportive of collaboration, advocates assert. Somewhat newer are methods for the generation and subsequent design of experiments for testing. Liedtka & Ogilvie (2011) surveyed the methods and approaches in practice and identified a core set of tools, a subset of which will be discussed here. These are identified in Exhibit 1:

Insert Exhibit 1 about here

These tools are designed to support a widely shared view of the design-thinking process (despite using different terminology for each consultancy) that suggest an exploratory data gathering first phase, followed by the generation of ideas, followed by a third phase of prototyping and then

testing. The process emphasizes iterative cycles of exploration using deep user research to develop insights and criteria, followed by ideation to develop new ideas and then prototyping and experimentation to test them. In their review of the literature, Seidel and Fixson (forthcoming) describe these three aspects as need finding, brainstorming, and prototyping.

Conclusion: Convergent Validity Test

In the literature and practices reviewed, then, there does appear to be broad consensus in both design theory and business practice about the attributes of design thinking and the process and tools used to implement it, presenting a compelling case for the internal consistency and coherence of the design-thinking process such that it meets the convergent validity test.

Conclusion: Divergent Validity Test

Having established the coherence of the concept, we turn now to the divergent validity test and question how distinctive design thinking is as a methodology. Given the basket of tools used in the approach, it is not surprising that elements of design thinking can be found in many other places in both the literature and the practice of management. The front end of the process, aimed at generating more novel and valuable ideas, can be linked with the marketing literature; consumer research has recognized the value of a deep understanding of customer needs at least since Ted Leavitt's famous *Harvard Business Review* article "Marketing Myopia" (1960). Ethnographic marketing research techniques are finding increased usage and support (Leonard & Rayport, 1997; Elliott & Jankel-Elliott, 2003; Mariampolski, 1999). Problem-finding has been discussed in the strategy literature (Leavitt, 1986). The emphasis on learning is strongly grounded in Senge's (1990) seminal work in the area. Certainly, specific techniques such as brainstorming are widely known in the creativity field (Paulus, Larey, & Dzindolent, 2001). The

hypothesis-testing dimension of the design-thinking process also echoes themes similar to a body of such currently popular ideas as small bets (Sims, 2011), effectuation (Sarasvathy, 2001), and lean startup (Reis, 2011). And so, many elements in both the process and toolkit are visible elsewhere.

But when individual elements of design thinking are combined and viewed together as an end-to-end system for problem solving, a case can be made that design thinking does emerge as clearly distinctive. The concept provides an integrating framework that brings together both creative and analytic modes of reasoning, accompanied by a process and set of tools and techniques. As with TQM, there is a distinctive set of practices and processes and a coherent set of shared assumptions underlying it. These include beliefs that treating the problem, not just its solution, as a hypothesis ultimately will yield more innovative and value-added solutions; 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 and logic and that translates these into design criteria to generate new ideas; and that users' unarticulated needs and desires can be revealed through ethnographic research that uses small samples but goes deep. Thus, conducting research to inspire better hypotheses, rather than merely to test them, will result in improved outcomes. There is also the assumption that, in an environment of uncertainty, experimentation will be superior to analytics as a decision-making approach, and that continued learning and the iteration of hypotheses will reduce risk and improve success rates in the innovation process. Finally, a belief that the use of concrete but low fidelity prototypes that aid the visualization process will increase the accuracy of feedback from potential customers when used in conjunction with small marketplace experiments**.**

Having examined the legitimacy of design thinking conceptually and asserting that it meets tests for both convergent and divergent validity, and thus can be subjected to scrutiny by management scholars, we now turn to the challenge of gathering and evaluating empirical data as to whether it offers improved outcomes in practice.

STEP 3: CONDUCTING RESEARCH ON DESIGN THINKING

A Starting Point

Thus far, we have endeavored to assess the case as to whether design thinking, as a management concept, is valid and therefore capable of being studied empirically. Having now asserted that the answer to that question is yes, we move to considering how it might be tested. Beyond the discussion of the validity of design thinking as a problem-solving approach lies the notion of design thinking as a *practice* in the larger scholarly meaning of the term. The set of assumptions and beliefs described here, taken together with design thinking's tools and processes can be seen as constituting such a practice. Orilkowski (2010) has documented the increasing interest of management scholars in the notion of practice and argued that these 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. In the design thinking realm, it is difficult to envision how to disentangle these three for purposes of study.

Clearly, the task of bringing rigorous empirical testing to a concept comprised of multiple and diverse facets and tools, and establishing causality with complex multi-dimensional outcomes like innovation performance is a challenging one. One understands the relative dearth of rigorous scholarly attention paid to the popular concept: so where to begin? There are many possibilities and an array of levels and perspectives. Design thinking could be studied directly in

comparison to other problem-solving approaches, with an eye towards empirical demonstration of the specific environmental and organizational conditions under which it yields superior outcomes - or conversely, its integration with other organizational approaches could be examined instead. A diversity of levels could also be addressed: it could be examined at the level of the individual, the team, or the organization. At the organizational level, for instance, many different questions could be asked through Oriltowski's (2010) perspective focus: 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 psychological safety or risk-taking behavior could be scrutinized, among many others. Even the concept itself presents choices to be made in framing the research: do we want to test design thinking as a unified concept, including its philosophy and inclusive of an end-to-end process and a complete toolkit? Or, instead, we could elect a more phenomenon based lends, testing particular tools or elements of the process, individually. We believe that a case can be made for any of these research approaches. Our aim here is to accelerate the scholarly conversation around research possibilities, and so the path we propose to follow in the remainder of this paper is perhaps the simplest one: to look for opportunities to relate existing knowledge in well-studied areas of potential relevance to particular tools used in design thinking, in order to form more specific hypotheses that will allow for rigorous testing.

Our initial explorations, based on our experiences in observing many managers in their practice of design thinking and familiarizing ourselves with a broad range of literatures in the organizational behavior and strategy fields, suggests at least three promising literatures with potentially significant explanatory powers for understanding the mechanisms through which design thinking may improve problem-solving processes: (1) the literature on organizational and

team learning; (2) the impact of positive affect on decision-making and (3) the literature on cognitive bias. Design thinking, we hypothesize, may facilitate better solving by facilitating learning, improving decision-makers' affect, or reducing their cognitive biases. Let us look very briefly at each area in turn.

