EMPOWERING THE CREATIVE PRACTITIONER:
TOWARDS AN ECOLOGICAL FRAMEWORK OF CREATIVITY AS EMBEDDED PRACTICE
TO INFORM ENVIRONMENTAL DESIGN

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A thesis submitted to the
Faculty of the Graduate School of the
University of Colorado in partial fulfillment
of the requirements for the degree of
Doctor of Philosophy
Cognitive Science
and
Design and Planning
2013
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Thesis directed by Associate Professor Raymond McCall

ABSTRACT

What role (if any) does the designed environment play in creativity? Cities like Athens, Florence, Paris, and Vienna are known for periods of spectacularly high creativity. Majestic landscapes and contemplative architecture are credited with inspiring creative insight. Famously creative people, like Proust, Kipling, and Kant, describe how rooms, tools, and inspirational objects are instrumental for their creativity. However there is a lack of empirical investigation into the relationship between the designed environment and people’s creative processes. On the rare occasions when creativity researchers do consider the role of the designed environment, they dismiss it as insignificant for creativity or suggest it is impossible to examine empirically. My inquiry is a response to the conflicting beliefs between creativity researchers who feel the physical environment is unimportant for creativity and environmental designers who create settings with the specific intention of increasing creative productivity.

With my dissertation I seek to lay the theoretical groundwork for a scholarly investigation of creativity as a physically situated process. This process is driven by a thorough evaluation of the creativity, cognitive science, and environmental psychology literatures; an analysis of environmental design strategies; first–person accounts of creativity; and my own experience as a creative practitioner. From this analysis I develop three creative contributions. First, I construct the Multi–Modal Process Model of Creative Practice, which describes creativity as a combination of five physically–situated and interrelated modes of creative cognition. This model rebuts opinions expressed in the creativity literature that the designed environment is unimportant for creativity. Second, I develop the Creativity–in–Context theoretical framework, which provides a structure to organize empirical investigation into the relationship between people’s creative processes and features of the designed environment. This framework rebuts suggestions that
empirical examination of this relationship is impossible. Third, I present some implications for practice with the Rich Environments Design Guidelines, which provide a preliminary structure to inform the design of settings intended to support creativity. Finally, I suggest that these three creative contributions might form the foundation for a new stream of research — an ecological psychology of creativity.

The form and content of this abstract are approved. I recommend its publication.

Approved: Raymond McCall
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CHAPTER I
SETTING THE STAGE
CONSIDERING THE RELATIONSHIP BETWEEN CREATIVITY AND THE DESIGNED ENVIRONMENT

Introduction

Stories abound about how creative people believe that aspects of their settings — including the spaces they inhabit along with the tools and materials they use — are important to their creative process. Anecdotes relay how Immanuel Kant felt he needed the church steeple view from his bedroom window to be creative (Wasianski, 1902), Marcel Proust preferred to work in a cork-lined room (Fuss, 2004), and Rudyard Kipling would only write with obsidian black ink (Kipling, 1937). Despite the appearance of idiosyncratic behavior commonly associated with creative people, these stories suggest that an individual’s creative process may be intrinsically linked with the physical setting. This belief has motivated the design of buildings (Doorley & Witthoft, 2012; Groves, Knight, & Denison, 2010; McCallam, 2010) and the planning policies of cities (Florida, 2003, 2004, 2012; Landry & Bianchini, 1994; Landry, 2000) yet current theoretical models of creativity do little to address the role of such settings in a person’s creative process (Drake, 2003; Dul, Ceylan, & Jaspers, 2011; Moultrie et al., 2007). As product designers, interior designers, architects, and city planners spend considerable time and money designing artifacts of the physical environment to foster human creativity, they do so with no common theory to guide such practice. This dissertation aims to begin to address this gap in the creativity literature.

Creative Places

Settings that are intended to foster creativity can be found across time and at every scale of intervention — from the single room including the designed objects within it, all the way up to
the city. Design of these settings is sometimes employed as a behavioral intervention, aimed at fostering social collaborations toward increasing creative productivity (Doorley & Witthoft, 2012; Dul et al., 2011; Harrington, 2011; Sawyer, 2007, pp. 164–166). At other times designs incorporate affective or phenomenological methods to provide settings to inspire people to produce creative work (Drake, 2003; McCoy & Evans, 2002; Roth, 1993).\(^1\) The Salk Institute in La Jolla, California, is one iconic example of a building that uses both strategies (Roth, 1993). This visually compelling facility constructed in the 1960’s was planned to provide flexible spaces to support the creative work of the scientists that occupy it. World-renowned architect Louis Kahn gave much consideration to the ways the scientists worked, designing the structure to maximize inspirational views and facilitate social interaction and collaboration among the occupants. Although Kahn’s Salk Institute may be one of the best known examples of a building designed to foster creativity, it is certainly not a unique case.

The earliest American colleges constructed during the colonial period also show evidence of architectural planning and design intended to foster new knowledge and innovation among the population of students and faculty (P. V. Turner, 1984). Like the Salk Institute, the colonial colleges were located in natural settings away from the bustle of the city. Influenced in large part by the belief that being close to nature would best lead the students to achieve enlightenment, this trend to incorporate nature views into the design of university buildings continues to this day (P. V. Turner, 1984). Connection to nature is also a theme in interior design, where studies have shown people identify rooms with natural materials and views of nature as being more likely to foster creativity in the workplace (McCoy & Evans, 2002). Common to all these examples is the inspirational quality of nature. Creativity is often anecdotally associated with the act of removing oneself from the structure and routine of daily life by escaping to inspirational natural places, but there has been little empirical investigation into the relationship between people and natural settings in this regard.

\(^1\) Affective and phenomenological strategies are aimed at using materials, shapes, colors, textures, light, and shadow to engage the user’s senses in the experience of a place. See Chapter III for additional discussion of this theoretical approach in architecture.
More recently, the social aspects of creativity have been emphasized in architectural designs and city planning strategies (Dul et al., 2011; Florida, 2004, 2012; Landry, 2000; McCoy, 2005). This reflects a shift in thinking about creativity from something that happens in the unaided human mind to that of a process influenced by the person’s socio-cultural environment (Amabile, 1996; Csikszentmihalyi, 1996; Feldman, Csikszentmihalyi, & Gardner, 1994a).

Workplace design has been significantly impacted by this shift, reflecting increased emphasis on design strategies intended to foster social interaction and collaboration (Doorley & Witthoft, 2012; McCoy, 2005; A. Williams, 2009). Recent interest in the city as an incubator for creativity has also influenced the development of planning policies (Florida, 2004, 2012; Landry, 2000). In city planning, emphasis is placed on the relationship between geographic proximity and knowledge transfer as a means to increase creative productivity (Bettencourt, Lobo, Helbing, Kühnert, & West, 2007; Carlino, 2001; Glaeser, Kallal, Scheinkman, & Shleifer, 1992; Stolarick & Florida, 2006). Whether the scientific research laboratory, the collegiate campus, an office building, or even a city, there are many designs that exemplify the attempt to associate cognitive and behavioral goals with the physical planning of rooms, buildings, and urban spaces. Despite these numerous examples, there is a lack of evidence that such design strategies are based on more than anecdotal evidence or substantiated by post occupancy analysis (Moultrie et al., 2007). Specifically, there is little indication that empirical findings from the psychology of creativity literature have been meaningfully integrated into architectural designs and urban plans. Conversely, the creativity literature also largely ignores the role of physical settings in creative processes (Dul et al., 2011).

**The Four P’s of Creativity**

Creativity is a multifaceted phenomenon that cannot be fully understood from the perspective of a singular perspective or domain of study (Mark A. Runco, 2007a; Sawyer, 2012), yet the physical context of creativity has received relatively little attention in the creativity literature (Dul et al., 2011; Hunter, Bedell, & Mumford, 2007). Over the past century, the field
has evolved from a focus on psychometric studies of creative personalities, to a multi-faceted and multidisciplinary approach informed by research from psychology, fine and applied arts, biological sciences, education, computer science, sociology, and business (Mark A. Runco, 2007a; Sawyer, 2012). Not surprisingly, there have been several attempts to organize the empirical contributions. One widely recognized structure was developed by Mel Rhodes (1961) who proposed a system to categorize different perspectives according to Four Ps: Person, Process, Product, and Press.

Research on the creative person has focused primarily on who is creative through identification of common personality traits. Despite the volume of literature generated in this research strand, it is frequently criticized for weak external validity (Feldman et al., 1994a) and its lack of accounting for environmental (Mark A. Runco, 2007a) and cultural (Csikszentmihalyi, 1996) differences among participants. Its low predictive value makes it improbable that findings solely from this domain could inform real world problems such as the design of buildings. Equally ineffective for practical application is the creative product literature. The product literature focuses on what people create and is generally concerned with efforts to measure creativity. Although this approach facilitates methods of objective analysis, it is also criticized for its low predictive value and the lack of insight it provides about the creative process (Mark A. Runco & Kim, 2011; Mark A. Runco, 2007a). This leaves the creative process and press literatures as the most relevant for understanding the relationship between creative people and the settings they inhabit while engaged in creative processes.

The creative process strand is concerned with how people are creative by identifying mental processes and cognitive mechanisms. This literature most commonly conveys findings through explanatory models. These models describe the mental stages of individual creativity and have influenced creativity training approaches (Rhodes, 1961; Mark A. Runco, 2007a; Sawyer, 2012; T. B. Ward & Saunders, 2003). Process models are not sufficient as “recipes” to predict creativity however, because individual personality factors and environmental conditions also come into play (Amabile, 1996, 1996; Csikszentmihalyi, 1996; Feldman et al., 1994a). The effect of environmental contexts on creativity is considered in the creative press literature.
The creative press addresses where creativity happens and considers the environmental influences that may affect creative behavior (Rhodes, 1961). This perspective has historically privileged socio-cultural over physical environments (Drake, 2003; Dul et al., 2011). Mooney (1963) describes the press literature as concerned with “what patterns of circumstances around individuals or groups accompanies what patterns of behavior in them” (p. 332). Much of the recent stream of creativity research has taken a systems (confluence) view of creativity that suggest multiple factors (personality, process, and/or environmental) are necessary for creativity to occur (Mark A. Runco, 2007a; Sawyer, 2012; R. J. Sternberg, 1999). The work of Amabile (1996) and Csikszentmihalyi (1996) are closely associated with this perspective and both describe creativity as an interaction between the creative person and the socio-cultural context of creativity. Despite emerging research from the systems perspective, there is still minimal integration between research strands in the Four Ps of creativity (Mark A. Runco & Kim, 2011; Sawyer, 2012).

**Bridging the Gap: Linking Creative Process and Place**

In order to effectively design places to support creativity, architects, planners, and other design professionals need a descriptive theory to inform them about what role these settings might play in creative cognition. There is, however, a significant gap in the literature where it concerns the physical context of creativity (Dul et al., 2011; Moultrie et al., 2007). Creative process models generally describe creativity as entailing purely mental activities (Kozbelt, Beghetto, & Runco, 2010; T. B. Ward & Saunders, 2003) and the creative press research prejudices the social context of creativity over the physical (Amabile, 1998; Drake, 2003; Dul et al., 2011) — thus rendering both these literatures insufficient for informing the design of settings to support creativity. Further, the creative press literature has suggested that the physical environment is not a productive area of investigation in creativity. Amabile (1998), who is known for her work on social environments and creativity, argues that the physical environment does not play any significant role in creative processes. Csikszentmihalyi (1996, p. 135), another highly
regarded creativity researcher, acknowledges that the physical environment may play a role in creativity, but argues that it is impossible to obtain empirical evidence to explain how features of the physical environment serve to catalyze creative processes. Although tools, rooms, buildings, landscapes, neighborhoods, and cities are designed with the intention of fostering creativity, knowledge gleaned from their design and implementation does not inform the creativity literature. This dissertation seeks to begin to bridge this gap in the creativity literature by addressing the problem of how to consider people’s relationships to their physical environments during periods of creativity.

**The Designed Environment**

Although both man-made and natural settings may play some role in people’s creative processes, this dissertation focuses primarily (albeit not exclusively) on man-made environments. I refer to these as *designed environments*. A designed environment encompasses all of the man-made objects in a particular setting, including tools, materials, furniture, rooms, buildings, streets, parks, plazas, etc. The professional disciplines involved in the design of these artifacts are thus referred to collectively as the field of *environmental design*, and the people who work in the field as *environmental designers*. The National Academy of Environmental Design (2011) defines environmental design as addressing "*the impact of the built environment on individuals and the natural world and ... comprises architects, planners, landscape architects, interior designers, preservationists, building technology specialists, and researchers from a wide range of disciplines.*" I extend this definition to include the discipline of product design (also referred to as industrial design.)

Product designers are not typically associated with the creation of designed environments; however in practice there is no hard boundary between product design, interior design, architecture, landscape architecture, and urban planning. Generally disciplinary divisions occur at the scale of the design intervention, with product designers responsible for the smallest scale artifacts, such as tools and furniture, and urban planners responsible for the largest scale of
environmental design, including the land use and transportation systems of cities and regions. However many professionals work across the different disciplinary scales. The inventor Buckminster Fuller famously blurred the division between product design and architecture, with his work on such projects as the geodesic dome and the Dymaxion House (Sieden, 2000) and architects frequently design artifacts commonly associated with product design. Many famous architects are well-known for their furniture designs, including Alvar Aalto, Eileen Gray, Le Corbusier and Mies van der Rohe (Hesse & Lueg, 2012). Michael Grave’s product designs for the retail store Target has arguably made him more famous among the general population than his building designs (Patton & Graves, 2004). Creative insight is also strongly (although anecdotally) associated with occurring in the bed, bus, and bath — all artifacts of the product design scale (Dart, 1989; Gruber, 1981a). There is evidence to suggest that when creative people inhabit a setting, all the features of their designed environments — including those at the scale of product design — may be leveraged in pursuit of a creative problem (Csikszentmihalyi, 1990, 1996; Schön, 1983). The literature about creative places however, is typically framed from the traditional disciplinary perspectives of interior design, architecture, urban design, or city and regional planning. I propose in this dissertation that it is useful to consider people’s relationships with the artifacts of their environments during creativity across all scales of the designed environment — from tools to cities — unencumbered by the constraints of disciplinary boundaries.

**The Creative Practitioner**

Creative places are designed for creative people; therefore it is necessary to define who is creative in order to determine what population these places may potentially serve. Researchers generally agree that creativity entails a suite of ordinary cognitive processes involving both conscious and unconscious mental work (T. B. Ward & Kolomyts, 2010). This suggests that anyone of normal abilities may be creative at a given point in time. To distinguish the high level of expertise and creative achievement of eminently creative people like Ben Franklin, Albert
Einstein, Pablo Picasso, and Mozart from people who engage in creative activities for the pleasure of the experience, creativity is typically categorized as either extraordinary or everyday (Boden, 2004; Csikszentmihalyi, 1996; Kaufman & Beghetto, 2009). Extraordinary creativity is defined by ideas that are a significant departure from those of their time and may transform knowledge or methods in a particular domain (Boden, 2004; Csikszentmihalyi, 1996). Everyday creativity encompasses ideas that are creative primarily to the person or persons who conceived of them (Boden, 2004; Csikszentmihalyi, 1996). These categories are not particularly useful for this dissertation. Settings that are intended to support creativity are typically designed for a more general population of creative peoples than the small sample of the extraordinarily creative, but a more specific group of people than the everyday creative population (which includes nearly everyone who is not extraordinarily creative.) Creative achievement is clearly a continuum, but more nuanced categories are required to support the practical application of creativity research (Kaufman & Beghetto, 2009).

Settings intended to support creativity are most often designed for people who are engaged in creative activities for a significant portion of their day (Drake, 2003; Fig, 2009; Groves et al., 2010; McCallam, 2010; McCoy, 2005). I refer to these people as creative practitioners. They are creative professionals who earn a living by practicing their creative work. They may be artists, writers, composers, choreographers, designers, scientists, mathematicians, or anyone else who is paid to produce creative ideas or products — whether or not they are typically associated with a creative discipline. There is a debate in the literature regarding whether creativity is domain–specific (domain–dependent) or domain–general (domain–

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2 Creative practitioner is a term that is similar to, yet distinct from, both Richard Florida’s (2004) “creative class” and the “Pro-c” category of creative expertise proposed by Kaufman and Beghetto (2009). Florida’s creative class definition has been criticized for being based largely on educational attainment without a clear relationship to creativity (Markusen, 2006). The Pro-c definition of creativity does not include all professionals working in a creative field, only those who have achieved “world-class, expert-level status” (p. 5). My definition includes both people who are becoming creative professionals as well as eminently creative practitioners who have achieved extraordinary levels of success.
independent) (Baer, 2010); however Silvia et al (2009) argue that the method of research has much to do with one’s perspective. Research that focuses on the creative person or cognitive processes often appears domain–general, whereas with examination of creative products the phenomenon appears domain–specific. It is my intention here to examine the domain–general aspects of the creative process as a means to understand the relationship between creative practitioners and their designed environments.

The term creative practitioner reflects the current understanding that creativity is a craft that can be practiced and develops from expertise (Boden, 2001; Csikszentmihalyi, 1996; Hayes, 1989; Jay & Perkins, 1997; Mark A. Runco, 2007a; T. B. Ward & Saunders, 2003). Creative practitioners have developed expertise in their domains and are financially rewarded for it — whether they are still in the process of establishing a reputation in their career or have already achieved extraordinary levels of creative achievement. There is a general agreement in the creativity literature that domain knowledge expertise is necessary to be creative within a field, although the precise amount of knowledge remains unanswered and may vary by discipline (Csikszentmihalyi, 1996; Hayes, 1989; Jay & Perkins, 1997; Mark A. Runco, 2007a). In lieu of quantifying expertise by years of knowledge acquisition, it is assumed that creative practitioners have sufficient expertise as evidenced by their ability to earn a living through their creative practice. Although this dissertation focuses primarily on the creative practices of professionals, I will occasionally use examples from people who are learning to become creative practitioners (e.g. design students) to illustrate how creative practice develops. Another debate in the literature concerns the appropriate level of empirical analysis: the creative individual or the group (Sawyer, 2010). Although both levels of analysis are important, I am interested in understanding the role of the designed environment in both explicit and intuitive creative processes. Intuitive processes are more challenging to examine in social groups; therefore my research focuses on the creative individual.

3 See also the debate between Baer (1998) and Plucker (1998).
Creativity is *what* the creative practitioner *does*, but the term is used in so many different contexts and situations that there is no single accepted definition (Mark A. Runco, 2007a; Sawyer, 2012). Since definitions serve to guide empirical investigation, variations in the creativity literature also generally reflect differences of focus on creative personality, individual or social processes, and creative product (Rhodes, 1961). For this dissertation the term must be defined in a way that is both appropriate and useful for understanding how creative practitioners may use the designed environment to support their creative practices. With this in mind, I extend Sternberg and Lubart’s definition (1999, p. 3) by describing creativity as the mental, social, and physical processes (from preliminary concern or problem identification through to externalization, materialization, or concretization of an idea) of creating something (e.g. a product, theory, technique, etc.) that is both original and has value or purpose for a segment of society. My definition acknowledges 1) the mental, social, and physical process of creativity, 2) the full range of human activities involved throughout the creative process, and 3) the role of the socio-cultural environment in evaluating what is creative. This definition, I suggest, more fully reflects current theories of human cognition as a situated phenomenon that involves not only mental processes, but also social and physical conditions.

**Creative Cognition: Situated, Embodied and Embedded**

Contrary to the creativity literature which largely ignores the role of the physical environment (or suggests that it is not important) (Amabile, 1998; Dul et al., 2011; Harrington, 2011), there is general agreement in the cognitive science literature that human cognition is situated, both physically and socially (Anderson, 2003; Robbins & Aydede, 2009). Situated cognition is a theory based on the premise that knowledge cannot be separated from context, that knowing is “inextricably situated in the physical and social context of its acquisition and use” (Brown et al, 1988, p. 1). There are three central ideas in situated cognition (Robbins & Aydede,

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4 Cognitive science is a multi-disciplinary field of study that typically includes psychology, neuroscience, computer science, philosophy, education, linguistics, anthropology, and others involved in human cognition research (Robbins & Aydede, 2009)
2009), 1) the embodied thesis – that cognition encompasses both the mind and the body; (Clark, 1998; Reed, 1996) 2) the embedded thesis – that people exploit features of the physical and social environment to increase cognitive capabilities; (Clark, 2008; Hutchins, 2006; Noë, 2004) and 3) the extended mind thesis – that cognitive processes are extended beyond the boundaries of a person’s body through “cognitive coupling” with artifacts in the environment (Clark & Chalmers, 1998; Clark, 2008.) Of these claims, the first two are commonly accepted in the field of cognitive science, whereas the third remains controversial (Robbins & Aydede, 2009; M. Wilson, 2002). This dissertation will consider how creativity is physically situated, by demonstrating how creative processes align with the embodied and embedded views of situated cognition. I will use the theory of situated cognition to begin to bridge the gap between the creativity and environmental design literatures.

The Structure of the Dissertation

This dissertation intends to respond to a recent surge in interest around creativity and the sometimes–problematic communication in the media about how the designed environment may impact people’s creativity. For example, Jonah Lehrer (2012) popularized the idea that the color blue makes people more creative with the publication of his book on creativity. In it he describes a study by Mehta and Zhu (2009) published in Science where the researchers examined the effect of red or blue background computer screen colors on detail-oriented versus creative tasks. The results indicated improved accuracy under the red background condition in the detail-oriented task and improved creativity scores under the blue background condition. Although the researchers discussed the limitations of the study and cited other studies with conflicting results, Lehrer (2012) uses this as evidence to assert that “We can now begin to understand why being surrounded by blue walls makes us more creative” (p. 51.)\(^5\) The study had

\(^5\) See Chapter III for a discussion about architectural determinism and how a statement like this suggests that the designed environment will determine human behavior.
nothing to do with environmental (wall) color, yet the publicity around the publication of Lehrer’s book popularized the idea that blue walls will increase creativity.\textsuperscript{6}

While it is certainly possible that certain colors may improve creative productivity under some conditions, examples like Lehrer’s run the risk of popularizing unfounded information — which may ultimately undermine efforts to truly understand the role of the designed environment in creativity. The intention behind this dissertation is to investigate the role of the designed environment in creativity. I will discuss how evidence suggests that it does play a role — but not as a stimulus intended to elicit specific creative behaviors as it is sometimes considered in the environmental design literature. I will demonstrate instead how features of the designed environment scaffold different creative processes for people and suggest what implications this may have for the design of settings to support people’s creative practices.

- I will not prescribe paint colors.
- I will not profess that the “right” environment will make you creative.
- I \textit{will} illustrate how creative people leverage features of their designed environments in order to increase their creative productivity. I will also formulate a hypothesis about why these strategies may work for them.

**Goals**

The ultimate goal of this dissertation is to first inform scholarly discourse around the subject of creativity as a form of embodied and embedded cognition, and then to suggest a framework that may begin to guide the design and evaluation of settings intended to support creative work. To that end, I will conduct an inquiry into the role of the designed environment in creativity. This inquiry is in response to the conflicting beliefs between creativity researchers who feel that the physical environment is not significant to creativity and environmental designers who create settings with the specific intention of supporting creativity. I approach the question \textsuperscript{6}In an interview published in Dwell Magazine, a periodical marketed to architects and interior designers, Lehrer encourage architects and designers to use red or blue room colors to influence the way people think (Pederson, 2012). For the full quote see http://www.metropolismag.com/story/20120608/designing-for-creativity
“What (if any) role does the designed environment play in creativity?” as a three-stage process. First I identify the different situated modes of creativity and describe the relationship between them through the development of the Multi-Modal Process Model of Creative Practice. This model suggests (contrary to Amabile’s (1998) view) that the physical environment is instrumental to people’s creative processes. Next I illustrate through the development of the Creativity-in-Context Theoretical Framework, how people use features of the designed environment to engender, sustain, and inhibit different creative modes. This framework is a response to Csikszentmihalyi’s (1996, p. 135) claim that it is impossible to empirically investigate the role of the physical environment in creativity. I suggest that the Creativity-in-Context framework provides the structure to empirically ground research on the relationship between people and their environments during creativity. Finally, I suggest the implications the framework has for environmental design strategies through the concept of Rich Environments. I consider this model and framework a first step in beginning to bridge the gap between the creativity and environmental design literatures. It is my hope that they will form a preliminary structure, to be further refined and developed as a future body of knowledge is constructed around the relationship between creativity and the designed environment.

**Methods**

This dissertation follows in the footsteps of the theoretical traditions established in creativity, architecture, and cognitive science research. The earliest (and most enduring) theoretical model of the creative process was developed by Graham Wallas (1926) and based primarily on two first-person accounts of creativity. The first was a speech given by the German physicist Hermann von Helmholtz at a banquet to celebrate his 70th birthday (pp. 79-80). The second was from a chapter titled “Mathematical Invention” in the book *Science and Method* written by the French mathematician Jules Henri Poincaré (p. 75). From these Wallas developed his four-stage model of creativity entailing preparation, incubation, illumination, and verification, which continues to be influential in the creativity literature to this day (Csikszentmihalyi, 1996;
My research builds on the theoretical process models developed by Wallas and others by integrating theoretical work from cognitive science on situated cognition. The hypotheses I develop from this integration is further informed by and tested against empirical research, documented first–person accounts from creative practitioners, and my personal experiences as an architect and educator of design students. First–person accounts provide practical, context-dependent knowledge that is particularly valuable for informing fields of applied practice, such as the environmental design professions (Merriam, 2009).

The methods employed in this dissertation are used with the intention of developing a testable theory. Karl Popper (1974) argues that scientific knowledge progresses more quickly when researchers develop theories and then attempt to refute them. As there is no current theory suitable for understanding what role the designed environment may play in people’s creative processes, this dissertation is primarily a theory building effort. My research adopts the method of logic model analysis (Yin, 2009) to gain insight into the relationship between creativity and the designed environment. Models are recommended by Frankfort–Nachmias and Nachmias (2008) “for gaining insights into phenomena that the scientist cannot observe directly, such as ‘decision making’” (p. 40). Logic model analysis consists of comparing both documented first–person accounts and observed events to a detailed hypothetical logic model that visually illustrates the relationship between events. When the data does not match the logic model, rival explanations are examined and the logic model is revised. The process of revision and comparative analysis continues until the model accurately reflects events.

The first model I develop through this method is the Multi-Modal Model of Creative Practice. It describes situated modes of cognition involved in the creative process and explains the relationships between them. The model is derived from an analysis of existing creative process models and uses as its starting point Csikszentmihalyi’s (1990) work on creative flow and Schön’s (1983) theory of reflective practice. It extends this work by drawing from empirical

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7 Csikszentmihalyi (1996) regularly references Wallas’s four stage model in his own research on creativity. Also, see Chapter IV for further explanation of the Wallas model.
8 The Multi-Modal Process Model of Creative Practice is introduced in Chapter V.
research, documented first–person accounts, and personal observations of creativity to describe five modes of creativity: problem–finding, immersion, reflection, rumination, and evaluation. The modes are organized to describe the “breakdown–and–repair” relationships between them.

The second model is the Creativity–in–Context Theoretical Framework. This framework integrates the Creative Practice model with the taxonomy of environmental features. The taxonomy is derived from the same data used to inform the Creative Practice model and identifies a system of six environmental categories that play a role in creativity: places, events, processes, place–scale objects, attributes, and relationships. Grounded in Gibson’s (1977) affordance theory, the Creativity–in–Context (CiC) framework describes relationships between a creative practitioner (when engaged in a mode of creativity) and features of his or her environment. With the framework I illustrate how people use environmental features to increase their creative productivity by demonstrating how the framework explains first-person accounts of creativity. Finally I use the CiC framework to discuss implications for practice by discussing how the particular features of the designed environment support the different modes of creativity.

Lang and Moleski propose (2010) functional theory as the instrument through which empirical evidence can meaningfully inform the practice of environmental design. Functional theory is “the positive basis for design in the sense that it consists of empirical assertions, or hypotheses, about reality” (Lang & Moleski, 2010, p. 315). In contrast to normative theory, which focuses on design principles often associated with stylistic trends, functional theory focuses on the principles of environmental experience and the relationship between users and their environments (both natural and designed.) It is a response to the gap between what environmental designers claim they are trying to achieve and the performance of their designed

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9 Frankfort–Nachmias and Nachmias (2008) describe a taxonomy as “a system of logically related categories constructed to fit empirical observations in such a way that relationships among the categories can be defined” (p. 34). See Chapter VI for a detailed explanation of the taxonomy of environmental features and the Creativity–in–Context Theoretical Framework.

10 They adopt the term from Kevin Lynch (1981) who coined the phrase to avoid negative connotations associated with positive theory. See Chapter II for a discussion of the negative connotations of positive theory in architecture and its relationship to the concept of architectural determinism.
environments. The functional theory developed in this dissertation aims to begin to bridge this gap for the design of settings intended to support creativity.

**Organization of the Chapters**

This dissertation will build a theoretical argument about the role of the designed environment in the creative processes of individual practitioners. The task will require the focus on three different literatures: creative press, cognitive theory, and creative process, organized as Chapters II - IV.

**Creative press.**

In Chapter II I present an overview of the environmental design literatures that addresses creativity. The intention behind this chapter is to 1) identify common themes across different scales of the designed environment and 2) uncover implicit theories that may be manifest in the design of places for creativity. There are three main design strategies used to support creativity. Most common is the links/nodes design strategy intended to build social density, diversity, and connectivity. This strategy reflects an understanding of creativity as a socially situated process and design interventions are implemented with the intention of increasing social interactions (Bettencourt et al., 2007; Stolarick & Florida, 2006). Flexible design is another common strategy where spaces are under–designed so that the users can determine their function. This strategy is a response to the uncertain and transitory nature of creativity (Apitzsch & Piotti, 2012). The third strategy involves designing for inspiration. Designs that incorporate majestic views of nature to inspire creativity suggest that the aesthetic qualities of an environment will inspire creative ideation. The inspiration strategy thus considers creativity a sub–conscious mental activity. Design strategies sometimes also incorporate environmental cues intended to sub–consciously shape creative ideation. The review of the environmental design literature suggests that 1) empirically grounded design strategies are most frequently based on the premise that increased social interactions will produce higher levels of creativity, 2) design
strategies reflect the debate in the academy concerning the nature of person–environment relationships, and 3) although similar design strategies are found across scales of the designed environment, they are not theoretically grounded in a common framework that describes the relationship between creativity and the physical environment. There is a gap between creativity theory and environmental design practices.

Environment and cognition relationship.

Chapter III frames the person–environment relationship debate in the environmental design literature by relating four environmental design approaches (deterministic, possibilistic, probabilistic, and free–will) to the epistemologies of human cognition. The intention behind this chapter is to identify theories of cognition that may help bridge the gap between the environmental design and creativity literatures. I will discuss how current theories of cognition suggest that the deterministic and free–will design approaches are not empirically supported in the literature. The theory of situated cognition does offer empirical support for the possibilistic and probabilistic approaches. Situated cognition theory considers people as autonomous agents who construct their own knowledge based on their interactions with the world and other people. The person–environment system view described by situated cognition indicates that the physical environment may impact people’s behavior but does not determine it. It also suggests that there is a fifth design approach — one that considers not how the environment affects people, but how people, as active agents, use the designed environment to extend their cognitive abilities. This approach differs from the other four (deterministic, probabilistic, and possibilistic, and free–will) because it does not consider the person a passive recipient of environmental interventions. Instead the designed environment is considered a cognitive and behavioral resource for people, and affords them opportunities for action. This chapter illustrates how situated cognition – and in particular theories of affordances from ecological psychology and embodied, embedded, and enactive cognition from cognitive science – can frame the person–environment relationship
during creativity and thus serve to bridge the creativity and environmental design creativity literatures.

**Creative process.**

Chapter IV is an overview of the creative process literature. The intention behind this chapter is to use the situated cognition theories to critique the creativity process models in terms of their applicability for informing the design of settings to support creativity. The process literature consists of stage models that describe creativity as a series of steps (e.g. the Wallas model mentioned previously) as well as creative cognition theories that examine the cognitive processes used in creativity, such as analogy and metaphor. An analysis of the creative process literature reveals that 1) there appear to be five modes of creativity: problem–finding, idea–generating, incubating, elaborating, and implementing, 2) these modes involve both intuitive and explicit cognitive processes, 3) the stage models and creative cognition theories do not adequately describe what people do during creativity nor do they explain the relationships between stages, and 4) none of the stage models sufficiently addresses the physical context of creativity.

I identify Csikszentmihalyi’s (1990) theory of creative *flow* as one creativity theory that does convey the physically situated nature of creativity. Flow describes a single mode of creativity, the process of intuitive immersion, which is employed to generate ideas. This mode is also described in Donald Schön’s (1983) theory of reflective practice, referred to there as *knowing–in–action*. Schön’s theory describes the interaction of two modes, the intuitive process of knowing–in–action and the explicit process of *reflection–in–action*, used by engineers, architects, town planners, managers, and psychotherapists during idea generation. Although reflective practice is more typically considered as either a situated design theory (Chai & Xiao, 2012) or experiential learning theory (Russell, 2005), I propose that together the theories of flow and reflective practice may provide a starting point for a new physically situated model of creativity.
The multi–modal process model of creative practice.

In Chapter VI I will introduce the Multi-Modal Process Model of Creative Practice. The Creative Practice model extends Csikszentmihalyi’s (1990) flow (which I refer to as intuitive immersion) and Schön’s (1983) reflection–in–action (which I call explicit reflection) to describe five interrelated modes of situated creativity: problem–finding, intuitive immersion, explicit reflection, adaptive rumination, and evaluation. First I illustrate how the physical environment is instrumental in Csikszentmihalyi’s theory of flow and use this as a starting point to build a model of situated creativity. Next I critique Schön’s work with respect to the creativity and situated cognition literatures. This critique demonstrates how Schön’s theory of reflective practice implicitly and systematically incorporates a physically situated view of creative processes. It also describes the intertwined relationship between two modes of creativity: immersion and explicit reflection. His theory, however, falls short of fully describing creativity in a number of ways. I propose how to extend Schön’s theory by using it as the nucleus for a more developed and explicit theoretical model of creative practice that is grounded in the situated cognition literature. I draw from current and emerging research in creativity and cognitive science, along with other relevant work from design theory, first-person accounts, and my own experiences as a practicing architect and educator to further illustrate, develop, and extend Schön’s theory to describe five modes of creativity. The formulation of this Multi-Modal Process Model of Creative Practice will provide the structure for a new framework that describes the relationship between people and their designed environments during creativity.