The potential linkages between the literature in organizational and team learning and the tools and processes advocated by design thinking's collaborative emphasis represent a fertile area for inquiry. Organizational learning has long been acknowledged to be a social phenomenon (Nonaka & Takeuchi, 1995). In their work on social capital, Tsai & Ghoshal (1998) found relationships to have significant effects on resource exchange associated with innovation. In design thinking, we hypothesize that these effects may be obtained through both the dialogic nature of the conversations and the creation of a climate of psychological safety conducive to team learning (Edmondson, 1999). Dialogue is central to innovation, Tsoukas (2008) argued - knowledge is created through direct social interaction. Design thinking's emphasis on collaborative tools for sense making and ideation would appear to be well-suited to facilitating such interaction. Further, Tsoukas (2009) asserts that, given the difficulty that individuals creating their own disconfirming data, dialogue among people is key to accomplishing successful experimentation. Design thinking's emphasis on diverse teams, especially cross-functional ones, can also be related to learning (Somech & Drach-Zahavy, 2013). Carlile (2004) asserts that knowledge creation occurs across domains. In a similar argument, Boland and Tenkasi (1995) argue that knowledge often results from "communities of knowing" questioning and revising their own routines. Accomplishing this requires a kind of perspective taking to make routines visible to others, and perspective making to then shape a newly shared and coherent set of beliefs. Design thinking, with its emphasis on visualization and prototyping, might be

hypothesized to aid both. Boland and Tenkasi contrast failed individual aviators' trial and error learning with the systematic kind of experimentation practiced by the Wright Brothers as they build on the work of others and deliberately created and tested the assumptions that evolved. Bersky (2003) finds in her research that visualizations and prototypes act as "boundary objects" in these conversations, and work to develop a shared view among participants. Hey, Joyce & Beckman (2007) demonstrate the extent to which a design approach aids in this creation of a shared perspective. Based on even this short review of key articles in the organizational literature, one could begin to formulate an argument about how design tools and processes might facilitate organizational and team learning.

Inquiry into the area of positive affect and its relation to design thinking as a problem-solving approach would take a different tack. The impact of positive affect on decision-making is now well-recognized, and numerous studies have found a positive relationship between affect and creativity (Amabile, Barsade, Mueller, & Staw, 2005), the ability to process information from diverse sources and produce integrative solutions, increased cognitive flexibility, the ability to handle complexity, and the broadening of the decision-maker's field of view (Isen, 2008). In fact, Fredrickson (2003) argues that the whole purpose of positive emotion is to "broaden and build" - to facilitate long term development and growth, through their ability to foster more creative and empathic thinking, in contrast to negative emotions, which set up immediate survival. As teachers and facilitators, it is our first hand observation that design thinking processes are often accompanied by heightened positive affect, though we have no definitive hypothesis as to why. We suspect that it may, in part, be due to the way in which its methods emphasize being human-centered, collaborative and playful - all attributes that research suggests improve affect.

The argument for the third area of cognitive bias reduction relies on the large and well-researched body of work over more than five decades delineating the flaws of human beings as information processors. In both hypothesis generating and testing activities, humans tend to project their own world view onto others, limit the options considered, ignore disconfirming data and in general behave in ways that result in impaired problem solving. Here again, many of design thinking's tools and processes may help to remediate these shortcomings.

Space limitations clearly prevent us from exploring all three of these potentially fruitful areas in this paper. Accordingly, in the remainder of this paper, we will focus on grounding the concept of design thinking in relation to the third literature discussed, the literature on human cognitive processes and its limitations. Our hope is that this simple approach will both advance specific work related to design thinking and cognitive bias, and also serve as a model for exploration in relation to organizational learning and positive affect, or in other relevant areas, that future researchers will deem relevant.

EXAMINING THE PSYCHOLOGICAL UNDERPINNING OF DESIGN THINKING IN THE COGNITIVE BIAS LITERATURE

In focusing on the well-researched area of the cognitive limitations of decision makers, our aim is to identify the theoretical contribution design thinking might make to addressing specific limitations already well-identified in human decision-making processes. We will first review the literature on flaws in hypothesis generation and then testing, followed by attention to prescriptions that have been offered to avoid these flaws. This will set the stage for a return to the topic of design thinking, for an analysis of the ways in which the specific tools of the design-thinking process might hypothetically contribute to improved decision making, and the creation of a specific set of testable hypotheses.

Challenges in Hypothesis Generation

The first category of challenges identified in the literature is associated with hypothesis generation. The central dilemma here is the difficulty involved in identifying truly novel ideas that are value-creating for targeted users. The frequent failure of traditional market research methodologies to accurately predict users' preferences are well documented (Elliott & Elliott-Jenkel, 2003). This research demonstrates that: (1) decision makers find it difficult to come up with novel ideas; (2); users find it difficult to accurately describe their preferences; and (3) decision makers find it difficult to predict users' preferences. Underlying each of these difficulties is the problem human beings have in generating new ideas, something that is well-recognized in the psychology literature. Gilbert (2006:26) deems these "failures of the imagination" and examines their sources:

> Imagination's first shortcoming is its tendency to fill in and leave out without telling us…and the features and consequences we fail to consider are often quite important…Imagination's second shortcoming is its tendency to project the present onto the future. Its third shortcoming is its failure to recognize that things will look different once they happen.

Loewenstein & Angner (2003) focus on prediction rather than imagination, but they note errors similar to Gilbert's that they term the projection bias, the focusing illusion, and the hot/cold gap. The projection bias is evidenced in a tendency to project the present into the future. Such "naive realism," Loewenstein & Angner contend, results in predictions that are too regressive, too biased toward the present. Kahneman & Miller (1986) discuss the power of

"backward thinking" and argue that "reasoning flows not only forward from anticipation and hypothesis to confirmation or revision but also backward from the experience to what it reminds us of or makes us think about." Related to this, Gilbert, Gill & Wilson (2002) demonstrate that people evidence a strong "presentism," defined as a "tendency to over-estimate the extent to which their future experience of an event will resemble their current experience of an event."