The creativity–in–context theoretical framework.

In Chapter VII, I will introduce the Creativity–in–Context theoretical framework as a means to organize knowledge about person–environment relationships during creativity in a way that is both useful and appropriate for informing environmental design strategies. The framework, grounded in situated cognition theory, incorporates Gibson’s (1977) theory of affordances to illustrate the role of perception during creativity. Affordance theory suggests that
features of the environment present action opportunities for people. I illustrate how people’s perception of these opportunities changes according to the mode of creative cognition in which they are engaged. Further, I develop the taxonomy of environmental features to help environmental designers consider how design interventions at different scales (e.g. products, rooms, buildings, etc.) may support creativity. Ultimately the framework describes three propositions about the relationship between people and their designed environments during creativity. First, people exploit, leverage, manipulate and alter features of the designed environment to enhance their creative ability and productivity. Second, environmental features serve different roles in engendering, sustaining, and inhibiting/curtailing five modes of creativity. Finally, changes in environmental features and changes in a person’s mode of creative cognition both alter the affordances of the person-environment relationship, thus affecting a person’s opportunities for action in the creative situation.

**Rich environments.**

In Chapter VII I discuss the implications the Creativity–in–Context framework has for environmental design practices. I suggest the concept of Rich Environments as a method of empowering creative practitioners through environmental design. Rich Environments entails a set of design guidelines — along with their rationale based on the Creative Practice model and Creativity-in-Context theoretical framework — to inform the design of settings intended to support creative practitioners. These design principles may be used as a preliminary critiquing system to both assist the environmental designer and advocate for the creative practitioner. Because environmental design is like any other creative endeavor, it is impossible to predict every possible outcome and use of a design intervention in advance. Rich Environments, therefore, provide both *structure* based on best empirical evidence to support creativity and *responsivity* that empowers users to adapt, modify, and customize environmental features to suit their needs over time.
**Summation, future research, and conclusion.**

In the final Chapter, I provide a summary of my creative contributions, discuss the limitations of this dissertation, and make recommendations for future scholarly investigations. In particular, I explain that what I propose here is not a fully developed theory of creativity as situated cognition, but rather a framework to serve as a starting point for future scholarly discussion. I suggest that together the Creative Practice model and Creativity–in–Context framework may contribute to a body of future research – including new methods of investigation into the role of the physical environment in human creativity – by providing a preliminary structure to bridge research and practice.
CHAPTER II
CREATIVE PLACE
A REVIEW OF ENVIRONMENTAL DESIGN STRATEGIES AND NORMATIVE THEORIES IMPLICIT IN SETTINGS TO SUPPORT CREATIVITY

Highlights

Creativity research is often categorized according to the topic of study, commonly referred to as the "Four Ps:“ Person, Process, Product, and Press. This chapter focuses on the creative press – the environments that exert "pressure" on the creative person. The creative press literature has largely focused on the socio-cultural environment, with little consideration for the role of the physical environment in individual creative processes. Yet, despite the lack of substantial theoretical support from the creative press literature, some physical environments are intentionally designed to foster both individual and social creativity. This chapter examines the man-made artifacts of the physical environment – ranging from the design of tools to the planning policies of cities – with the intention of uncovering common strategies and implicit theories of creativity in their design. It illustrates the lack of empirical investigation into how environmental design strategies may support creativity and highlights underlying issues that may help to explain the gaps between the environmental design and creativity literatures.

Introduction

Review

In the first chapter I briefly described how settings (cities, landscapes, buildings, rooms, and the artifacts within them) have historically been designed to foster creativity, yet their design strategies are rarely based upon empirical evidence or verified through post–occupancy evaluation. I also explained how the creativity literature is organized according to the four P’s:
person, process, product and press. The creative press literature, which entails systematic study of creative practitioners in their environments, has focused primarily on socio-cultural environments and thus is insufficient for informing the design of physical settings. In this chapter I will conduct a more detailed cross-disciplinary review of the environmental design literature that addresses creativity.

**Thesis**

I will illustrate in this chapter how a cross-disciplinary review of the environmental design literature is essential for understanding key issues concerning 1) how the relationship between environmental design and creativity has been considered in settings and products, and 2) why common design strategies to support creativity have produced inconsistent results. Such a review is unusual in environmental design, where scholarly publications tend to be discipline-specific. This cross-disciplinary review reveals three common design strategies employed to support creativity across different scales of the designed environment. They are listed in order of the frequency with which they are referenced with respect to creativity in the literature. The first strategy, *links/nodes*, is intended to increase social interaction and collaboration by creating areas of social density and connectivity. *Inspiration*, the second strategy, makes use of the attributes, materials, and natural elements believed to appeal to creative practitioners in order to provide aesthetically pleasing settings. *Flexibility* is the third strategy often referenced in the literature, however the term is not used consistently. Each design strategy thus suggests a different normative theory about the relationship between the creative person and the designed environment during creativity: 1) that environmental designs can determine social interactions and thus increase creativity, 2) that the aesthetics of a setting may influence intuitive creative processes, and 3) environmental designs cannot predict creative behavior so users should customize flexible settings to suit their needs.
Significance

This chapter seeks to illustrate the need for a common framework to guide the design and evaluation of settings intended to support creativity. The following review of the environmental design literature suggests that 1) common design strategies are found across scales of the designed environment, 2) the normative theories implicit in these design strategies are generally based on anecdote, folk knowledge, and people’s preferences for certain environmental features, 3) the perceived effectiveness of these design strategies is inconsistent, and 4) the few empirical studies that examine the effect of environmental design strategies on creative productivity yield results that often appear to contradict the normative design theories upon which they are based. The significance of this review is that it reveals that the role of the designed environment in creativity is a “chicken–and–egg” problem. Environmental design strategies rely largely on anecdote and folk knowledge, which yield inconsistent outcomes. The apparent ineffectiveness of environmental design to produce predictable outcomes leads creativity researchers like Amabile (1998) to suggest that the physical environment is not important for creativity. Yet, without a sufficient creativity theory to guide empirical investigation in environmental design, environmental design research currently consists primarily of studies that examine people’s preferences for different environmental features during creativity — instead of examining the role such features might play in the creative process. This suggests that without a theoretical framework to link environmental design and creativity, creativity researchers may continue to ignore the physical context of creativity and environmental designers may continue to replicate ineffective design strategies to support creativity.

Creative Press (Place)

Press is a term introduced by Murray (1938) to broadly describe environmental pressures that influence people’s behavior. Much of the creative press literature has emerged in the past 35 years and emphasizes the influences of social environments on creativity (Amabile & Pillemer, 2012). Teresa Amabile (1983), whose research focuses on the social psychology of creativity,
formulated the componential model of creativity, which describes the relationship between intra–individual components (e.g. skills and motivation) and the social environment (an external component.) Componential models describe the separate component necessary (but not individually sufficient) for creativity to happen (T. B. Ward & Saunders, 2003). A number of researchers have developed their own componential models based on Amabile’s work (Amabile & Pillemer, 2012).

Today four influential componential models are those developed by Gruber (1988), Amabile et al. (1996), Sternberg and Lubart (1991), and Feldman, Csikszentmihalyi, and Gardner (1994a). Gruber’s (1988) evolving systems model approaches creativity from the developmental perspective, describing how it evolves over time and is based on new schemas that emerge from encounters with a variety of different experiences and social situations. Amabile’s (1996) componential model demonstrates the effect of the social environment on a person’s task motivation, domain-relevant skills, and creativity-relevant skills. In their investment theory of creativity, Sternberg and Lubart (1991) suggest that six resources work together to form a creative investment: intellectual processes, knowledge, intellectual styles, personality, motivation, and environmental context. They hypothesize that creative practitioners “buy low” by investing in creative problems and ideas that are little known or previously abandoned and present their work when it is likely to be most favorably received, thus “selling high.” Finally, the DIF model developed by Feldman, Csikszentmihalyi, and Gardner (1994a) describes creativity as an interaction of three systems: ‘domain,’ ‘individual,’ and ‘field.’ The domain consists of the knowledge, rules, and procedures for a specific discipline and the field is the members of the discipline. They suggest that the field must not only judge the product of a creative process to be creative, but the product itself must also transform the domain. There are no componential models that include the physical environment with respect to creativity.

This review will draw together the literatures that consider the physical context of creativity. Recently, Runco (2007b) has recommended sub-categorizing the press literature by distinguishing distal press, such as historical and cultural influences, from immediate press, which...
he refers to as *place*. This chapter will focus on a sub-set of the place literature by addressing primarily the physical aspect of place. I will refer collectively to the environmental design literature in the following sections as the *creative place literature*.

In the following sections I have organized the creative place literature by discipline, with the creative city literature presented first. The creative city literature is the largest body and frames the discussion for the remaining sections. The remaining literatures are organized by scale around the disciplines of urban design, landscape architecture, architecture, interior design, and product design. For each of these scales, I will describe the design strategies that have commonly been employed to support creativity. I will also discuss how these design strategies are informed by different implicit theories of creativity and normative theories about the role of the designed environment in creativity. Although some environmental design scales appear to have been the focus of little or no empirical investigation, I will compare research findings with the design strategies whenever possible to reveal both similarities and inconsistencies.

**Creative Cities and Regions**

It is often said, "necessity is the mother of invention." In recent decades many cities and regions have felt the pressures of scarcity due to dwindling resources, growing unemployment, and the changing global economy (Apitzsch & Piotti, 2012) and in response have brought innovation and creativity to the forefront of discussions about city planning and development policies as a means to attract creative professionals and improve economic competitiveness (Currid, 2009; Florida, 2002a, 2012; Hilpert, 1991; Mawson, Begg, Fairley, & Foley, 1990). Cities have been a dominant focus of the creative place literature in part because there is compelling evidence to suggest that levels of innovation rise exponentially with an increase in population density (Bettencourt et al., 2007). The scholarly literature at the city/regional scale considers creativity through a socio-economic lens, as a form of human capital (Florida, 2002a, 2012; Landry, 2000, 2006). At the foundation of this movement is the question of whether geographical proximity is necessary and sufficient to enhance creativity. The creative city literature generally
considers four dimensions: economic, social, environmental, and cultural (Landry, 2000). Three main themes emerge from the environmental dimension: networks and clusters, density and diversity, and flexibility (Florida, 2002a; Landry, 2000).

Overview

Historically, some cities (like Athens, Florence, and Paris) have been associated with periods of high levels of creativity. Prior to the early 2000’s, however, the geography of creativity at the city or regional scale was not a widely recognized concept (Landry, 2006). Two books, published within a couple years of each other, spurred a global paradigm shift by introducing strategies to encourage growth of creative capital into the planning policies of cities: The Creative City: A Toolkit for Urban Innovators by Charles Landry (2000) and The Rise of the Creative Class by Richard Florida (2002a). Based on studies of European cities conducted with Comedia, a think tank Landry founded in 1978, he and Bianchini (1994) proposed the notion of “the creative city” as a solution to the problems of modern society in a small publication. It was not until a decade later — when Landry developed his research into a toolkit for city planners and managers and the effects of global restructuring were beginning to profoundly impact the economies of cities in North America and Europe — that the concept began to gain popular attention (Landry, 2006). Landry (2000) identifies key criteria that distinguish a creative city, including the environmental factors: density, diversity, distinctiveness, and linkages. It was the work of economist Richard Florida, however, that truly galvanized the creative city movement (Landry, 2006). Florida (2002a) popularized the idea that a “creative class” of people profoundly influences economic conditions and social norms. He first classifies these creative class people as a form of human capital and then identifies the environmental factors that influence their decisions to live in a particular place. Landry (2000), Florida (2002a), and others identify some similar characteristics of creative cities, such as networks/linkages, clusters/scenes, density, diversity, and flexibility.
Despite the popularity of his ideas and widespread adoption of them into planning practices, negative critiques of Florida’s work have been numerous. He has been criticized for his definition and measurement of the creative class (e.g. conflating creativity with educational attainment) (Markusen, 2006); use of same-sex male households as a measure for diversity (T. N. Clark, 2004; Markusen, 2006); an inability to describe significant correlation between level of creativity and the growth of cities (Malanga, 2004); failure to identify causal mechanisms (Huggins & Clifton, 2011; Peck, 2005; A. J. Scott, 2006); prejudicing urban areas as more creative than suburban or rural areas without examining the spatial distribution of where creative practitioners live and work (Huggins & Clifton, 2011; Stam, De Jong, & Marlet, 2008); and even running the risk of “hyping the concept out of favour” (Landry, 2006). Nonetheless, as of 2006 there were over 60 self-proclaimed creative cities (Landry, 2006) — demarking a profound shift in thinking about creativity from something that happens solely in the mind of the individual to that of a socially situated, collaborative process.

In the next sections I will introduce the design strategies and planning policies commonly employed to increase creative productivity in the city. Some design strategies are simply aimed at attracting creative practitioners in order to increase the city population, because larger cities appear to have exponentially higher rates of creativity (Florida, 2002a; Johnson, 2010; Landry, 2000). These often entail providing the type of city attributes believed desirable by creative practitioners — such as ready access to outdoor recreation opportunities and cultural venues. Other design strategies are geared toward facilitating knowledge transfer and the diffusion and adoption of innovation (Blair, 2009; Florida, Mellander, & Stolarick, 2010; Landry & Bianchini, 1994; Landry, 2000; O’Connor, 2004; Stolarick & Florida, 2006). Three common spatial themes emerge from this second strategy: 1) network and cluster configurations, 2) density and diversity characteristics, and 3) flexibility attributes that allow places to change and evolve over time.

11 Florida has also been accused of promoting neo–liberalism, although this discussion is beyond the scope of this dissertation, see for example Zimmerman (2008), Christophers (2008), and Markusen (2006).
Although they are sometimes addressed separately in the literature, I consider the first two themes different aspects of the same link/nodes design strategy.

**Links and Nodes: Social Interaction and Creativity**

**The diffusion and adoption of innovation.**

Much of the research on the creative city or region is marked by the tendency to frame the diffusion and adoption of creative ideas in terms of *clusters* and *networks* (Apitzsch & Piotti, 2012; Harvey, Hawkins, & Thomas, 2011). A cluster is an agglomeration of people from a particular creative industry, such as music, art, design, or fashion (Florida, 2002a), which creates a distinct area of concentration, or *node*, within a city or region. Networks form the *links* between clusters and determine how creative ideas are controlled, encouraged, disseminated, and/or accepted (Apitzsch & Piotti, 2012). Networks may be physical or virtual, but the creative city literature emphasizes physical connectivity both within a city or region and between them. This type of links/nodes model assumes that creative production depends upon social relationships and physical proximity (Blair, 2009; Florida et al., 2010; Landry & Bianchini, 1994; Landry, 2000; Stolarick & Florida, 2006). Similar in concept to Amabile’s (1996) componential theory, the creative city literatures hypothesize that clusters function to disseminate both explicit knowledge and tacit skills within the domain (Leadbeater & Oakley, 1999, p. 14; O’Connor, 2004; Ribault, 2010). The glass industry cluster in Murano, Italy, which has long been associated with a distinctive style of decorative Venetian glassware, is a well–known example of knowledge and skill transfer within a creative cluster. The Murano glass industry has functioned for centuries to pass specific localized skills in glass blowing from generation to generation, from master to apprentice, with small innovations evolving over time (Ribault, 2010). Although there has been little empirical investigation into the role of physical networks in the transfer of either explicit
knowledge or tacit skills, the very nature of tacit learning suggests that physical proximity may be important — if not essential — to this type of learning (O’Connor, 2004).12

Networks function as the links between clusters and serve as “gatekeepers” to control the evaluation and dissemination of creative products. As such they can vary widely concerning how they foster or inhibit creativity. They may contain a homogenous population who inhibit innovation within a domain in favor of protecting traditional methods and practices; or they may contain a very diverse membership that embraces change and rewards those who challenge the status quo (Harrington, 2011). For example, since 1291 the Murano, Italy glass industry has been geographically isolated on an island near Venice (Figure II.1.) Although its location was primarily intended to reduce the risk of fire, this geographic separation also helped preserve the secrets of the craft. Until the early 20th century the knowledge and skills associated with Venetian glasswork were closely guarded and master glassmakers were forbidden to leave Venice under penalty of imprisonment (Ribault, 2010). The closely controlled network allowed for the preservation and incremental perfection of the craft for generations. Venetian glass was a highly sought out commodity due to the scarcity and exclusivity of the product until after World War I, when the laws regulating trade were significantly loosened (Ribault, 2010). Today the knowledge and skills required to produce Venetian glass are widespread and have resulted in low cost production in Asia, threatening the Murano industry, which has been slow to innovate (Ribault, 2010).

12 See Chapter III for further explanation of tacit and explicit learning.
The Murano glass industry is geographically isolated from Venice, which helped to preserve the secrets of the craft.

The function of cluster-network relationship bears resemblance to the DIFI (Domain Individual Field Interaction) model of creativity (Feldman et al., 1994a), and suggests that networks serve two primary functions in the creative process; they not only control how domain knowledge and skills are transferred between clusters, but they also serve an evaluative role in the adoption of creative ideas and products. When networks restricted the flow of trade secrets between clusters — while simultaneously facilitating the distribution of Murano glasswork in the Venetian glass industry — the glasswork was considered highly creative. As the restrictions on the transfer of domain knowledge and skills between the different glass industry clusters loosened, the glassware produced was no longer considered as unique (or creative). The industry failed to develop new innovations to sufficiently distinguish itself from the other glass industry clusters that began producing Venetian style glass. Research concerning networks in the creative city literature has focused primarily on policy issues and social networks and clusters (Brennan-Horley & Gibson, 2009; Y. Evans & Smith, 2006; Hilpert, 1991; Jayne, 2005; Landry, 2006; O’Connor, 2004). One study by Brenan–Horley and Gibson (2009), however, uses a Graphical Information System (GIS) to examine creative practitioners’ physical networks during creativity. Their work reveals an apparent disconnect between how the policy approach considers creative...
clusters and networks and the more varied types of physical networks that surface when the
physical context of creativity is considered from the perspective of the creative individual
(Brennan-Horley & Gibson, 2009). This approach is unusual for the creative city literature, and
suggests that new methods like GIS may lead to greater understanding regarding the role of
physical networks in creativity. For the majority of the creative city literature, however, physical
proximity is considered as a means to foster informal social networks through serendipitous social
interactions and knowledge spillover (Johnson, 2010; Landry, 2000).

**Knowledge spillover and creativity.**

Density and diversity are characteristics of clusters and networks that are believed to
increase creativity in four key ways: (1) dense clusters attract creative practitioners because the
excitement generated by social and cultural stimuli motivates and inspires them (Drake, 2003;
Florida, 2002a); (2) dense clusters generate “knowledge spillover” which is transferred across
industries and sectors through geographic proximity and fosters the diffusion of innovation
(Carlino, 2001; Glaeser et al., 1992; Jacobs, 1970; Stolarick & Florida, 2006); (3) diverse
networks create tolerant environments that are more conducive to experimentation and
innovation (Florida, 2002a); and (4) networks that are both dense and diverse create resource
rich edge conditions, or adjacencies, where knowledge can easily transfer across domains
through geographic proximity and facilitate creative problem-finding and ideation (Johnson,
2010). Much of the literature addresses the affective qualities of the social environment as noted
in points (1) and (3), whereas points (2) and (4) begin to address some of the mechanisms
underlying creativity in cities by examining the role of density and diversity in knowledge transfer
and creative ideation. The affective qualities of the links/nodes approach will be discussed in the
next section. The remainder of this section will focus on the mechanisms that may help to explain
why increased density and diversity is associated with exponential leaps in creativity.

Many have written qualitatively about the creative benefits resulting from the density
neighborhood is among the better known examples. Even in 1890 Sir Alfred Marshall (1961) considered how urban density seemed to foster innovation and famously wrote that ideas may be found “in the air” (p. 261). Athens during the Classical period, Renaissance Rome, and fin de siècle Paris are just a few cities that people may commonly associate with periods of exceptional levels of creativity. Researchers have recently been looking to quantitative measures to better understand why some cities seem to be more creative than others. Theoretical physicist Geoffrey West and colleagues have found evidence that cities become exponentially more creative with increased population density (Bettencourt et al., 2007). Their research suggests that creativity, as measured by quantity of patents, research and development budgets, and creative professions, follows a positive 1.2 power law scale relationship with city growth. This suggests that there are mechanisms in urban environments that may enhance the creative abilities of people, leading to increased creative productivity.

One hypothesis commonly referenced in the literature attempts to explain how density and diversity in cities may increase creative ideation through a concept called “knowledge spillover” (Carlino, 2001; Glaeser et al., 1992; Stolarick & Florida, 2006). Knowledge spillover is a principle from economics that describes the exchange of knowledge, skills, and ideas between people. There are two types of spillovers considered relevant to creativity: MAR spillovers and Jacobs spillovers (Carlino, 2001). Sir Alfred Marshall developed the MAR spillovers theory in 1890; and it was extended by Arrow in 1962 and Romer in 1986. It describes how the density of firms within the same industry facilitates the transfer of knowledge and, consequently, increases growth and creativity (Carlino, 2001; Glaeser et al., 1992). Jacobs spillovers are named for Jane Jacobs’s (1970) theory that the most important knowledge transfers for increasing creativity and growth are those that occur between different industries as a result of industrial diversity in a city (Glaeser et al., 1992). Both types of knowledge spillover lead to ideation — either by obtaining new domain–specific knowledge or by applying knowledge from another domain. This hypothesis bears some resemblance to Sternberg and Lubart’s (1991) investment theory of creativity,
suggesting that greater diffusion of knowledge will provide more opportunities for creative practitioners to discover and invest in ideas.

A second hypothesis considers how density and diversity may help creative practitioners make novel conceptual combinations (Johnson, 2010). This hypothesis is grounded in Gruber’s (1988) *evolving systems model* which describes how creativity develops through encounters with different environmental situations (Johnson, 2010). Gruber’s theory was largely influenced by Charles Darwin’s work on the origin of species (Gruber, 1981a, 1981b). Darwin chronicled his creative developments in notebooks, allowing Gruber to see how this thinking was influenced by environmental experiences. The ability to radically restructure schemas within a particular domain is prerequisite for making creative leaps in the knowledge base within the domain (Dunbar, 1995; Finke, 1997; Welling, 2007). Some of the most creative minds have used knowledge from other disciplines to transform domain knowledge in their own field including Piaget (who used biology to transform cognitive development,) Freud (who used physiology to transform psychoanalysis,) and Darwin (who used geography and geology to transform evolutionary biology) (Dunbar, 1995). Johnson (2010) borrows a term from chemistry, describing this phenomenon as “the adjacent possible” (pp. 23-42). He suggests that density and diversity in the physical environment can influence the creative mindset about a problem or concern.

Design strategies to support knowledge transfer in the city are generally informed by planning policies, which may delineate and describe particular development zones for different geographic areas (e.g. business, retail, entertainment, recreation, residential, etc.). Landry (2000) emphasizes the need for public spaces in cities that support social density and facilitate knowledge spillover, such as public plazas; urban centers (where the majority of public facilities are located); meeting places (conference facilities as well as bars, clubs, and coffee shops); research and educational facilities; and cultural facilities that offer affordable entertainment (pp. 119-123). Landry (2000, pp. 34–35) and Florida (2002a, pp. 283–314) both describe how the city urban core may provide a central hub around which other nodes of social density may be organized in an inner ring. This spatial arrangement is believed to facilitate connectivity between
the nodes (Landry, 2006). Thus many of the design strategies referenced in the creative city literature are founded on the belief that, in the designed environment, cluster density will foster knowledge spillover within a particular domain and cluster diversity will create edge conditions where rich cross-disciplinary knowledge spillover increases creative ideation.

Figure II.2 Downtown Boulder, CO.
Boulder, CO was ranked highest on Florida’s (2012) creativity index (see Appendix Table A.2 in his book). The Pearl Street Mall in downtown Boulder offers pedestrian connections between the public plaza, meeting places, and cultural facilities located in the city urban center. Image from www.sangres.com/colorado/boulder/boulder.htm
Features of Boulder include close geographic proximity between the urban center (downtown), education hub (university), retail hub (pedestrian mall), and transportation hubs (bus, plane, and highway). Recreations opportunities are offered by the surrounding greenbelt and nearby Rocky Mountains.

Inspirational Settings: Motivation and Creativity

Much of the environmental design literature at the city and regional scale is based on the assumption that attracting more people (and particularly creative practitioners) to a city or region will cause an exponential increase in creative productivity (Florida, 2012, pp. 304–349). Florida (2002a) argues that the physical attractions that most cities emphasize (sports arenas, shopping malls, amusement parks, etc.) are not attractors for the creative class (p. 218). Instead he

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13 Florida (2012) has been criticized for presenting a tautological argument that “creative people seek out places that draw a lot of creative people.” (See for example Macgilllis (2009)). In his defense, he references Aaron Renn’s explanation that urban development is tautological, because it is a “positive feedback system” (p. 318).
suggests that cities focus their efforts on developing the "just-in-time" recreational opportunities that creative practitioners have expressed preferences for — such as park and trail systems and pedestrian friendly nightlife attractions that include cultural venues, bars, clubs, and coffee shops (pp. 224-225). Design strategies to encourage creative productivity in the city thus often focus on developing these types of attractions to bring more creative practitioners to a city or region (Florida, 2002a; Landry, 2000).

![Figure II.4 The Inspirational Rocky Mountain Setting in Boulder, CO. Boulder attracts creative practitioners despite the relatively high cost of living. Image from the University of Colorado website http://ibg.colorado.edu/general_information/about_boulder.html](http://ibg.colorado.edu/general_information/about_boulder.html)

Of the creative city researchers, Florida, an urban planner, focuses the most on design strategies to influence the physical environment (2002a, pp. 215–234). Yet even he is primarily concerned with the economic geography of cities, which focuses on planning policies to address the socio–cultural creative environment (Florida et al., 2010; Florida, 1999, 2002b, 2002c; Stolarick & Florida, 2006). Although networks may be considered as physical artifacts (e.g. roads, bike paths, transit lines, etc.) the creative city literature focuses primarily on socio-cultural networks, formed by conditions of social diversity and geographic proximity (Florida, 2002a,
Diverse places may create the tolerant social networks that inspire and motivate experimentation and innovation (Drake, 2003; Florida, 2012, pp. 293–294; Landry, 2000, pp. 111–113; Stolarick & Florida, 2006).

Florida (2002a, 2012) describes how cities that inspire and motivate creative practitioners possess the 3T’s: Technology, Talent, and Tolerance. Technology references the level of innovation (measured by number of patents) and concentration of high-tech industries in a city or region. Talent refers to the percentage of people working in a creative industry (Creative Class Index). Tolerance concerns how receptive a city or region is to innovative ideas. Florida uses the Composite Diversity Index, which includes three measures: The Melting Pot index (percentage of immigrants), the Gay Index (percentage of the population who identify as gay for sexual orientation), and the Bohemian Index (percentage of people working in creative arts professions.) This combination of existing innovation, intelligent people, and socio-cultural diversity, Florida believes, creates an ideal setting to foster creativity. Amabile’s (1996) componential model also emphasizes the motivational significance for the social environment in creativity. The numerous parallels between her work on workplace environments and Florida’s creative city research are discussed later in this chapter. Tolerant environments are thus believed to reduce barriers to creative exploration and risk-taking (Amabile et al., 1996; Csikszentmihalyi, 1996; Feldman et al., 1994a; Florida, 2002a).

**Flexibility: The Temporal Nature of Exploration Zones in the City**

Flexibility is an attribute frequently associated with a variety of creative environments, and the city — where creative industries must respond to economic uncertainty, exploit informal networks, and depend upon flexible labor conditions — is no exception (Apitzsch & Piotti, 2012; Haunschild, 2003; McKinlay & Smith, 2009). The uncertain and transitory nature of creative

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14 In his original research on the creative class, Florida (2002a) combined the Creative Class Indicator with a Human Capital Index (HCI), determined by the level of educational attainment of the area’s population. (HCI is based on the percentage of the population who have a Bachelor’s degree or higher.) In response to criticisms that he conflated creativity with education, he removed the human capital measure and found similar results (Florida, 2012, p. 231).
industries is considered unique. City planning policies have attempted to remove structural barriers and provide strategies to adapt to the spontaneous and sometimes chaotic evolution of informal clusters and networks that can emerge within a creative city or region (Apitzsch & Piotti, 2012; Landry, 2000, pp. 224–253). Historically many cities have experienced an ebb and flow of creative production (Landry, 2000, pp. 205–210). The spectacular levels of creativity and innovation associated with Classical Athens, Renaissance Rome, or fin de siècle Paris, suggest that while a particular environment may engender high levels of creativity, the effect appears to be temporary. Although there has been little empirical investigation into the mechanisms behind this phenomenon, I posit that mature creative clusters may suffer from a concept in creativity called the cost of expertise — and flexible environments may help to ameliorate this problem.

Although adequate domain knowledge is essential to be creative, expertise can also create barriers to creativity (Mark A. Runco, 2007a, p. 225). Experts have large knowledge bases that are organized in sophisticated schemas with multiple interconnections between knowledge (R. J. Sternberg, 2006a). Unlike novices, their knowledge tends to be highly organized and structured by years of experience. Although this complex knowledge structure may facilitate creativity, it may also lead to problems developing creative insights (Runco, 2007). Experts tend to make assumptions and rely on tacit understandings instead of questioning the way knowledge is structured in their own domain (Sternberg, 2006). Novices, on the other hand, have much looser systems of knowledge making it easier to restructure schemas to develop novel insights (Runco, 2007). It is perhaps for this reason that many creative practitioners move from one field to another creating what Runco (2007) refers to as "professional marginality." Florida (2012) makes particular mention of physical mobility among creative practitioners (p.306-308). Such mobility may help to determine the natural lifecycle of creative clusters.

Mobility may also help to increase creativity through a concept called reseeding (Fischer & Ostwald, 2002; Fischer et al., 2001). Seeds are the knowledge, ideas, skills, processes, tools, products, and methods found within a creative cluster or node (Fischer et al., 2001; Harrington, 2011). As that cluster matures, rates of creative productivity typically peak and then begin to
decline. The insertion of new knowledge or restructuring of existing knowledge within the cluster (reseeding) may improve creative productivity once again (Fischer & Ostwald, 2002; Fischer et al., 2001). This suggests that mobility is instrumental to the reseeding process and, consequently, creative productivity — both for the creative practitioner as well as the creative cluster. Creative practitioners may seek out environments where they will encounter new seeds for creativity (Harrington, 2011). Conversely, their participation in new environments may initiate a reseeding process for those creative clusters. The creative city design strategies have focused on attracting and retaining the mobile creative population (Florida, 2012). The concept of cluster reseeding suggests, however, that some mobility among the creative population may be beneficial.

**Creative Cities as Places of Problem–Finding and Evaluation**

There is a clear focus on the social context of creativity in both the creative city literature and the componental models of creativity. From the creative city literature five implicit theories about the relationship between the physical context of the city emerge: 1) physical socio-cultural networks serve as gatekeepers for the evaluation and dissemination of creative products or ideas; 2) social density and geographic proximity facilitate the transfer of explicit and tacit domain knowledge and skills required for creativity; 3) diverse clusters foster cross-disciplinary interactions, which facilitates seeding of creative ideas and paradigmatic shifts within a domain; 4) diverse networks create an inspirational climate, conducive to motivating creative practitioners to take risks and experiment, and 5) the temporal nature of creativity suggests that flexible environments allow creativity to develop over time and respond to the ebb and flow of creative cluster formations. These theories describe how the creative city may play a role in both the adoption and diffusion of creative ideas. It is possible, therefore, that cities may play a role in

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15 The creative city literature often considers creativity from an economic geography perspective. It is possible that this has focused empirical investigations around concerns for how to attract and retain a mobile creative population, ignoring the potential benefits for creativity of some mobility within a city or region.
how people find creative problems to pursue and how their creative ideas and products are implemented and evaluated by others.

**Limitations of the Creative City Approach**

There are several significant limitations of the creative city with regard to how it may successfully inform design strategies. First, a review of the creative city literature reveals a lack of investigation into the relationship of the city with the suburban and rural geographies of a creative region. Critics have argued that this literature prejudices the city as the only place to be creative, and recommends researchers look at larger regions and also examine individual processes to see how and when people are creative in the city (Brennan-Horley & Gibson, 2009; Drake, 2003; Morris, 2005). Second, the literature review presents a narrow focus on the physical attributes of the designed environment as mediator for social interactions. This is a theme that is prevalent at other scales of the designed environment as well. Although the body of creative city literature does acknowledge the relationship between place and personal inspiration, it focuses almost entirely on social interactions while neglecting individual creativity (Drake, 2003). It does not consider how features of the designed environment may play a role in non-social creative processes. The most significant shortcoming of the creative city literature, however, is that it has failed to empirically identify causal mechanisms to explain how environmental design strategies may help to increase creative productivity (Huggins & Clifton, 2011; Markusen, 2006; Peck, 2005; A. J. Scott, 2006).

The most compelling evidence that cities may cause an increase in creative productivity is the study by Geoffry West and colleagues (Bettencourt et al., 2007), which showed that creative productivity follows a positive 1.2 power law scale relationship with city growth. This suggests that there are mechanisms in urban environments that may enhance the creative abilities of people, leading to increased creative productivity. Florida’s (2012) research has also uncovered direct correlations between the percentage of creative workers in a city, levels of technological innovation, and social diversity, suggesting that all three components are necessary
for economic development (p. 228). The policy decisions and design strategies aimed at increasing creative productivity are primarily based on this descriptive evidence. The assumption that increasing the density of a creative population in a city will increase creative productivity has not been empirically tested.

Summary of Key Findings from the Creative City Literature

- Empirical findings suggest that cities with higher creative population densities have exponentially higher rates of creative productivity.
- City planning strategies have focused on “attracting and connecting” creative people by appealing to their preferences for certain amenities.
- Implicit in these planning policies is the belief that creative productivity increases with social interaction through knowledge spillover.
- There does not appear to be any empirical evidence to validate the effectiveness of these planning policies.