Deeming their own personal preferences more universal than they are presents decision makers with another significant obstacle as they try to generate successful new hypotheses. Van Boven & 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 studying a series of interactions between buyers and sellers, Van Boven & Dunning (2000) for instance, 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.

The second dysfunction that Loewenstein & Angner (2003), like Gilbert, describe is a "focusing illusion," in which decision makers tend to overestimate the effect of one factor at the expense of others. This is the "putting in" and "leaving out" that Gilbert refers to. Third, they argue, 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. We will discuss this further in our next section on hypothesis-testing challenges.

And so, would-be innovators exhibit a series of dysfunctions as they attempt to generate hypotheses: a projection bias in which decision makers project the past into the future; an empathy gap in which they deem their own personal preferences more universal than they are; a

focusing illusion in which they overreact to specific stimuli and ignore others; and a difficulty assessing, in the present, what their reaction to any new idea or experience in the future will be.

Innovators have long sought to compensate for these prediction problems by *asking* users what they want. Unfortunately, this too has proven to be problematic, as work in the market research field has long demonstrated, in a phenomenon that some have called the "say/do" gap. Consumers are frequently unable to accurately describe their own current behavior, much less make reliable predictions (Fellman, 1999). Morwitz , Steckel & Gupta (1997), after a meta-analysis of over 100 studies, demonstrated that consumers were not reliable predictors of their own purchase behavior for any type of goods studied. Even focus groups, the sine qua non in marketing research for decades, routinely fail to perform satisfactorily, Mariampolski (1999) argues, due to factors such as the limitations of language and the respondents' desire to impress those conducting the sessions.

Thus, would-be innovators seeking to produce more novel, value-creating, and differentiated rather than "me too" ideas face significant challenges. The projection bias inhibits the creation of novel ideas. The focusing illusion inhibits the creation of a broader array of ideas, and the egocentric empathy and say/do gaps inhibit the creation of ideas that are truly valuable to users.

Challenges in Hypothesis Testing

An equally vexing set of challenges to good hypothesis testing has been well-documented in the literature. Even if they succeed in generating innovative hypotheses, decision makers face a series of challenges to their ability to test them well. First, they are overly optimistic in their predictions about the future. This human view of the rosiness of the future has been well

documented. Kahneman & Tversky (1979) termed this the "planning fallacy." 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 & Taylor, 1998). These views only rarely include considerations of failures, except in the case of the clinically depressed (Newby-Clark & Ross, 2003). This same overconfidence and unfounded optimism has been documented in organizational planning processes as well (Larwood & Whittaker, 1977). Due to the hot/cold gap discussed earlier, decision makers' 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" or "cold."

There is also a well-recognized "hypothesis confirmation bias" (Snyder & Swan, 1978): decision makers seek explanations that coincide with their preferred alternative. They search for facts, Gilbert (2006) notes, which *allow* them to have faith in favored solutions, whereas they must be *compelled* by data to believe that which points to a less favored one. Kahneman, Knetsch & Thaler (1991) term this the "endowment effect" in which decision makers become attached to the solution they already have created. This results in a loss aversion that makes giving something up more painful than the pleasure of getting it (Kahneman, 2011). Kahneman & Tversky (1979) also identify an availability bias in which decision makers undervalue options that are harder for them to imagine.

Similarly, Ditto & Lopez (1992) demonstrate that decision makers use different levels of intensity in processing information consistent with their preferences versus that which is not. Inconsistent information is more likely to be heavily scrutinized than information agreeing with the preferred solution, and alternative explanations allowing them to ignore this disconfirming data are often pursued. They summarize: "People are less critical consumers of preference-

consistent than preference-inconsistent information." In other studies, Eyal, Liberman, Trope, & Walther (2004) demonstrate that this tendency to give greater attention to positives worsens as a decision grows more distant in time: their subjects generated more pros and fewer cons toward new procedures in the distant future. Even when decision-maker bias is revealed to them, they often fail to correct it, as Gilbert & 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."

Exhibit 2 summarizes this list of flaws in human cognitive processes and their consequences for problem-solving when the aim is successful innovation.

Insert Exhibit 2 about here

And so, creating innovation and organic growth requires that decision makers specify alternative futures, yet they suffer from numerous deficiencies as they do so. They are overconfident in the predicted futures and tend to terminate the search process prematurely, becoming overinvested in their early solutions. To worsen matters, decision makers then have difficulty even seeing disconfirming data when they proceed to test them. Another quandary: the more distant in time predictions are, the more abstract and simplistic they become, losing detail and complexity (Liberman, Sagristano, & Trope, 2002).

Dealing with Identified Dysfunctions

Thus, a significant body of research exists in the decision-making literature demonstrating that those who aspire to successfully create and test new ideas face a series of challenges. Fortunately, research also points out ways to mitigate some of these dysfunctions in

both hypothesis generating and testing. By reviewing these and making linkages to the design thinking approach, we can begin to develop specific hypotheses for testing.

In hypothesis generation, for decision makers who have difficulty seeing novel solutions and figuring out what users will value, researchers have identified a number of solutions. As we review these particular solutions that the cognitive bias literature recommends, they begin to allow us to generate some nascent hypotheses about design thinking's potential contribution.

Remedy: Employ ethnography

Ethnography, a well-established methodology in the social sciences for over a century, has only recently become accepted in the marketing field, something that Mariampolski (1999) attributes to "the seduction of positivist methods" that sold "relief from uncertainty," albeit illusory. The increasing acceptance of the constructionist perspective in management fields has been accompanied by recognition of the power of ethnography whose purpose he describes as "not only to watch but also to decode human behavior…to discover the underlying meanings behind behavior, to understand feelings and intentions." Ethnography has been revived, he asserts, as a way to compensate for the clear failure of focus groups and quantitative methodologies and is especially valuable when innovative insights are desired.