Urban Design: Creative Districts and Neighborhoods

Urban design is primarily distinguished from the city planning literature by its focus on the proactive, physical design of urban spaces (Saelens, Sallis, & Frank, 2003). City planning emphasizes regulatory policies that may influence physical designs by considering the interaction between physical, social, and political factors in a city or region. Urban design is more concerned about the relationship between buildings and exterior spaces and the effect these relationships have on the people who use them (Carmona, Heath, Oc, & Tiesdell, 2003; Saelens et al., 2003). Urban design is not specifically limited to a particular geographic size, but for the purposes of this literature review I will delimit the scale to the area of a neighborhood or district. This geographic area is a size within the realm of the average pedestrian — or bicyclist at its largest.

There is no evidence of explicit empirical investigation into the role of urban design in creativity, however there is a recent stream of literature that considers how creative practitioners
seek out different types of environments (*creative milieus*) during their creative processes (Borggren, 2010; Meusburger, 2009; Törnqvist, 2004; Wu, Wen, Wu, & Lin, 2007). This concept is also a key theme in an earlier seminar report authored by Ann Buttmer (1983). She describes the results of a conference held in June 1978 in Sigtuna, Sweden where 45 scholars from diverse disciplinary fields met to discuss the physical context of creativity. Several key themes emerged from the conference. First, when considering the context of creativity, it is most useful to consider creativity as a process that entails different stages. Second, the significance of context for the participants varies with the creative stage. Third, styles of communication during creativity also vary according to the creative stage. Although the participants could not agree on the specific stages in the creative process, they did agree that they all sought out different types of environments according to their perception of the stage in which they were engaged. Many of the participants described moving between their offices, outdoor settings, and third places (such as the coffee shop).

**Third Places**

The *third place* is a concept developed by Oldenburg (1989) to describe the role of informal public gathering spaces in communities. Third places are the coffee shops, pubs, cafés, markets, community centers, or other places where people seek informal social interaction. Oldenburg explains that people inhabit home (first place) and work (second place) to meet a need, such as to sleep or to earn a living. The third place is inhabited by choice. Creative practitioners often talk about going to third places as part of their creative processes (Buttimer, 1983; Törnqvist, 2004; Wu et al., 2007). Historically the coffee house has been a place for the exchange of knowledge and scholarly debate (Livingstone, 2003, pp. 84–86). The London coffee houses in the 17th and 18th centuries often hosted scientific lectures and became places of knowledge propagation through the mingling of people from different walks of life (Livingstone, 2003, p. 84). Although third places are recommended as places to support creativity (Florida, 2002a, 2012; Landry, 2000), there has been little empirical examination of their modern day role.
in the creative process (Wu et al., 2007). Based on Florida’s work, Wu et al. (2007) examine the modern coffee house in the cities of Taipai and Hsinchu. They found that the coffee house serves as a “social bridge” between talent and entrepreneurship among urban and professional people. Because the researchers did not find a relationship between third places and social diversity, they suggest that like-minded people use the coffee shop as a place to network and share ideas.

Creative practitioners also use third places for solitary work. Buttimer (1983) describes how creative practitioners sometimes feel more productive there than in their offices. Csikszentmihalyi (1996) also found that many creative practitioners like to work alone in a social context. He suggests that they seem to draw inspiration and motivation from such settings. Although third places are generally considered to be buildings, the preference that some people have for working on the train was mentioned in both Buttimer’s (1983) report and in Törnqvist’s (2004) analysis of biographies written about Nobel Laureates.

**Interstitial Spaces**

There are many stories by creative practitioners about the importance of interstitial spaces — the areas between places like buildings, districts, or cities — to their creative processes (Buttimer, 1983; Csikszentmihalyi, 1996; Törnqvist, 2004). Törnqvist (2004), examines the role of geographic mobility and travel in his study of Nobel Laureates and describes how the train was instrumental to Niels Bohr’s creative process. Törnqvist suggests that Bohr’s preference for the train as a place of both solitary and social work may help to explain the central role he played in the physics network during his lifespan. Trains and carriages are so often referenced in anecdotes about creativity that Harding and Nichols (1948) suggest that the rhythm of these transportation modes may induce in creative practitioners a hypnotic state conducive to ideation.16 Mozart famously described in his correspondences how his creative ideas often came during a carriage ride, while walking, or at night when he couldn’t sleep (Holmes, 1845, p. 329).

The interstitial spaces between destinations — such as the train, time sitting in traffic while

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16 This phenomenon is commonly referred to as the “bed, bus, and bath,” referring to the places people often associate with “a-ha” moments of creative insight (Dart, 1989).
driving, the bicycle ride, and the walk — are often described by creative practitioners as opportunities to think (Buttimer, 1983; Ghiselin, 1954).

**Urban Design Strategies for Creativity**

Third places and interstitial spaces are themes prevalent in urban design strategies to promote creativity through the physical design of universities and colleges. Architectural historian Paul Turner (1984) describes how the designs of the early American colleges were based on a radical new curriculum intended to foster creative innovation in their students. He hypothesizes that the great variety in building design among the nine colonial colleges was a result of experimentation in architecture designed to support these educational goals. Some of these design strategies intended to create an “academic village”, a concept that persists in collegiate planning to this day (Turner, 1984, p. 3). The extensive grassy lawns of the campus invite strolling or bicycling in the interstitial spaces between buildings, and also foster a feeling of connection and receptivity to the world at large. The integration of working, living, dining, and recreation facilities into one campus plan is intended to create a sense of community — that the students and faculty are one body working together to creatively solve the world’s problems. The third spaces of the dining halls, recreational facilities, and plazas invite informal social interactions, connecting spaces of solitary reflection like offices, dormitories, and libraries. Today, however, many universities are re–envisioning the library as another third space to support social creativity. This likely reflects the current shift in thinking from creativity and learning as primarily solitary activities to social processes.
The library was recently renovated as a “third place” to include a coffee bar, computer stations, and a variety of reconfigurable seating options. Image from the University of Colorado website at 
http://ucblibraries.colorado.edu/about/coffee.htm

Mobility and Creativity

Although empirical investigation into the relationship between urban design and creativity is virtually nonexistent, the stories creative practitioners tell about their creative processes suggest that this scale of the designed environment may be overlooked. These people seem to vote with their feet. They change environments in an effort to keep their creative productivity high (Buttimer, 1983). They describe how they take advantage of opportunities to move between home, work, and third places — and even use the interstitial spaces between these places as part of their creative process. Buttimer (1983) suggests that “creative work demands quiet and privacy, but also needs movement and a sense of change...” (p. 59.) Despite the lack of research in this area, it appears that urban designs may incorporate some of the same strategies used in city planning. On the university campus, for example, the primary spatial form is the links/nodes arrangement — where landscaped lawns form interstitial spaces, linking the nodes of living, working, and socializing located in dormitories, classrooms, dining halls, and libraries.
Figure II.6 The Campus of the University of Colorado, Boulder. Interstitial spaces such as plazas and lawns link destinations at the University of Colorado in Boulder and provide opportunities for physical activity, relaxation, and informal social gatherings. Photograph by Neil Kearney.

Summary of Key Findings from the Urban Design Literature

• People seek out third places for solitary and social work.
• People prefer to move to different spaces when creative productivity wanes.
• The interstitial spaces between destinations may also support creative processes.
• There does not appear to be any empirical investigation into the effectiveness of design strategies at this scale.

Creativity and Landscape Architecture

The role of landscape architecture in creativity is primarily addressed through the concept of “greening” the creative city (Florida, 2002a, 2012; Landry & Bianchini, 1994; Landry, 2000). Natural areas are most often described as desirable features of a creative city (or as ideal characteristics of any healthy city), but without much rationale for the role they may play.

17 There is another body of Landscape Architecture literature that considers the relationship between creativity and landscape design, but it is primarily focused around children’s playscapes and beyond the scope of this dissertation. I will describe one concept from this literature, the theory of “loose parts,” in Chapter 7.
specifically play in the creative process (Landry & Bianchini, 1994; Landry, 2000, 2006). This approach generally seems to reflect an acknowledgement of people’s preferences for natural views during creativity. Florida (2012), however, suggests that for many creative practitioners, outdoor leisure activities (such as walking, running, rock climbing, bicycling, kayaking, and snowboarding) appear to be part of their creative work process (pp. 133-147). Banks (2009) has coined the term “instrumental leisure” to describe the phenomenon of employing leisure activities in service to economic productivity. Natural areas that afford recreational activities are one of the city attributes that Florida suggests may help to attract and retain a creative population.

**Instrumental Leisure**

Anecdotes about creative practitioners suggest that the integration of leisure activities (especially walking) into the creative process is commonplace (Buttimer, 1983; Ghiselin, 1954). Research on the relationship between exercise and creativity also suggests that creative productivity increases after exercise (Ben-Soussan, Glicksohn, Goldstein, Berkovich-Ohana, & Donchin, 2013; Blanchette, Ramoki, O’del, & Casey, 2005; Cavallera, Boari, Labbrozzi, & Bello, 2011). Walking and creative thinking have historically gone hand–in–hand. The Peripatetic School of ancient Athens was so named because its founder, Aristotle, was said to have habitually walked together with his students while he taught (Solnit, 2001). According to Solnit (2001), Hobbes, Kant, and Wittgenstein were also known to include walks as part of their daily routines. More recently, scientists have been examining the positive effects of walking in natural settings on attention and memory (Berman, Jonides, & Kaplan, 2008; Hartig, Evans, Jamner, Davis, & Gärling, 2003). These studies suggest that natural landscapes may help to combat cognitive

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18 Peripatetic means “one who walks habitually and extensively” (Solnit, 2001, p. 15). According to Solnit, (2001) the Sophists, who predated the Peripatetics, are also associated with habitual walking and teaching.

19 Many studies consider the effect of nature on attention in both sedentary and active (walking) conditions, with positive effects found in both conditions. Physical activity alone has also been shown to have a positive effect on cognition in numerous studies and with people of different ages. See for example Hillman et al. (2008) and Weuve (2004).
fatigue (Berman et al., 2008; Herzog, Colleen, Maguire, & Nebel, 2003; Kaplan, 1995; Van Den Berg, Hartig, & Staats, 2007).

Florida (2012) references some of this research to describe how outdoor areas may play an instrumental role in creative work (pp. 133-147). He cites a study conducted by Marc Berman and colleagues (2008) that compared the restorative effects of a 50 minute walk in a natural setting (Ann Arbor arboretum) versus an urban setting (downtown Ann Arbor, MI). The researchers found that cognitive attention (as measured by a backwards digit-span task and the Attention Network task) was significantly improved in the natural setting condition. This study was based on Kaplan’s (1995) Attention Restoration Theory (ART) which hypothesizes that stimuli from natural settings grab people’s attention in a “bottom-up” fashion, allowing directed attention to replenish. There does not appear to be any empirical investigation into the role of walking in natural settings on creativity in particular. However, creativity is understood to entail ordinary cognitive processes — thus the apparent benefits of walking in natural settings for attention and memory may also help to explain why many creative practitioners incorporate such activities into their routines.

Emerging research suggests that there may be some evidence behind the benefits of instrumental leisure to creativity. Blanchette et al. (2005) found that moderate aerobic exercise had immediate positive effects as well as enduring residual effects on creative productivity. Cavallera et al. (2011) found that participation in sports had a positive effect on creative elaboration. Ben-Soussan et al. (2013) examined whether it is the cognitive or motor effects of exercise that positively influence ideational fluency and concluded that it is the combination that is effective. The concept of instrumental leisure is beginning to influence the design of some landscapes intended to support creativity. The landscape at Pixar in Emeryville, CA, designed by Peter Walker Partners (PWP), is one such example (Searer, 2012). PWP designed the 20 acre grounds as a place to invite both casual leisure activities and more structured exercise opportunities. The site includes soccer fields, a volleyball court, a basketball court, an Olympic swimming pool, and jogging trails. It also provides an outdoor amphitheater, a variety of
vegetable and flower gardens, wildflower meadows, and numerous native and exotic trees to foster casual exploration of the grounds. The intention was to create “many seemingly undiscovered places to walk, sit and talk, or eat lunch.”

**Inspirational Settings**

People often claim to draw inspiration from majestic, natural settings during the creative process (Buttimer, 1983; Csikszentmihalyi, 1996; Jerome and Dorothy Lemelson Center for the Study of Invention and Innovation, 2007; McCoy & Evans, 2002). The association of creativity with majestic settings has frequently influenced the selection of building sites toward places that maximize natural views. Two famous scientific facilities are well known for their spectacular landscapes: The Mesa Lab for the National Center for Atmospheric Research (NCAR) in Boulder, CO and The Salk Institute in La Jolla, CA.20 Designed by I.M. Pei, the Mesa Lab sits high above the Boulder valley in Colorado, where Table Mesa meets the Flatirons formations of the Rocky Mountain foothills (2.7).

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20 La Jolla, CA is in the San Diego area, which ranked sixth on Richard Florida’s (2012) Creativity Index for 2010.
The Mesa Lab was constructed in an area beyond the "blue line," which is intended to restrict development adjacent to the foothills in order to retain views and open space for the city residents (S. W. Leslie, 2010). As a condition of the City of Boulder’s development terms, NCAR agreed to leave its 565 acre parcel on the mesa as public open space, surrounding the facility with a naturalistic landscape (S. W. Leslie, 2010). Leslie (2008, 2010) describes how Pei’s design responds to the scientists’ requests for views from their offices, benches located around the site where they could sit and take in the scenery, and a building design that would not detract from the natural beauty of the site. Pei also provided a variety of other ways that occupants could take in the mountain air and inspirational views — from tiny perches located atop the building towers, on an outdoor dining patio, in the formal tree-lined courtyard, and by the walkway that connected the staff lounge to the mesa. Although high winds on the mesa often prevent these outdoor areas from the heavy use Pei envisioned, the inspirational significance of the natural
landscape to the scientific work at NCAR is documented through post–occupancy interviews and the continued tradition of annual mountain retreats.

In contrast to NCAR’s naturalistic landscape, the grounds around The Salk Institute are quite formal (2.8). The facility was designed by Louis Kahn to perch above the cliffs adjacent to the Pacific Ocean in La Jolla, CA. The central plaza is arguably one of the most recognized features of the facility and its form is strategically designed to draw people’s attention toward the ocean (Lobell, 2008, pp. 76–77). The Salk plaza design intends to focus and magnify the majesty of nature.21 A central trough of water visually connects the main entrance of the facility to the western sky, giving the illusion that the courtyard is suspended in the air. On the equinoxes the sun sets on axis with the trough, further adding to the visual effect. The architect Stephen Holl (1989) describes how the design of the plaza and its natural setting are “phenomenologically linked” (pp. 9-10).

At Louis Kahn’s Salk Institute, there is a time of day when the sun, reflecting on the ocean, merges with light reflecting on the rivulet of water in the trough bisecting the central court. Ocean and courtyard are fused by the phenomenon of sunlight reflecting on water. Architecture and nature are joined in a metaphysics of place.

Holl attempts to capture the experience that many people describe concerning the visual play of light, water, surface, and sky in the design of the courtyard (Moe, 2008).

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21 The courtyard was the idea of Mexican architect Louis Barragan (Kahn, 2003, pp. 208–209). Kahn originally intended a garden with trees where the courtyard now sits; but when Barragan saw the plans, he convinced Kahn to create a paved plaza instead, to “add another façade, a façade which looks to the sky.” It is unclear how much influence Baragan had on the final design with axial water trough.
Historically there has been little scientific attempt to understand why spaces like the Salk plaza seem to inspire creativity. There is some emerging research that uses fMRI studies to examine the neurological effects of environmental design. Images of the Salk plaza were found to induce contemplative states according to preliminary results from one fMRI study. This research indicates that new methods of empirical investigation may eventually lead to better understanding about the physiological effects of inspirational settings.

**Summary of Key Findings from the Landscape Architecture Literature**

- Creative people claim to draw creative inspiration from majestic settings.
- Emerging research suggests that majestic settings may induce psychological states.
- Creative people engage in instrumental leisure activities to increase creative productivity.
- Exercise has been found to have immediate and residual benefits for creativity.
- Engagement with nature has been found to have positive effects on attention.

22 Julio Bermudez of Catholic University presented this work–in–progress on architecturally induced contemplative states at the ANFA 2012 conference.
Architectural Design: Behavior Settings for Creativity

The Salk Institute and the Mesa Lab are projects commissioned by people who believed that a signature architectural design could shape both user experiences and collective identity in an organization (S. W. Leslie, 2008). Built in the 1960’s, the projects shared common design strategies and intentions (S. W. Leslie, 2008) — although The Salk Institute is more often regarded as an iconic example of a building designed to foster creativity (C. W. Taylor, 1988, p. 102). Jonas Salk hired Kahn to fulfill his dream of designing a place to inspire the kind of creativity that he experienced at the St. Francis of Assisi monastery (S. W. Leslie, 2008, 2010). Salk credited the contemplative environment at the monastery with his breakthrough in developing the polio vaccine, and hoped that Kahn could capture some of the same aesthetic qualities. Kahn set out to design a visually compelling facility that both captured the spirit of the monastery and reflected his understanding about how space could foster creativity for the Salk researchers (Kahn, 2003, pp. 132–134, 142, 207–208). He gave much consideration to the ways the scientists worked, designing the structure to maximize inspirational views and facilitate social interaction and collaboration among the occupants (Kahn, 2003, pp. 71, 132–134, 142–145). The strategies that Kahn and Pei incorporated in their designs are still prevalent today: inspirational spaces for solitary work; flexible spaces to accommodate changes in workplace practices; and circulation configurations that link destinations with hallway nooks and crannies, gardens, and courtyards. These places for meeting and relaxation create opportunities for social interaction and collaboration (Kahn, 2003, p. 71; S. W. Leslie, 2008).