Hypothesis: To the extent that design thinking places a strong emphasis on the use of ethnography and its early immersion in the user experience to order to develop a deep understanding of their current situation and needs before moving to the creation of solutions, it ought to help to mitigate the projection bias: by immersing themselves in the user's experience, decision makers may become less reliant on their past as a source of new ideas. This in turn could produce more novel ideas than when they rely on their own assumptions about the users' world. Ethnography might also aid in avoiding the egocentric empathy and say/do gaps, which

might produce more value-creating solutions. Rather than projecting their own needs onto others or asking users what they want, ethnography might help decision makers to uncover needs that users cannot articulate.

Remedy: Use stories versus data

Kahneman (2011) notes the attraction that the coherence and concreteness of stories holds for people—stories about "agents who have personalities, habits, and abilities." Pennington & Hastie (1996) advocate as well for the power of narrative. Schoemaker (1993) in his exposition of the power of scenario planning offers the following proposition: "Comprehension of complex evidence relies on weaving intentional and causal accounts around strands of evidence that would otherwise seem disparate and hard to remember. The downplaying of probabilities is consistent with the focus on learning as opposed to problem solving and choice."

Hypothesis: Design thinking's emphasis on the use of storytelling, one of the most frequently used visualization techniques, might improve the novelty and value of the ideas generated by helping decision makers to take in and hold onto the rich details of the lives of those for whom they seek to create value. It might also improve the accuracy of the testing of these ideas, another topic we will consider shortly.

Remedy: Work with metaphor

Lakoff & Johnson (1980) 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 us to make sense of our experiences, to understand past experiences, and to act as a guide to future ones. They describe metaphors as acts of "imaginative rationality."

Hypothesis: Because the use of metaphor is another one of design thinking's frequently used visualization tools, it may help to stimulate decision-makers' imaginations, thereby potentially reducing reliance on the past (the projection bias), broadening their field of vision (avoiding the focusing illusion), and producing more novel ideas.

Remedy: Expose decision makers to divergent views

One obvious way to both compensate for and provoke the limited imagination of individuals is to work in groups—preferably diverse ones. Madjar, Oldham, & Pratt (2002) note that interactions with others from diverse backgrounds improve the creativity of individual responses. Much of the team learning literature that we reviewed recently makes a similar point (Boland & Tenkasi, 1996; Somech & Drach-Zahavy, 2013).

Hypothesis: Another mechanism through which design thinking might encourage more innovative thinking is through the way in which its advocates emphasize collaboration across diversity as core to the approach. The nature of many design tools and processes, advocates argue, is naturally supportive of collaboration—especially collaboration across differences. Visualization can capture individual ideas on post-it notes and whiteboards so they can be shared and developed jointly. Co-creation invites others into the processes of both idea generation and testing. Introducing prototypes aims to enhance the accuracy of these conversations. Structured sense-making and brainstorming tools facilitate team-based processes for drawing insights from ethnographic data. Proponents argue that design advocates withholding judgment, avoiding debates, and paying particular attention to the tensions difference creates, and thus might encourage more innovative solutions.

In relation to hypothesis testing, we find a similar set of prescriptions, researchers suggest:

Remedy: Create vivid and specific representations of the future

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 & O'Neill (2001) introduce the term "episodic future thinking," a "projection of the self into the future to pre-experience an event." They 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 they note there is new evidence emerging out of neuropsychological research that planning for a personal future involves different parts of the brain. Gilbert, Gill, & Wilson (2002: 431-432) agree, citing multiple sources agreeing that decision-makers' assessments of their reaction to imaginary events can serve as stand-ins for the real thing:

> Because real and imagined events activate many of the same neurological processes, reactions to imaginary events can provide useful information about one's likely reaction to the events themselves…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.

But the positive effects go beyond assessing reactions, as Johnson & 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, & Stock, 1981).

Hypothesis: Design thinking's emphasis on prototyping might provide a mechanism to allow 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 more tangible and allow the solicitation of more accurate feedback during testing. If these tools succeed in increasing the accuracy of feedback, they might mitigate the effect of many of the hypothesis-testing biases—the planning fallacy, the availability bias, and the time effect.

Remedy: Talk about the details of what success and failure look like

In this "pre-experience," details and specificity matter. Committing not just to the goal of taking a pill but also to the specifics of when and where produced more consistent pill-taking, Sheeran & Orbell (1999) demonstrate. Respondents in their studies who explained hypothetical successes actually 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 & Sherman describe their interpretation of these results: "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: Design's hypothesis-driven approach that emphasizes assumption surfacing might prove valuable. 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, might act to mitigate the confirmation bias and the endowment effect.

Remedy: Pay attention to emotions

There is an additional component to the imagery discussion: the role of "goals" versus "desires." Kavanagh, Andrade, & May (2005) assert that cognition does not capture the whole story and that affect plays a strong role in evoking more accurate feedback about imagined futures. Sensory imagery—visual, taste, smell, touch, hearing—is a key feature of evoking desire. Citing Lang (1994), they predict that "when other factors are controlled, a stronger sense of desire will be derived when the imagined experience is more closely associated with affect or is more subjectively vivid." Interfering with visual imagery, they note, reduces desire, and it is emotions that do the crucial work of translating goal-directedness into desire. Metaphorical language and aspirational questions, in particular, are inherently emotion-laden. Talking in metaphors, analogies, and stories is more compelling than analytical logic and reasoning (Pugmire, 1998). Deighton, Romer & McQueen (1989) argue for the power of *feeling* as well as seeing new futures.

Hypothesis: Design thinking's attention to emotions—through the use of tools like ethnography, metaphor, and storytelling—are likely to produce both more novel ideas and more accurate feedback in testing by making future prospects more vivid.