Circulation Configurations for Social Interaction

Similar to the patterns found in the creative city literature, buildings designed to support creativity most often emphasize strategies intended to influence social interactions (McCoy, 2005). At the Salk Institute, Kahn separated the scientists’ studies from their laboratories. He linked the studies and labs with small courtyard spaces intended for the impromptu conversations and collaborations that would occur as people passed by them on their way between these two
spaces. Prior to beginning his design, Kahn met with the scientists and learned that they had studies adjacent to their labs. The scientists told him, however, that when they worked in the studies they were often bothered by all the equipment noises coming from the labs (Kahn, 2003, p. 133). He also observed that the scientists habitually ate their lunch in the lab, even though the place was “full of microbes” (Kahn, 2003, p. 133). Although the scientists told him that it was important that they be close to their labs, Kahn (2003) decided that “they were all wrong about what they wanted” (p. 202) and chose to separate the laboratory “architecture of clean air” from the study “architecture of the oak table and the rug” (p. 133). In collaboration with Salk, he chose to locate a courtyard garden directly across from every lab and place the studies over arcades such that they are not visible from the labs (p. 207).

![Diagram](image)

**Figure II.9 Cross Section of the Salk Institute Laboratory by Louis Kahn.**  
A sectional view showing the relationship between the column-free laboratory spaces, interstitial service “pipe” spaces, courtyard garden, studios, and arcades.

The links/nodes design approach is prevalent in buildings intended to facilitate social creativity, yet there is little evidence of its effectiveness at promoting social interaction or collaboration (Fayard & Weeks, 2007; McCoy, 2005; Steen, 2009). Kahn located the labs, studios, and dining area at the Salk as distributed nodes, which are linked by pleasant exterior spaces where he envisioned people would stop for impromptu socialization. He even located chalkboards on the equipment chases in the plaza so that people could jot down their ideas as they develop.
Although the facility is largely considered a success, many of Kahn’s design strategies did not produce the social interactions he envisioned. The scientists rarely used the studies, choosing instead to build out office spaces in the labs and giving their postdoctoral fellows the study as a place to work (and sometimes live) (S. W. Leslie, 2008). The gardens outside the laboratories have become places to store surfboards and the plaza remains generally free of the impromptu social collaborations Kahn imagined. Pei’s Mesa Lab design has experienced similar outcomes. Postdoctoral researchers use the “crows–nests” he designed as scientists’ studies atop the towers because they are too far from the labs. The nooks and crannies intended for social interactions along the corridors are rarely used and the courtyard is largely deserted, its fountain long since shut down. Social spaces that have been successful in both of these projects, however, are the dining areas. The cafeteria at the Mesa Lab is the source of the spontaneous conversations envisioned by Pei. Kahn’s strategy of designing a small dining room may have contributed to the social success of the outdoor dining patio below the main plaza. This area became a place where postdoctoral fellows could dine with Salk himself.

23 On a recent visit to the Salk I had the occasion to chat with several of the scientists who have worked there for decades as well as some of the post doctoral students. I was told several stories about how the high cost of housing in the area meant that some junior researchers choose to live in the studies, which have adjacent full baths. The senior scientists also shared with me stories about the informal collaborative culture in the dining plaza.
The dining patio at the Salk Institute is said to successfully foster the type of informal social interactions intended by Kahn in other areas of the facility. The patio is below the main plaza, adjacent to the small dining room (located in the lower right area of the photo) and overlooks the natural cliffs leading to the Pacific Ocean.

Despite the apparent failure of the design strategies employed at The Salk Institute and Mesa Lab to facilitate social interaction, many of these same strategies are used today in buildings designed to support creativity. One such example, the newly constructed and award-winning Sanford Consortium for Regenerative Medicine (SCRM) building by Fentress Architects is located across the street from the Salk Institute (Figure II.11). It mirrors many of Kahn’s strategies — including housing senior scientists’ studies in isolated pods with views of the ocean — with the intention of “fostering collaboration and communication among researchers” (Sanford Consortium for Regenerative Medicine / Fentress Architects,” 2011). Frank Gehry’s

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24 The building has received several awards since its completion in 2011: The 2012 Gold Nugget Grand Award (“Sanford Consortium for Regenerative Medicine Wins Gold Nugget Grand Award,” 2012), the 2012 AIA Colorado Honor Award for Built Architecture, and the 2012 AIA Denver Merit Award for Built Architecture (“Fentress Architects take home three prestigious design awards and Colorado Architect of the Year,” 2012)
controversial Stata Center completed in 2004 at The Massachusetts Institute of Technology (MIT) also employs a links/nodes model (based on the suburban cul-de-sac neighborhood form) to promote chance social encounters (Hughes, 2008). Gehry intended to induce the types of serendipitous social encounters associated with the beloved (and since razed) Building 20 by creating corridors based on a “prairie dog town” that link classrooms, an auditorium, library, and café (S. W. Leslie, 2010). At Pixar the building atrium is used an attractor hub of activity nodes to facilitate social interaction (Isaacson, 2011, pp. 430–431). It houses the employee mailboxes, a café, recreational center, fitness center, and theaters. Steve Jobs famously described how he intended to have only one restroom located in this area for the roughly 1,000 employees in order to “make people get out of their offices and mingle in the central atrium with people they might not otherwise see” (Isaacson, 2011, p. 431). Although there is more than one restroom location in the current facility, John Lasseter considers the design a success, stating “I’ve never seen a building that promoted collaboration and creativity as well as this one” (Isaacson, 2011, p. 431). The perceived success of the atrium in fostering social interactions in several research facilities has prompted Yaneva (2010) to suggest that the atrium may be more important than the lab for creativity. In practice environmental designs intended to facilitate social interactions have often produced unintended effects (Fayard & Weeks, 2007; Grajewski, 1993).

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25 Users and critics have called the building “a disorienting zoo” (S. W. Leslie, 2010), “difficult-to-alter and inflexibly complex” (Hughes, 2008).
Empirical evidence regarding the relationship between workplace design and social interactions has been both limited and contradictory (Fayard & Weeks, 2007; McCoy, 2005). The often-cited research by Thomas Allen (1977) suggests that frequency of all forms of communication declines with respect to social distance, a phenomenon called the Allen Curve. Grajewski (1993) found that 64% of creative interactions occurred in private offices, and not in multi-purpose rooms, cafés, or meeting rooms. Similarly, social interactions were greater among workers in enclosed office spaces than those in open office workstations in a study conducted by Hatch (1987). Studies by Sundstrum and Herbert (1982) and Oldham and Bass (1979) suggests that lack of privacy leads to decreased job satisfaction. These findings run contrary to the study by Szilagyi and Holland (Szilagyi & Holland, 1980) that suggests increased social density will lead to reduced stress and improved communication and job satisfaction. Although architectural design strategies intended to influence social behaviors persist, there appears to be a lack of
empirical evidence to support them. Strategies aimed at increasing social density and connectivity may not predict increased social interactions or creative productivity.

**Spatial Flexibility to Accommodate Dynamic Creative Processes**

Flexibility is another common theme in buildings designed for creativity. The term is rarely defined, however, and can mean anything from 1) giving people freedom to choose from a variety of spaces, 2) designing spaces that are easy (and relatively inexpensive) to remodel and reconfigure, or 3) under-designing a space so that users become "co-designers" in order to make it functional. The first approach is evident in the design of SCRM. The Salk Institute and Building 20 at MIT are both often described as examples of the second strategy. The third strategy falls more directly under the realm of interior design and will be discussed in that section.

The SCRM building by Fentress Architects provides a variety of spaces for different types of activities and social interactions. Signage is provided outside of different rooms to describe to occupants how the architects intended they be used. The exterior courtyard adjacent to the main entrance hosts colorful flags that convey the purpose of the facility to foster imagination, innovation, communication, and acceleration of research (Figure II.12). This signage appears to convey the implicit theories of creativity that informed the building design. For example, a space configured for solitary work has a desk oriented to a window with a western view of the golf course and Pacific Ocean. The signage on this space states "a green outlook" (Figure II.13), perhaps reflecting studies that demonstrate people's preference for views of nature during creativity. The same signage is found on the private office "pods" that hang from the western façade of the building. A room on the interior of the building (Figure II.14), configured with a white board and informal seating, is labeled "brainstorming is a circular flow," referencing Osborn's (1953) creative method. A small conference room, located in a corner of the building, displays the statement "none of us is as smart as all of us" (Figure II.15). Finally, a space with modular workstations is labeled "plant don't land" (Figure II.16). The personal artifacts displayed
on work surfaces suggest that employees have disregarded the signage in this case. With the exception of the private office pods, all of these spaces are intended to remain open to use by any of the building occupants.

Figure II.12 The SCRM Main Entrance
A series of colorful flags outside of the main entrance convey the buildings design intentions. They are labeled (from front to back) imagin[ase]on, innov[ase]on, communic[ase]on, and acceler[ase]on.
Figure II.13 “A Green Outlook” Office at SCRM
Signage labeled “a green outlook” on a small room with a desk and two chairs oriented to the western view of the golf course and Pacific Ocean.

Figure II.14 “Brainstorming” Room at SCRM
A space designed for brainstorming is located in the center of the building with glass walls to corridors on either side. It contains informal seating, a white board, and technology for digital projection and teleconferencing.
Figure II.15 Conference Room at SCRM
Signage on a small conference room states that “none of us is as smart as all of us,” conveying the idea that creativity requires social collaboration.

Figure II.16 Open Office Area at SCRM
A room with flexible furniture systems and a white board is labeled “land don’t plant.” The personal artifacts on the desks, however, suggest that users have already “planted.”

As well known as The Salk Institute is for its plaza design, it is perhaps even more highly regarded for its innovative and flexible laboratory design (Latour & Woolgar, 1979; S. W. Leslie,
Kahn used Vierendeel trusses and enclosed them in a service floor above each laboratory floor (Figure II.17). This allowed for clear spans up to 45 feet in the laboratory below (Moe, 2008). Kahn (2003) referred to the interstitial service floor as the "pipe space," because it provided for movement of pipes, water, and air required to reconfigure the labs (p.209.) Salk, however, referred to it as "mesenchyme space," using the analogy of mesenchyme tissue to describe the role the space plays in the temporal adaptability and capacity for growth to support laboratory research (Moe, 2008). Even the curtain wall that provides natural lighting and views to the gardens is considered a flexible and moveable system (T. Leslie, 2003). Fred Gage, a scientist at The Salk, describes how "periodically, and more often than you would think, [they] tear out whole sections of the soft wall spaces and just redesign it" (Jermome and Dorothy Lemelson Center for the Study of Invention and Innovation, 2007).

Figure II.17  Pipe Spaces at The Salk Institute, La Jolla, CA.
The pipe areas at The Salk Institute are full story spaces above the laboratories that allow the lab spaces to be easily reconfigured.

In his book, How Buildings Learn, Brand (1994) describes the flexibility of Building 20 at The Massachusetts Institute of Technology (MIT). Although it was designed as a temporary structure to provide space for radiation research during the Manhattan Project, the building has
become known as one of the most creative places of our time. It was designed in an afternoon by Don Whinston and remained in use for 50 years, housing a number of significant scientific breakthroughs. It was the ease with which the building could by changed, however, that people attributed to its success as a place to support creativity. As Merton Flemings describes it,

Even later, when other buildings began to go up around MIT, people still loved that lab. And not just from memory, they loved it to work in!....If they didn't like a wall, they could knock it out! It didn't take much more than sticking a foot through it. (Jermome and Dorothy Lemelson Center for the Study of Invention and Innovation, 2007, p. 13)

Like the Salk laboratories, the construction system used in Building 20 allowed its users to easily configure the space.

Numerous buildings have been designed with the intention of increasing the creativity of the occupants, yet architects largely base their design decisions on intuitive knowledge gleaned from prior personal experiences and anecdotal evidence. Design strategies from award–winning buildings are frequently replicated in new projects, whether or not they were successful in the original design. These decisions are infrequently substantiated by post-occupancy analysis or other behavioral research, and at best are informed by ‘fragmented empirical insights.’ (Hamilton & Watkins, 2009; Zeisel, 2006) Not only is the effect of the built environment on creativity unmeasured, but building awards are largely based on the aesthetics of design, emphasizing the architect’s imagination and originality over the users’ health, happiness, and creativity. (Mikellides, 2008)

**Summary of Key Findings from the Architecture Literature**

- Architects commonly replicate design strategy patterns in order to create settings to influence social behaviors. This frequently involves physically separating building functions to require that people move between spaces.

- Anecdotal and empirical evidence suggest that these design strategy patterns produce unintended results.
• Post occupancy evaluations are rare for buildings that are easily reconfigured, but findings do suggest that this design strategy supports creativity.

• Emerging fMRI research suggests that inspirational settings may induce physiological responses. The relationship between such physiological responses and creativity remains unexplored.

**Interior Design: Creativity Rooms**

Virginia Woolf (2001) famously said all she required to write fiction was money and a room of her own. Many anecdotes relate the importance that creative practitioners place on the room where they feel they are most creative. The story of Immanuel Kant is one such example. Kant worked from a room with a view of an old church tower (De Quincey, 1873, pp. 115–116). When a neighbor's trees grew to obscure he view he felt that it so negatively impacted his creativity that he insisted they be cut down (De Quincey, 1873, p. 116). The view appears to have been for Kant a significant part of his creative process. As Thomas De Quincy (1873, p. 115) observed:

> During this state of repose he took his station winter and summer by the stove, looking through the window at the old tower of Lobenicht; not that he could be said properly to see it, but the tower rested upon his eye as distance music on the ear--obscurely, or but half revealed to his consciousness. No words seemed forcible enough to express his sense of the gratification which he derived from this old tower, when seen under these circumstances of twilight and quiet reverie.

The fascination that people have with these personal places of creativity is evident in the books published about artists’ studios, blogs on writers’ offices, and the numerous museums created to document the places where famous artists, writers, architects, and scientists worked. However the small body of empirical literature in interior design focuses on creativity in the corporate workplace. Half of the studies examine people’s perceptions about how different features of

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26 For books on artist studios see for example: Richards (2004), Kirwin and Lord (2007), and Fig (2009). A blog on The Guardian website documents the spaces where writers’ work (“Writers’ rooms,” 2008). Some museums include The Mark Twain and Harriet Beecher Stowe houses in Hartford CT; the studios of N.C. and Andrew Wyeth in Chadds Ford, PA; Frank Lloyd Wright's studio in Oak Park, IL; Thomas Edison’s lab in Menlo Park in New Jersey and the “Places of Invention” exhibit at the Smithsonian Museum in Washington, DC.
interior spaces support creativity. Of these, three compare people’s experiences in open office versus private office spaces (Ekvall & Tångeberg-Andersson, 1986; Sailer, 2011; Vithayathawornwong, Danko, & Tolbert, 2003) and two examine design features such as materiality and lighting (Ceylan, Dul, & Aytac, 2008; McCoy & Evans, 2002). Other studies consider how aspects of the interior office space (such as spatial arrangements, social density, and noise) affect creative productivity.

Communication and Privacy

Although Virginia Woolf wrote that creativity required a room of one’s own, the trend in workplace design has been to implement open plan office systems with workstation “cubicles” to increase communication, collaboration, and flexibility.27 Studies by Vithayathawornwong et al. (2003), Ekvall and Tångeberg-Andersson (1986), and Sailer (2011), however, bring into question the benefits of open office systems for creativity. Vithayathawornwong et al. (2003) compared perceptions of creative professionals working in four different office environments. They found that workers perceived the environment with private offices to best support interpersonal interactions, communication, and the exchange of information and ideas. Ekvall and Tångeberg-Andersson examined workers in a creative Swedish newspaper office who moved from an open office environment to a space with private offices. The workers perceived that the move reduced the frequency of discussions, quantity of information, and playfulness among workers, but increased the quality of information and level of freedom in the environment. Sailer (2011) found that spatial configurations that increased social density also increased chance encounters among office workers. Although serendipitous social interactions are believed to increase creativity, the workers in this study perceived that the interactions decreased their creativity by causing loss of concentration on their work. None of these studies measured creative productivity, relying instead on participants’ perceptions of productivity. The three studies suggest that social density

27 Open offices may also be adopted for financial reasons, but this rationale was not given with respect to the creativity literature.
may increase social interactions. However, the quality of those interactions may not be beneficial for creativity and their frequency may negatively impact creative productivity.

**Inspirational Spaces**

**Daylighting, nature, color, and visual complexity.**

Several studies examine people’s preferences for certain interior design features during creativity (Ceylan et al., 2008; de Korte, Kuijt, & Kleij, 2011; McCoy & Evans, 2002). Two of the studies examined meeting rooms (Ceylan et al., 2008; de Korte et al., 2011) and one included photographs of a variety of spaces where people might be creative — including classrooms, waiting rooms, libraries, offices, living rooms, hallways, dining facilities, sports facilities, and retail stores (McCoy & Evans, 2002). Two studies found that people prefer rooms that have natural lighting and views of nature (Ceylan et al., 2008; McCoy & Evans, 2002). This feature was not examined in the third study. All three studies considered colors and materials, but the findings were contradictory for these features. Two studies found that people preferred warmer colors and visual complexity (Ceylan et al., 2008; McCoy & Evans, 2002) whereas the other study had the opposite results. The differences may be attributed to the sample populations (undergraduate students in the former and office managers in the latter) or the perceptions of the creative task (divergent versus convergent thinking.) Numerous studies have found positive effects of daylighting on mood and cognition in healthcare, educational and office settings (Boubekri, Hull, & Boyer, 1991; Choi, 2012; Heschong et al., n.d.; Leather, Pyrgas, Beale, & Lawrence, 1998; Wang & Boubekri, 2010, 2011). The relationship between daylighting and creativity, however, is not specifically investigated. Nature in the workplace has also been a topic of empirical investigation, with several studies finding positive effects for views of indoor plants on attention and stress (Bringslimark, Hartig, & Patil, 2009; Dijkstra, Pieterse, & Pruyn, 2008; Raanaas, Evensen, Rich, Sjostrom, & Patil, 2011). Shibata and Suzuki (2004) compared creative productivity in three rooms (with a plant, with a magazine rack, and with no decoration.) They found that creative performance was higher for all participants in the plant and magazine rooms,
and higher for female participants in the plant room. They also found that some participants used the magazines as a visual source of information (i.e. an environmental cue) during the creativity task, which may account for the differences between male and female participants in the plant room.

Environmental cues.

Some emerging design strategies in workplace settings include the use of visual cues and themed spaces intended to influence creative ideation (Groves et al., 2010; McCallam, 2010). Workplaces incorporate visual cues about company goals and objectives, such as stories about its history, inspirational action words or phrases, or themed interiors to help the employee “think” in a particular way. At Johnson & Johnson in the New York Starett-Lehigh Building, the growing history of the products developed (from bandages to baby shampoo) is displayed as living artwork on the reception area wall (Groves et al., 2010, p. 112). The SCRM facility in La Jolla, described earlier, uses colorful graphics to encourage workers to imagine, innovate, communicate, and collaborate (Figure II.12). The office interiors at Adams & Knight, an advertising agency in Avon, Connecticut, are decorated to look like the 1960’s — designed to reflect the Baby Boomer demographic of their target audience (McCallam, 2010, pp. 15–19). Another common design strategy is to use unexpected or surprising design features to create unconventional workspaces. Some companies create work areas that look more like the rooms in a home. This is the case at Naked Communications in Sydney, Australia where one workspace is designed as a large, functioning bathroom (McCallam, 2010, pp. 147–151). A large piece of glass sits atop the central bathtub, converting it to a small conference table. The theory behind this design strategy is that unconventional spaces will foster unconventional thinking. Use of visual cues and themed spaces appear to be quite popular in modern workplace designs for creative workers. Yet there is no evidence of post occupancy evaluation concerning people’s perceptions of these design strategies or their effectiveness at increasing creative productivity.
Perception and productivity.

There are a few studies that consider the relationship between people’s perceptions about how their workplace supports creativity and their creative productivity. Dul and Ceylan (2011) conducted a survey with 409 Dutch employees working in 49 different companies from various industries. The survey included measures for both social–organizational (9 items) and physical (12 items) environment (Dul et al., 2011). They found that people who believed that their office environment supported creativity also reported higher levels of creative productivity. Dul et al. (2011) used the same instrument plus a creative personality measure in a study with 274 Dutch people employed in creative industries. In this study they found that highly creative people report greater increases in creative productivity in supportive environments. McCoy and Evans (2005) found similar results in their study which isolated the physical features of the environment. They measured actual creative performance in two settings designed to reflect low creative potential and high creative potential as based on their previous study. They also found that the effect of the supportive environment was more pronounced for people who scored higher on creative potential. Although these studies suggest that physical space does impact creative productivity, it remains unclear whether productivity increases because people accurately identify features that support productivity or due to other psychological effects such as overall satisfaction with the workplace.

Effects of Spatial Characteristics on Arousal and Processing Disfluency

Although many of the creativity studies use self-report to assess people’s perceptions, a few (like McCoy and Evans’s) consider how spatial characteristics of a creative setting influence measured creative performances. Three of the studies consider the role of arousal in creative productivity (de Korte et al., 2011; McCoy & Evans, 2002; Mehta, Zhu, & Cheema, 2012). Of these, two attempt to identify the mechanisms behind increased productivity (de Korte et al., 2011; Mehta et al., 2012). In the study by McCoy and Evans (2005) the authors suggest that the interior design features (e.g. warm colors, high visual complexity, daylighting, and views of
nature) of the setting found to increase creative productivity may be more stimulating. De Korte and colleagues (2011) compared creative productivity in three rooms designed to be neutral, restful, or high arousal. They measured participants’ heart rate variability (HRT) and confirmed arousal only in the “high arousal” setting. The researchers found that ideational fluency was higher in both the restful and high arousal settings and originality was higher only in the high arousal setting. These findings suggest that arousal may improve original thinking, but that there may be other physical factors that influence fluency. A study by Mehta and colleagues (2012), however, suggests that it may not be arousal but processing disfluency (e.g. distraction) that influences idea originality.

Mehta et al. (2012) examine the effect of ambient noise on creative productivity in a series of five studies. They find that the relationship between noise and creativity is an inverted-u, with productivity increasing from no noise to moderate noise environments and then declining again as noise increases to high levels. The researchers rule out arousal as the mechanism behind increased productivity and suggest that processing disfluency (moderate environmental distraction) may help people come up with more original ideas. Processing disfluency has been found to increase abstract thinking and reduce confirmation bias (the tendency that people have to let prior beliefs and expectations influence their thinking) (Hernandez & Preston, 2013; Mehta et al., 2012). Although research is quite limited, these few studies do provide some evidence that characteristics of a setting can increase creative productivity. It is possible that the settings people find inspirational may distract them slightly from the creative task, helping people think more abstractly and flexibly about the creative problem.

**Flexible Workplaces: Innovation Labs and Creativity Rooms**

An emerging trend in interior design is to designate a particular space for creativity — either as a separate space in the workplace setting or, more typically as a place “away” from the office (Lewis & Moultrie, 2005; Magadley & Birdi, 2009). Two studies examined “innovation labs” in the United Kingdom. These labs provide a separate space that is designed to support
organizational creativity (Lewis & Moultrie, 2005; Magadley & Birdi, 2009). Lewis and Moultrie (2005) conducted a comparative case study analysis of innovation labs designed for three different organizations: a postal service, a government department of trades and industry, and an academic institution. They found that, despite the differences among the organizations they serve, all three labs are very similar in design. All the labs conveyed intentions to influence human behavior through the physical design of the setting; but none of the designs appeared to be explicitly based on empirical research or theory. The labs employed curved walls, flexible seating configurations, write–on surfaces, toys, and “brainstorming” technology (e.g. computer software, internet access, and projection devices.) Findings also revealed that although the labs were designed to be flexible and reconfigurable, the curved walls and technology caused high degrees of spatial inflexibility. The researchers found that users generally attributed the brainstorming technology and the ability to “get away” from the regular office environments as beneficial to creativity.

Magadley and Birdi (2009) conducted a mixed-methods quasi-experimental study examining the effect of one innovation lab from Lewis and Moultrie’s (2005) research on employee productivity. They found that employees working in the innovation lab produced many more ideas (and that the ideas were generally more useful) than employees in the regular office environment. It remains unclear whether the increased productivity might be attributed to the new environment, the spatial design, the use of technology, or simply the expectations communicated by the setting. Lewis and Moultrie (2005) previously found a correlation between how “junk laden” (i.e. full of toys and other materials) a setting is and the level of creativity expected from the participants in the space. Although the interior design literature appears to be the most promising in terms of providing evidence that physical space affects creativity, the lack of any consistent theory behind interior design strategies greatly impairs the ability for researchers to identify mechanisms that may inhibit or support creative processes.
Summary of Key Findings from the Interior Design Literature

- Workplace design strategies to support creativity commonly employ open office designs to increase social interactions and creative collaborations and environmental cues to influence creative ideation.

- Evidence suggests that open office designs do increase social interactions; but these interactions are not productive and negatively impact creativity. Creative collaborations appear to occur most often in private offices.

- People associate settings that provide natural daylighting and views of nature with creative productivity; and evidence suggests that these features have positive influences on attention and stress.

- Settings that highly creative people feel support their creativity do have significant positive effects on creative productivity, although the mechanisms behind the effects remain unclear.

- Emerging research suggests settings may cause moderate processing disfluency (distraction), which may improve ideational fluency and originality.

Product Design: Tools to Think With

A thorough evaluation of the entire product design literature is well beyond the scope of this dissertation. However, the innovation lab design discussed in the previous section highlights two themes prevalent in the product design literature as it pertains to creativity: technological settings to support social creativity and things with which to think creatively.

Socio–technical Environments for Creativity

People often associate creativity support tools with computer based applications that facilitate brainstorming and group ideation (Lewis & Moultrie, 2005). When people engage with these technologies they form a socio–technical environment. A socio–technical environment is an organizational system that includes both people and technology and may involve physical and/or virtual settings (Fischer, 2007; E. Mumford, 1985; Whitworth & Sylla, 2012). Fischer's (2005a,
2007) research has specifically focused around how socio–technological settings can support creativity. There are parallels between concepts in his research and themes presented thus far in this chapter. The seeding, evolutionary growth, reseeding (SER) model, discussed previously with respect to the natural lifespan of clusters, describes how “reseeding” can counteract a trend toward a decline in creative productivity over time (Fischer et al., 2001). Meta–design is a concept that falls under the flexibility design strategy. It involves empowering stakeholders by allowing them to co–design the socio–technical system at both the planning stage and throughout the lifespan of the system (Fischer & Scharff, 2000). The idea of empowering creative practitioners is central to his work on expert systems (Fischer & Nakakoji, 1992). These systems are intended to help creative practitioners perceive problems and opportunities in a design situation, by providing them with information–rich digital “objects to think with” (Fischer & Nakakoji, 1992, p. 27).

**Inspirational Things to Organize Imaginative Experiences**

The “junk laden” space in the innovations labs mentioned by Lewis and Moultrie (2005) provided materials intended to inspire play and creativity. The variety of different toys and magazines provided were influenced by Weick’s (1977) assertion that to foster creativity, laboratories should be like “Frank Oppenheimer's Exploratorium in San Francisco” (p. 126). Weick (1977) appears be describing the importance of “things to think with” during creativity. People have historically used inspirational objects to spur creativity. The “cabinet of curiosities,” popular in Renaissance Europe, was a way that people curated and displayed unique objects (Livingstone, 2003, pp. 27–33). The “curiosities” included both scientific specimens and fabricated mythological histories about common objects to inspire the imagination. The role of inspirational objects in creativity is the subject of many anecdotes (Fig, 2009). Rudyard Kipling (1937) wrote an entire chapter in his autobiography dedicated to the significance of his “working tools.” These “tools” included meaningful objects from his travels kept on his desk, as well as the
particular pen and ink that he felt were instrumental to his creativity. He explains how he feels these items are essential for influencing his creative thoughts.

Some products are designed to intentionally influence the way people think about and with them. The design of “things to think with” is the focus of the Things That Think initiative at the Massachusetts Institute of Technology Media Lab (Resnick, 1996). This initiative considers how technologically enhanced objects can “change not only what we do, but how we think, what we think about, and who we think with” (Resnick, 1996, p. 441). These products use environmental cues that go beyond the visual thematic strategies used in interior design. Michael and Ann Eisenberg (1998; 2002) take the concept a step further by linking computationally enhanced objects to creativity through “craft technology.” Technologically enhanced craft construction kits inspire and motivate creativity by helping creators extend their abilities through computation while still supporting engagement in tactile and embodied experiences (Crawford, 2009, pp. 23–24; Eisenberg & Eisenberg, 1998).

**Summary of Key Findings from the Product Design Literature**

- Socio–technical environments are intended to empower creative practitioners through knowledge sharing, co–design, and critique.
- Both “low tech” and computationally enhanced objects are “things to think with” that may affect the ways creative practitioners physically, socially, and mentally engage with a creative problem.

**The Gap Between Design Strategies and Empirical Evidence**

A review of the empirical literature that examines the relationship between the designed environment and creativity reveals that 1) there is very little empirical research in this area, 2) what research there is focuses primarily on identifying people’s preferences for certain environments during creativity, and 3) the few empirical studies that consider the effect of environmental features on creative productivity suggest that some commonly accepted design
strategies to support creativity may actually inhibit creativity. There is a gap between the empirical literature and design strategies that are based on anecdote and folk knowledge.

Three common design strategies reveal their own implicit theories about creativity. First, the links/nodes strategy considers creativity a product of social interactions. It assumes that design interventions will increase impromptu social interactions, thereby increasing creativity. The city planning, urban design, architectural, interior, and product design scales all reflect this ideology. The creative city literature is almost exclusively focused on how knowledge transfer may increase creativity. Buildings and interiors are often designed to “push” people into social interactions. Empirical examination of this strategy is minimal, but studies do suggest that interior design strategies that influence social interaction do in fact increase communication levels in an organization; however the quality of the communication is low and overall creative productivity is negatively affected. Conversely, socio–technical environments appear to use a “pull” strategy by enticing social interaction through empowerment.

The inspiration strategy considers creativity a sub–conscious mental activity. It assumes that the aesthetic qualities of a design will inspire creative ideation. This strategy is found at all scales of the designed environment. Strategies at the interior and product design scale sometimes also incorporate environmental cues intended to shape creative ideation. A few empirical studies have examined the direct and indirect (perceived) effects of this strategy. Research suggests that the environments people perceive to be creative do increase their creative productivity (Dul et al., 2011; Dul & Ceylan, 2011; McCoy & Evans, 2002). It remains unclear whether this is because they correctly identify mechanisms that affect creativity or if other variables are involved (such as motivation or satisfaction.) There appear to be three primary hypotheses regarding the direct effects of inspirational settings on creativity. First, the attention restoration hypothesis suggests that the aesthetic qualities of nature restore cognitive fatigue (Kaplan, 1995). Although numerous studies have confirmed the relationship between nature and stress, the effect on creativity remains largely unexplored. Second, the arousal hypothesis suggests that aesthetics stimulate people, improving ideational fluency. Evidence
suggests that although aesthetics do appear to have a stimulating effect on people, it is unclear whether arousal affects ideation (de Korte et al., 2011). Finally the processing disfluency hypothesis suggests that the aesthetic qualities of a space provide low level distractions that help increase abstraction and reduce confirmation bias, thus affecting ideational fluency and originality. This hypothesis has been confirmed in one study, thus currently only the processing disfluency hypothesis has empirical support (Mehta et al., 2012).

Finally, the flexibility strategy considers creativity is an idiosyncratic personal process. It assumes that individual creative processes are impossible to predict, so environments must be designed to accommodate a variety of different activities that may change over time. This strategy is manifest in three different design approaches. The first approach, choice, provides creative practitioners with a variety of different spaces to use for creative work. This approach is evident in the design of the SCRM building in La Jolla, CA. There does not appear to be any empirical investigation into how this approach might impact creativity. The second approach involves designing spaces that are easy (and relatively inexpensive) to remodel and reconfigure. This approach was employed at the Salk Institute and post occupancy evaluations suggest that it has been successful there (Latour & Woolgar, 1979; S. W. Leslie, 2008; T. Leslie, 2003; Moe, 2008). The third approach involves under-designing a space so that users become “co-designers” in order to make it functional. While it is often associated with creativity, there is remarkably little reference to this approach outside of the product design literature. The approach is sometimes used as justification for modular office systems; but there is no discussion about how or when such systems are reconfigured or the effect reconfiguration has on creativity.