Remedy: Generate multiple options

Getting decision makers to consider—and explain—a range of possible outcomes also holds promise for improving the accuracy of predictions. This is the basis for the contribution of scenario planning techniques (Schoemaker, 1993). Considering multiple predictions of the future, rather than a single one, has been demonstrated to mitigate over-optimism, for instance. When subjects in experiments conducted by Griffin, Dunning & Ross (1990) were asked to come

up with multiple construals of potential future situations, they were significantly less likely to exhibit the overconfidence that characterizes most subjects in these studies. In a similar vein, Anderson (1982) demonstrated that the hypothesis confirmation bias effect is also greatly reduced when respondents are asked to perform counter-explanation tasks. Gary Klein (1998) calls this a "pre-mortem."

Hypothesis: The idea of optionality - of working with multiple alternatives for the future - is a core element of a design thinking approach. This insistence on generating and evaluating multiple options in a hypothesis-driven way may provide another mechanism, through which the effects of both the planning fallacy and confirmation bias can be lessened.

Remedy: Hold after action reviews with specifics

In addition to the improved accuracy associated with visualizing future experiences, the frequency and breadth of feedback-seeking behavior has been demonstrated to relate positively to improvements in creative performance (de Stobbeleir, Ashford, & Buyens, 2011). A number of studies have also examined the impact of after-event reviews (AERs)—learning from successes and failures—on future performance. Ellis & Davidi (2005) demonstrated that reviewing both successes and failures is beneficial under those circumstances where understanding *why* events happened as they did is important. They 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." Interestingly, they concur with Sitkin (1992) that learning from success happens less naturally and requires more motivation and effort to replicate. Finally, in alignment with earlier research, Grahaug & Falkenberg (1998) find that knowing the general cause of an outcome is less useful in improving future performance than knowing a specific

cause, and that, in particular, factors leading to a specific performance are more useful guides for future behavior. One of the important by-products of AERs is the nature of the feedback received and its specificity to the process of task performance (Alexander, Scabert & Hoe, 1991). Anseel, Lievers, & Schollaert (2009) demonstrate that "effortful" reflection, in conjunction with external feedback, accelerates performance. Reflection without external feedback did not, and the depth and focus involved in the reflection process mattered to performance improvement.

Hypothesis: Design thinking's process focus on conducting field experiments to test the identified assumptions using prototypes with external users, ideally in real market contexts, might fulfill the function of AARs. The emphasis on testing with actual customers, rather than in more artificial environment like traditional techniques like focus groups, could be of aid to decision-makers. These experiments may provide a particularly vivid form of the "action" that creates the input for the after-action reviews, central to a hypothesis-driven approach. Making assumptions sufficiently specific to be testable may introduce additional rigor. Because the outcomes of the tests must be reflected on and used to either reject or improve the hypothesized idea for the next round of testing, "effortful" after action reviews are embedded as a core element of the approach.

And so, in examining the cognitive bias literature in reference to our previous discussion defining the design thinking approach, we are able to hypothesize about the role of design thinking tools and processes to provide mechanisms for mitigating well-known cognitive biases. Some core elements of design thinking—the use of ethnography, the creation of vivid concrete mental images in the form of prototypes, the use of metaphors, and stories that encourage decision-makers to pre-experience the new, the insistence on the generation and testing of multiple options, the articulation of specific assumptions and their counter explanations, and

after-action reviews in the form of field experiments - offer a potential route to mitigating cognitive challenges identified in the decision-making literature. Exhibit 3 summarizes the way in which specific design tools might be hypothesized to address particular cognitive biases:

Insert Exhibit 3 about here

STEP 4: CREATING TESTABLE HYPOTHESES CONCERNING THE CONTRIBUTION OF DESIGN THINKING

Based on the identification of these more specific mechanisms through which design thinking might hypothetically address well-documented cognitive problems and their attendant solutions, we believe it is possible to develop even more rigorously testable hypotheses around the research question of whether or not, in practice, design thinking process and tools, when studied individually, may succeed in improving problem-solving performance under conditions of uncertainty. Let us review our argument thus far: design thinking may potentially improve hypothesis generation through the introduction of a data-driven exploratory stage that attends to emotion as well as reason and potentially reduces decision-makers reliance on their pasts. Other techniques such as co-creation might also mitigate the effects of both the projection bias and the egocentric empathy gaps. In addition, we have hypothesized that design thinking might improve hypothesis testing through the introduction of techniques for prototyping, visualization, and assumption surfacing as well as the generation of multiple options and market-based experiments. Furthermore, each of these mechanisms can, in turn, be linked logically linked with a dependent variable, such as the novelty of ideas generated or the accuracy of the testing process, which could serve as specific performance measures.

Thus, this exploration of the definitional and validity questions concerning design thinking and the delineation of its specific tools and process approaches, can offer researchers a place to begin by suggesting the outline of a set of preliminary hypotheses, related to the cognitive bias literature reviewed here:

Hypothesis 1 (H1): The use of a design-thinking approach that incorporates the tools of visualization, ethnography, ideating with a diverse group, and co-creation tools , will increase the *novelty* of the ideas surfaced during hypothesis generating processes by reducing the effects of the projection bias (the tendency to project the past onto the future).

Hypothesis 2 (H2): The use of a design-thinking approach that incorporates the use of ethnography, ideating with a diverse group, and co-creation tools will increase the *value-creation potential* of the ideas generated through the reduction of the egocentric empathy gap (the projection of one's own preferences onto others).

Hypothesis 3(H3): The use of a design-thinking approach that incorporates the use of ethnography, optionality, ideating with a diverse group, co-creation, and field experiments, will result in the *exploration and testing of more ideas* by the reduction of the focusing illusion (over emphasizing particular elements), and the endowment effect (the attachment to first solutions).

Hypothesis 4(H4): The use of a design-thinking approach that incorporates visualization, co-creation, optionality, prototyping, assumption testing and field experiments will result in *improved accuracy in the hypothesis testing process'* ability to estimate the likely success of the new idea, through the reduction of the

endowment effect, the availability bias (the undervaluing of more novel ideas), the hypotheses confirmation bias (overlooking disconfirming data), the planning fallacy (over-optimism), and the impact of time (in which distant ideas are less specific and thus harder to analyze).

Having developed these hypotheses, researchers can now turn to a clearly specified and well documented set of research methodologies in the literature to design research protocols to test them, as well as accepted metrics for measuring dependent variables like the novelty of ideas. Taking this approach could represent a route out of the quagmire created by the challenges involved in conducting academic research on a phenomenon like design thinking, one that is obviously popular in management practice but that appears resistant to serious academic inquiry due to the multi-faceted nature of its "basket" of tools and process and the complexity of the outcomes created.

CONCLUSION

Our review of the concept suggests that design thinking appears to be a concept deserving of increased attention from management scholars. An examination of practitioner work in the area reveals a concept that is both internally consistent and coherent and externally distinctive and that appears to meet the tests of both convergent and divergent validity. A review of the decision-making literature suggests that it may hold significant potential for improving management practice in the innovation space through its ability to address a well-known set of cognitive flaws.

Clearly, the approach and the hypotheses offered here are mere starting points. Significantly more work is required to design research studies that can rigorously assess whether, in fact, these hypothesized benefits bear out in practice, and under what conditions. A series of

measures will need to be developed to assess whether any given process meets the specifications of the concept as defined here.

Beyond this, there exists a much broader set of questions around design thinking and its proper role within the portfolio of approaches to problem-solving that organizations have at their disposal, and its linkage to existing bodies of research. We have suggested that the organizational and team learning and positive affect literatures provide two promising palaces to start. Questions like the nature of the specific problems and opportunities that design thinking is best suited to address, the sense-making process that accompanies it, the organizational culture and values that best support it, or the development of the individual managerial capabilities and experiences that facilitate its adoption. In this paper, we have endeavored to start with a focused agenda, in the hope of demonstrating that this is work worth doing on the part of researchers and to suggest some initial directions that may prove fruitful.

Having watched, as educators, the transformative effect mastering a design thinking approach can have on the confidence of managers to explore a more creative side of problem-solving, we believe that this is important research to take on. The implications for practice are particularly intriguing from the perspective of an educator in the management field. Whereas many studies of creativity look at individual traits and personalities (De Stobbrleir, Ashford and Buyens, 2011), Design thinking bears more similarity to initiatives like Total Quality Management, in which a process-orientation and set of accompanying tools and techniques suggests a capability set that can perhaps more readily be taught to both managers and students. Thus, the promise it holds for improving managerial problem-solving appears especially actionable. As such, it is a topic with clear implications for business practice and is worthy of our attention as management scholars.

REFERENCES

Alexander, C.1964. ***Notes on the synthesis of form***. Cambridge, MA: Harvard University Press.

Amabile, T, Barsade, S. Mueller, J. & Staw, B. 2005. Affect and creativity at work. ***Administrative Science Quarterly***, 50: 367-403.

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

Archer, L. 1963. Systemation method for designers**.** ***Design*****:** 172-188.

Anderson, C.A. 1982. Inoculation and counter-explanation: debiasing techniques in the perseverance of social theories. ***Social Cognition***: 1:126-139.

Armor, D.A. & Taylor, S.E. 1998. Situated optimism: Specific outcome expectancies and self-regulation. In M.P. Zanna (Ed.), ***Advances in Experimental Social Psychology*** (Vol. 30: 309-379). New York, NY: Academic Press.

Atance, C. M. & O'Niell, D. K. 2001. Episodic future thinking. ***Trends in Cognitive Sciences***, Vol. 5, No. 12:533-539.

Bazjanac, V.1974. Architectural design theory: Models of the design process. In W. Spillers (Ed.), ***Basic Questions of Design Theory***: 3-20. New York, NY: American Elsevier.

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

Berger, W. 2009. ***Glimmer: How design can transform your life, and maybe even the world***. New York, NY: The Penguin Press.

Bersky, B. 2003. Sharing meaning across occupational communities. ***Organization Science***, 14(3):312-330.

Boland, R. & Collopy, F. 2004. **Management as designing: Exploring a new vocabulary of practice**. Palo Alto, CA: Stanford University Press.

Borja De Mozota, B. 2003. ***Design management: using design to build brand value and corporate innovation*.** New York: Allworth Press.

Brown, S. & Eisenhardt, K. 1995. Product development: past research, present findings, and future directions. **Academy of Management Review**, Vol.20 (2): 343-378.

Brown, T. 2009. ***Change by design: How design thinking transforms organizations and inspires innovation***. New York, NY: Harper-Collins. **Cooper, R., Juninger, S. & Lockwood, T. 2009**

Buchanan, R. 1992. Wicked problems in design thinking. ***Design Issues***, Vol. 8, No. 2: 5-21.

Collopy, F. 2009. Thinking about design thinking. www.fastcomapny.com/blog/fred-collopy/manage-designing/thinking-about-design-thinking. July 9.

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

Cross, N. 1995. Discovering design ability. In Buchanan & Margolis (Eds.), ***Discovering design***: 105-120. Chicago, IL: University of Chicago Press.

Csikszentmihalyi, M. 1996. ***Creativity: Flow and the psychology of discovery and invention***. New York, NY: Harper Collins.

Deighton, J, Romer, J. & McQueen, J. 1989. Using drama to persuade, ***Journal of Consumer Research***, 16: 335-343.

De Stobbrleir, K., Ashford, S., & Buyens, D. 2011. Self-regulation of creativity at work: The role of feedback seeking behavior in creative performance. ***The Academy of Management Journal***, 54(4): 811-834.

Dorst, K. & Cross, N. 2001. Creativity in the design process. ***Design Studies***, 22: 425-437.

Ditto, P. H. & Lopez, D. F. 1992. Motivated skepticism: Use of differential decision criteria for preferred and nonpreferred conclusions. ***Journal of Personality and Social Psychology***, Vol. 63, No. 4: 568-584.

Dougherty, D. & Tolboom, J. 2008. Creative organizing to enable organizational creativity. In J. Zhou &CE Shalley (Eds.) Handbook of organizational creativity. Lawrence Erlbaum Associates, Mahwah, NJ. 237-262.

Edmondson, A. 1999. Psychological safety and learning behavior in work teams. A**dministrative Science Quarterly.** 44 (2) 350-383.

Elliott, R. & Jankel-Elliott, N. 2003. Using ethnography in strategic consumer research. ***Qualitative Market Research,*** 6(4): 215-223.

Ellis, S. & Davidi, I. 2005. After-event reviews: Drawing lessons from successful and failed experience. ***Journal of Applied Psychology***, 90 (5):857-871.

Esslinger, H. 2009. ***A fine line: How design strategies are shaping the future of business***. San Francisco, CA: Jossey-Bass.

Evans, J. 2008. Dual processing accounts of reasoning, judgment, and social cognition. ***Annual Review of Psychology***, 59:255-278.

Eyal, T., Liberman, N., Trope, Y, & Walther, E. 2004. The pros and cons of temporally near and distant action. ***Journal of Personality and Social Psychology***, Vol. 86, No. 6: 781-795.

Faraj, S. & Y. Xiao. 2006. Coordination in fast response organizations**.** ***Management Science***. 52(8): 1155-1169.

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

Feldman, 1989.Gilbert, D. T., Gill, J. J., & Wilson, T. D. 2002. The future is now: Temporal correction in affective forecasting. ***Organizational Behavior and Human Decision Processes***, Vol. 88, No. 1: 430-444.

Findeli, A.1990. The methodological and philosophical foundations of Moholy-Nagy's design pedagogy in Chicago (1927-1946). ***Design Issues,*** 7(1): 4-19**.**

Fraser, H. 2012. Design Works: How to Tackle Your Toughest Innovation Challenges through Business Design. Toronto: Rotman-UTP Publishing.

Fredrickson, B. 2003. The Value of Positive Emotions. ***American Scientist***, 91(4): 330-335.

Garud, R., Jain, S. & Tuertscher, P. 2008. Designing for incompleteness; incompleteness by design. ***Organization Studies***, 29(3): 351-371.

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

Gilbert, D., Gill, M. & Wilson, T. 2002. The future is now. ***Organizational behavior and Human Decision Processes***. 88(1): 430-444.

Gilbert, D. T. & Jones, E. E. 1986. Perceiver-induced constraint: Interpretations of self-generated reality. ***Journal of Personality and Social Psychology***, Vol. 50(2): 269-280.

Griffin, D.W., Dunning, D., & Ross, L. 1990. The role of construal processes in overconfident predictions about the self and others. ***Journal of Personality and Social Psychology***, 59(6): 1128-1139.

Hackman, J. & Wageman, R. 1995. Total Quality Management: Empirical, Conceptual, and Practical Issues. ***Administrative Science Quarterly***, 40(2):309-342.

Hey, J., Joyce, C., & Beckman, S. 2007. Framing innovation: negotiating shared frames during early design phases. ***Journal of Design Research***, 6(1-2): 79-98.

Isen, A. 2008. Some ways in which positive emotion. In Lewis, D., Haviland-Jones, J. & Barrett, L. (Eds.), ***Handbook of Emotions***, Chapter 34:548-573.

Johansson, U., Woodilla, J. & 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, E. J. & Tversky, A. 1983. Affect, generalization, and the perception of risk. ***Journal of Personality and Social Psychology***, Vol. 45, No. 1: 20-31.

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

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

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

Kahneman, D. & Miller, D. T. 1986. Norm theory: Comparing reality to its alternatives. ***Psychological Review***, Vol. 93, No. 2: 136-153.

Kahneman. D. & Tversky, A. 1979. Intuitive prediction: Biases and corrective procedures, ***Management Science*** 12:313-327.

Kavanagh, D. J., Andrade, J., & May, J. 2005. Imaginary relish and exquisite torture: The elaborated intrusion theory of desire. ***Psychological Review***, Vol. 112, No. 2: 446-467.

Kelley, T., with Littman, J. 2001. ***The art of innovation: Lessons in creativity from IDEO, America's leading design firm.*** New York, NY: Doubleday.

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

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

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

Lang, P.J. 1994. The varieties of motivational experience: A meditation on James-Lange theory. ***Psychological Review,*** 101:211-221.

Larwood, L. & Whittaker, W. 1977. Managerial myopia: Self-serving biases in organizational planning. ***Journal of Applied Psychology***, Vol. 62, No. 2: 194-198.

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

Leavitt, T. Marketing Myopia. 1960. ***Harvard Business Review***. August:3-13.

Leonard, D. & Rayport, J. 1997. Spark innovation through empathic design. ***Harvard Business Review*** 75 (6): 102-113.

Lindberg, T., Koppen, E., Rauth, I. & Meinel, C. 2012. On the Perception, Adoption and Implementation of Design Thinking in the IT. In Plattner, H., Meinel, C. & Leifer, L. (Eds.) ***Design Thinking Research***. Heidelberg: Industry Springer Berlin Heidelberg

Liberman, N., Sagristano, M. D., & Trope, Y. 2002. The effect of temporal distance on level of mental construal. ***Journal of Experimental Social Psychology***, 38: 523-534.

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

Liedtka, J. & Mintzberg, H. 2006. Time for design. ***Design Management Review***, Spring, 2006.

Liedtka, J. & Ogilvie, T. 2011. ***Designing for Growth: A design thinking tool kit for managers.*** New York: Columbia Business Press.

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

Loewenstein, G. & Angner, E. 2003. Predicting and indulging changing preferences. In G. Loewenstein, D. Read, & R. Baumeister (Eds.), ***Time and decision: Economic and psychological perspectives on intertemporal choice***: 12:351-391. New York, NY: Russell Sage Foundation.

Lovelace, K., Shapiro, L. & Weingart. 2001. Maximizing cross –functional new product teams' innovativeness and constraint adherence. **Academy of Management Annals**. 44(4):779-793.

Madjar, N., Oldham, G. & Pratt, M. 2002. There's no place like home? The contributions of work and nonwork creativity support to employees' creative performance. ***The Academy of Management Journal***, 45: 757-767.

March, L. 1976. The logic of design. In L March (Ed.), ***The Architecture of Form***. Cambridge University Press.

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

Martin, R. 2007. ***The opposable mind: Winning through integrative thinking***. Boston, MA: Harvard Business School Press.

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

Mason, R. & Mitroff, I. 1981. ***Challenging Strategic Planning Assumptions***, New York, NY: Wiley

Newby-Clark, I. R. & Ross, M. 2003. Conceiving the past and future. ***Personality and Social Psychology Bulletin***, 29(7): 807-818.

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

Orbell, S. & Sheeran, P. 1999. Implementation intentions and repeated behaviors. ***European Journal of Social Psychology,*** 29:349-369.

Orilkowski, W. 2010. Engaging practice in research. In D. Golsorkhi, L. Rouleau, D. Seidl, & E. Varra (Eds.). **The Cambridge Handbook on Strategy as Practice**. 23-33. Cambridge University Press.

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

Paulus, P, Larey, T.& Dzindolet, M. 2001. Creativity in groups and teams. In M. Turner (Ed.), **Groups at work: Advances in theory and research**: 319-338. Mahwah, NJ: Erlbaum.

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

Pennington N. & Hastie, R. 1986. Evidence evaluation in complex decision-making. ***Journal of Personality and Social Psychology***, 51(2):242-258.

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

Pugmire, D. 1998. ***Rediscovering emotion***. Edinburgh University Press.

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

Rittel, H. 1972. On the planning crisis: Systems analysis of the first and second generations. ***Bedrift Sokonomen***, No. 8: 309-396.

Romme, G. 2003. Making a difference: Organization as design. ***Organization Science*** 14(5):558-573.

Rowe, P. 987. ***Design Thinking***. Cambridge, MA: The MIT press.

Sarasvathy, S. 2001. Causation and effectuation. ***Academy of Management Review***, 26 (2):243-265.

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

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

Schoemaker, P. 1993. Multiple scenario development: Its conceptual and behavioral foundations. ***Strategic Management Journal***, 14 (3): 193-213.

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

Seidel, V. & Fixson, S. 2013. Adopting 'Design Thinking' in Novice Multidisciplinary Teams: The Application and Limits of Design Methods and Reflexive Practices, ***Journal of Product Innovation Management***, 30 (6): forthcoming.

Sherman, S.J. 1980. On the self-erasing nature of errors of prediction. ***The Journal of Personality and Social Psychology***, 39: 211-221.

Sherman, S.J., Skov, R.B., Hervitz, E.F. & Stock, C.B. 1981. The effects of explaining hypothetical future events. ***Journal of Experimental Social Psychology***, 17: 142-158.

Simon H. 1969. ***The sciences of the artificial*.** Cambridge, MA: MIT Press.

Sims P. 2011. ***Little bets: How breakthrough ideas emerge from small discoveries*.** New York, NY: Free Press.

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

Snyder, M. & Swan, W. B. 1978. Hypotheses testing processes in social interaction. ***The Journal of Personality and Social Psychology***, 36:1202-1212.

Somech, A. & Drach-Zahavy, A. 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., Dunning, D., & Loewenstein, G. 2000. Egocentric empathy gaps between owners and buyers: Misperceptions of the endowment effect. ***Journal of Personality and Social Psychology***, 79 (1): 66-76.

Van Boven, L. & Loewenstein, G. 2003. Social projection of transient drive states. ***Personality and Social Psychology Bulletin***, Vol. 29, No. 9: 1159-1168.

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

Veryzer, R. & Borja de Mozota, B. (2005). The Impact of User-Oriented Design on New Product Development: An Examination of Fundamental Relationships. ***The Journal of Product Innovation Management***, 22:128-143.

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

Exhibit 1

COMMON DESIGN THINKING TOOLS

1. Visualization This 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, or capturing individual ideas on post-it notes and whiteboards so they can be shared and developed jointly.

2. **Ethnography** This 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. Ethnography is a core element in design thinking's exploratory first stage. Design thinking begins with immersion in the user experience to develop a deep understanding of their current situation and needs before moving to the creation of solutions.

3. **Structured collaborative Sense-making and ideation techniques** Sense-making tools 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 can 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** This focuses on identifying assumptions around value creation, execution, scalability and defensibility that underlie the attractiveness of a new idea.

5. **Prototyping** These techniques facilitate making abstract new ideas tangible. These include approaches such as storyboarding, user scenarios, metaphor, experience journeys, and business concept illustrations. Prototypes aim to enhance the accuracy of these conversations by providing a mechanism to allow decision-makers to create more vivid manifestations of the future.

6. **Co-creation** incorporates techniques that engage users in the process of 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 testing the identified assumptions using prototypes with external stakeholders.

Exhibit 2

Flaws in Cognitive Processing and their Consequences for Innovative Problem Solving

Cognitive Bias	**Description**	**Innovation Consequences**
Projection bias	Projection of past onto future	Failure to generate novel ideas
Egocentric empathy gap	Projection of own preferences onto others	Failure to generate value-creating ideas
Focusing illusion	Over-emphasis on particular elements	Failure to generate a broad range of options
Hot/cold gap	Current state colors assessment of future state	Under or over valuing ideas
Say/do gap	Inability to accurately describe own preferences	Inability to accurately articulate future wants and needs
Planning fallacy	Over-optimism	Unrealistic expectations set that can create over commitment 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	Under valuing of more novel ideas
Impact of time	Distant ideas are less specific and harder to analyze	Predictions and assessments increasingly flawed as horizon lengthens

Exhibit 3

Areas Where Design Thinking Tools Address Cognitive Flaws

	Projection	Empathy Gap	Focusing Illusion	Hot/Cold Gap	Say/Do Gap	Planning Fallacy	Confirmation Bias	Endowment Effect	Availability Bias	Time Effect
Visualization thru stories, metaphors, and imagery	X								X	X
Ethnography	X	X	X	X	X					
Creating multiple options			X				X	X		
Ideating with diverse group	X	X	X	X						
Prototyping						X	X		X	X
Assumption testing						X	X			
Co-creation	X	X	X	X	X	X				
Field experiments						X	X	X	X	