This review of the environmental design literature reveals that a few design strategies are replicated across scales of the designed environment and that strategies persist despite evidence that they are ineffective or even counter–productive. Ultimately there appears to be a lack of coherent understanding about the role of the designed environment in creative cognition and behavior. Environmental design strategies would benefit from theoretical grounding in a framework that links creativity and the designed environment. Such a framework should consider
three things: 1) the physically situated processes involved in the stages of creativity, 2) the nature of the relationship between creative practitioners and their environments during these processes, and 3) the features of the designed environment (across the environmental scales from product design to city planning) that support creativity.
CHAPTER III
THEORIES OF PERSON–ENVIRONMENT RELATIONSHIPS

TOWARDS A THEORETICAL FRAMEWORK TO BRIDGE CREATIVE PROCESS AND PLACE:
AN EXAMINATION OF EMBODIED, EMBEDDED, EXTENDED, AND ENACTIVE COGNITION
THEORIES IN ECOLOGICAL PSYCHOLOGY AND COGNITIVE SCIENCE

Highlights

As illustrated in Chapter II, the gap between the literatures on environmental design and creativity is due to a lack of coherent theory concerning the role of the designed environment in creative cognition and behavior. This chapter frames the person–environment relationship debate in the environmental design literature and compares theories that address this relationship in the ecological psychology and cognitive science literatures. The intention behind the chapter is to identify theories that might form an initial structure to help bridge the gap between the environmental design and creativity literatures. I propose that Gibson’s (1977) Theory of Affordances provides the most appropriate starting point from which to develop common theoretical grounding for two literatures. I also point to the enactive literature in cognitive science (which describes how action and perception are intertwined,) to provide the empirical basis from which to address the limitations of Gibson’s affordance theory for describing creativity. The enactive literature helps to explain how Gibson’s theory might account for imagination, planning, and reasoning during creativity. Based on the enactive cognition research, I introduce the concept of potential affordances. Potential affordances are action opportunities in the environment that are not yet available to the perceiver who imagines them. They will require additional work in order to actualize them. I conclude this chapter with a list of next steps required to develop this preliminary structure based on affordance theory into a framework that describes the person–environment relationship during creativity.
Introduction

Review

My review of the environmental design literature in Chapter II described how common design strategies are employed across the different scales of the designed environment. These strategies reveal three implicit theories of creativity: 1) that creativity arises through social interactions, 2) that creativity is an intuitive mental process, and 3) that creativity is the product of individualized practices that change and evolve over time. I suggested that the differences between the design strategies and their respective implicit theories is likely due to particular assumptions designers make about the person–environment relationship during creativity. Design strategies intended to influence social behaviors suggest that human behavior is a response to environmental stimuli. Design strategies to provide inspirational settings suggest that mental processes may be subconsciously influenced by the aesthetics of the environment. Finally, design strategies that make no attempt to provide spaces that support particular activities may suggest that the environment has no influence on either creative behavior or cognition. It is clear from this review that environmental designers would benefit from a functional (i.e. useful) theory to guide the design and evaluation of settings intended to support creativity.

Thesis

This chapter will consider how theories of situated cognition in ecological psychology and cognitive science might ground design strategies and begin to bridge the gap between the environmental design and creativity literatures. Situated cognition takes the position that knowledge emerges from a person’s experiences in the world (Robbins & Aydede, 2009). A review of the situated perspective in ecological psychology and cognitive science reveals two key aspects of the person–environment relationship that are significant for environmental design. First, people initiate exploratory actions in their environments. They are not passive recipients of stimulus provided by design interventions. Instead they make changes in their environments to
better support their needs; or they seek out new environments when it is difficult or impractical to alter an existing one. Second, people have a reciprocal relationship with their environments. Their sensory and motor experiences shape how people think and act. They exploit features of their environments to improve their cognitive and psychomotor abilities and they adapt their behavior to fit their environment. The complementary theories of affordances from ecological psychology and enactive cognition from cognitive science describe how the designed environment is not only a cognitive and behavioral resource for people. This chapter illustrates how together the theories of affordances and enactive cognition can form an empirically grounded structure for the person–environment relationship during creativity — thus providing the first step towards bridging the creativity and environmental design literatures.

**Significance**

This chapter provides the theoretical grounding for a new framework to bridge the creativity and environmental design literatures. In Chapter II I proposed that such a framework should consider three things: 1) the physically situated processes involved in the stages of creativity, 2) the nature of the relationship between creative practitioners and their environments during these processes, and 3) the features of the designed environment (across the environmental scales from product design to city planning) that support creativity. The second point highlights the gap that I will begin to address in this chapter. I propose that an extension of Gibson’s (1977) Affordance theory may provide a solution to the person–environment relationship problem. I suggest that enactivism, a new paradigm in cognitive science, addresses some of the limitations of Gibson’s original theory. Enactivism is based on the assumption that people are autonomous agents and cognition emerges through person–environment relationships (Di Paolo, Rohde, & De Jaegher, 2010). Enaction theory helps to explain imagination, a key component of creativity and something Gibson’s theory does not adequately address (Reed, 1996, p. 183).
Person–Environment Relationship: Four Environmental Design Approaches

The debate over the nature of the relationship between people and their environments has been largely contested in the environmental design literature — and particularly so in architecture (Franck, 1984; Lang & Moleski, 2010; Lang, 1987). This is evident in the different design strategies reviewed in Chapter II. Lang (1987) categorizes environmental design approaches according to four different theories of the person–environment relationship: deterministic, possibilistic, probabilistic, and free–will. Deterministic approaches employ design strategies with the intention of determining a desired user behavior. Conversely, the free–will approach assumes that the physical environment exerts no influence on people’s behavior. Probabilistic approaches suggest that the environment exerts pressures on people but other factors, such as personal and social influences, also influence how environments affect people’s behaviors. This approach takes the position that design strategies are likely to cause certain behaviors, but do not fully predict them. Finally, the possibilistic approach suggests that the environment provides opportunities for certain behaviors, but people chose whether or not to make use of them. As the literature review in Chapter II reveals, environmental designers employ all of these approaches. However, the deterministic approach has failed to produce predictable outcomes and free–will approaches are neither empirically supported by the ecological psychology literature nor the situated cognition view in cognitive science — two fields of research that examine the structure of the person–environment relationship.

Physical Determinism

*Physical determinism* posits that natural and designed environments directly predict people’s behaviors (Franck, 1984; Lang, 1980, 1987). Design strategies based on this approach support a limited range of desired activities and are sometimes inflexible to alternative uses.

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Lang (1980) and Franck (1984) recommend the use of the term physical determinism in lieu of environmental determinism in order to avoid the nature versus nurture debate often associated with the later term. Physical determinism is the inclusive term to describe the theories commonly referred to as geographical determinism, a term associated with the natural environment and architectural determinism, which refers to the built environment (Franck, 1984).
(Mikellides, 1980). As described in Chapter II, some environmental design strategies intended to increase creative productivity (e.g. links/nodes) remain largely influenced by physical determinism. Such a design approach is problematic however, for it follows a trend in architectural practice where the designer’s intentions for a building becoming equated with the answer to social and spatial problems. The utopian visions prevalent in modern architecture were largely influenced by deterministic theories that equated architecture and planning with social engineering (Lang, 1980). The deterministic approach is influenced by Barker’s (1968) eco–behavioral theory of behavior settings, discussed in the next section. However, the application of Behavior Setting Theory to environmental design strategies has produced unpredictable outcomes.  

Modern cognitive and social theories describe how behavior is influenced by such individual factors as intentionality, forethought, self–regulation, meaning, and purpose (Bandura, 2001), which are not considered in deterministic design approaches. A significant body of research has shown that individual and social behaviors cannot be predicted solely by the physical conditions of their environments. Thus the deterministic approach is likely untenable and an unproductive design approach (Franck, 1984; Lang, 1980).

**The Mind–Building Problem**

Reactions against the failure of designed environments to determine human behavior influenced a counter movement in environmental design (and architecture in particular). The abysmal failure of projects like the Pruitt–Igoe housing development, based on Le Corbusier’s idealized Ville Radieuse planning principles, to solve complex social problems gave rise to stern criticism of the deterministic design approach (Boys, 2011; Lang & Moleski, 2010; Lang, 1987). Behavioral scientist blamed architects and planners for 1) failing to meet social objectives, 2) simplistic models of human behavior, and 3) naïve perceptions of the person–environment relationship (Lang & Moleski, 2010, p. 10). This backlash caused many environmental design professionals to wash their hands of social issues, focusing instead on materiality and visual form.

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29 See Chapter II for more detailed explanation and examples of these outcomes.
The free–will design approach posits that the physical environment has no effect on people’s behavior (Franck, 1984; Lang, 1987). In architecture these ideologies may be manifest in design approaches that primarily consider the building an object to behold as opposed to a sequence of spaces to inhabit (i.e. environments) (Lang & Moleski, 2010). This approach provides settings that may be appropriated by users as they see fit. In contrast to the deterministic approach where the environment is understood to cause behavior, the free–will design approach suggests that the behavior helps to create the environment. In other words, “environment” is a socially constructed mental representation and there is no meaningful relationship between the physical form of a setting and the events that take place within it.30

Around the time that the Pruitt–Igoe housing development was demolished in the early 1970’s a group of scientists were reacting against the behaviorist tradition in psychology, which focused exclusively on functional relationships between environmental stimulus and behavioral response. This gave rise to a counter movement, Cognitivism, which considered the role of internal mental representations in human cognition. Cognitivism takes an information processing perspective on human cognition. It assumes that environmental sensory stimuli are converted to mental symbols, and that rule–based processes operate on the structure of these mental symbols to produce behavior (Thagard, 2005). In other words, people receive sensory information from the environment, but they use mental processes, such as judgment, to determine how to react. This perspective was the foundation upon which the cognitive sciences were laid (Leidlmair, 2009; Thagard, 2005). It also gave some theoretical support for the free–will approach.

Current thinking in cognitive science, as discussed later in this chapter, challenges the Cognitivism categorical structural and centralized processing perspective (Thagard, 2005). It is now generally accepted that environmental structure is critical to human cognition (Leidlmair, 2009; Robbins & Aydede, 2009; Thagard, 2005). Thus, although it remains influential in

30 The architect Bernard Tschumi (1981) famously questioned whether there could be any meaningful relationship between architecture and event with his publication *The Manhattan Transcripts.*
architectural theory and education, the free–will approach is no longer empirically supported by the cognitive science literature (Lang & Moleski, 2010).

**Mind–Body–World**

The *possibilistic* and *probabilistic* design approaches remain as the most potentially viable of the four proposed by Lang. Theories in cognitive science and ecological psychology of the person–environment relationship describe how the environment does not determine behavior, but it does appear to be part of our cognitive system.\(^{31}\) The problem remains, however, in understanding how and why environmental designs can “possibly” or “probably” predict human activity. What are the relationships between the mind, the body, and the world in a person’s cognitive system? This is a question that the fields of ecological psychology and cognitive science have sought to address.

In the following sections I will review theories of the person–environment relationship in ecological psychology and cognitive science with the aim of identifying those most appropriate for bridging the environmental design and creativity literatures. Although historically quite separate, there is today significant overlap between cognitive science and ecological psychology. This reflects the shift in cognitive science from a focus on categorical structures of human cognition to environmental structures. First, I will explain some of the fundamental principles from the field of ecological psychology, focusing on Barker’s (1968) behavior setting concept and Gibson’s (1977) Theory of Affordances. I will describe the influence of these two schools on environmental design approaches and discuss the strengths and limitations of each for informing a new framework to bridge creativity and environmental design. Next, I will review the situated cognition literature in cognitive science. Lakoff and Johnson (1999), who were instrumental in laying the groundwork for this literature, argue that cognition is shaped by our brain, our body, and our interactions with the world around us. I will demonstrate how emerging research in enactive cognitive science has moved the field much closer to ecological psychology. Finally I suggest how theories of

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31 Clark (2008a) describes a cognitive system as including the mind, body, and the environmental resources that people use to help them think.
enactive cognition may address some limitations of affordance theory for informing the design of settings to support creativity.

**Person–Environment Relationship: The Ecological Psychology Perspective**

Ecological psychology takes as its central tenet the interdependent relationship between living organisms and their environment (Barker, 1968; Gibson, 1977; Heft, 2001; Reed, 1996; von Uexküll, 2010). Two foundational principles can be traced back to the early 20th century work of theoretical biologist Jakob von Uexküll (2010). First, the appropriate unit of empirical analysis for understanding the person–environment relationship is the interaction between organisms and their environment, because “meaning” is embodied in the experience of exploring and obtaining information from the environment. Second, such interactions must be examined in their naturally occurring context (as opposed to a laboratory environment), because cognition and behavior emerges from the dynamic and self-organizing system of the organism and its environment. These principles are evident in two schools of thought that have influenced the field of ecological psychology, one based on James Gibson’s (1977) ecological theory of perception and the other on Roger Barker’s (1968) concept of behavior settings (Heft, 2001).

There are many similarities between these theories, the most notable being how they describe human-environment interactions as dynamic systems (Heft, 2001). The key difference between them is the ecological unit of empirical analysis.\(^\text{32}\) Gibson was interested in the interactions between individual organisms and the structure of their environments - thus a single person would be used to define the boundary of the ecological unit. The setting defines the unit of analysis in Barker’s theory. Although Barker refers to his research as ecological psychology, his theory also focuses primarily on social behaviors.\(^\text{33}\) For this reason, Heft (2001) refers to it as eco–behavioral science. Both theories have influenced the environmental design professions.

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\(^{32}\) The ecological unit of analysis refers to the subject of empirical investigation. In Gibson’s case he considered a single person the appropriate unit to examine empirically. Barker examined the behavior setting as an episodic unit defined by space, behavior, and time.

\(^{33}\) Barker’s behavior setting theory is also commonly called environmental psychology. Gibson’s theory is more consistently referred to as ecological psychology.
Gibson's work has had particular impact in product design where his term *affordance* was appropriated (and redefined) by Donald Norman (2002) for use in human–computer interaction design. Barker's theory, with its focus on the setting, historically has had more impact on architectural and urban design theory and practice than Gibson's (Lang & Moleski, 2010; Lang, 1987).

**Behavior Settings**

According to Barker (1968), behavior settings are defined by both dynamic and structural properties, including 1) a standing pattern of social behavior and 2) a setting, or *milieu*, which encompasses and supports the activities inherent in the pattern of social behavior. Synomorphy is a term Barker uses to describe the congruence between environmental properties of the milieu and behavior patterns required to form a behavior setting. He developed the behavior setting theory with Herbert Wright in 1949, based on observations that different people behave more similarly when they are in a particular setting (such as church or school) than individual people behave in different settings (Barker, 1968). A behavior setting exists for the period of time that a milieu (setting) and a particular pattern of behaviors co-exist (Lang & Moleski, 2010). A single milieu may be part of multiple behavior settings if it supports several different patterns of behavior. Because of its emphasis on behaviors (as opposed to individual psychology), Heft (2001) refers to Barker's theory as *eco–behavioral science*.

According to Lang and Moleski (2010), architects and urban planners are generally concerned with two types of behavior settings: places (e.g. nodes) and the connections between them (e.g. links). Barker’s concept of behavior settings was influential in the development of design patterns in architecture and urban planning (Lang & Moleski, 2010). Design patterns are spatial strategies that environmental designers employ with the intention of creating behavior settings. They often replicate patterns of physical features in existing behavior settings based upon assumptions about what behavior patterns should occur in a new setting (Lang & Moleski, 2010). The goal of the design pattern is to create a milieu, which will bound and sustain a
desired behavior. The architect Christopher Alexander and colleagues (1977) popularized the
design pattern approach in architecture and urban planning. Informed by the belief that patterns
of event-spaces in architecture and urban design form a design language, they set out to define
and document 253 specific behavior settings that covered a range of scales from interior design
to urban.

As was illustrated in Chapter II, although the practical application of design patterns has
been controversial and the results inconsistent, their use persists in buildings intended to foster
creativity. Settings observed to encourage creativity and collaboration at the urban scale, such as
the street, atrium, hub, café, and nook are used as links/nodes design pattern metaphors in
office buildings and schools intended to promote creativity (Nair & Fielding, 2007). Architects and
urban designers have applied design patterns with the assumption that replicating the spatial
patterns observed to promote particular behaviors will predict and produce those same patterns
of behavior in a new space (Nair & Fielding, 2007). Design patterns are thus often associated
with the deterministic design approach. Although the intention may be to provide the proper
milieu to fit a particular behavior, this strategy tends to treat people as a collective and assumes
they perceive the environment in the same way. This is very different than the way environment
is considered by von Uexküll’s (1926) and Gibson’s (1977) ecological approaches.

**Environment**

The subjective nature of the environment was paramount to von Uexküll’s (1926) concept of Umwelt. He described Umwelt as the “surrounding environment” of an organism that is structured through its senses and abilities. Every organism has its own Umwelt, even if multiple organisms occupy the same space. The living organism is always at the center of its Umwelt and is conceptually bound to it.\(^3^4\) Environment, as it may be collectively referred to in a building or urban space, is therefore heterogeneous. It entails the relationships between people and the objects that they sense and with which they interact. This concept of the heterogeneous

\(^{34}\) People can conceptually escape this boundary by using their imagination.
environment reveals a limitation of the behavior setting theory for informing environment design strategies. It fails to address the idea of environment from the perspective of the individual. This shortcoming is highlighted by Heft (2001) and Wicker (2002) who both suggest that the theory would be strengthened by addressing the individuality of the behavior setting participants. Heft (2001) proposes that a synthesis of Barker’s behavior setting theory and Gibson’s Theory of Affordances might provide a much-needed unified theory of ecological psychology. To more fully understand how the relationship between people and their environments might impact environmental design strategies, we must shift from the focus on behavior settings to affordances and the interactions between individual people and their environments.

**Affordance Theory**

Von Uexküll first introduced the concept of affordances, describing the latent action possibilities of an object as *funktionale Tönung* (functional coloring) and a person’s perceptions of an object as related to the ability to exploit such action possibilities. Psychologist J.J. Gibson (1977) extended the work begun by Uexküll with the Theory of Affordances, which was based on his research in visual perception. Gibson believed that people understand the world in terms of functional relevance; the form and capabilities of a person’s body and its interactions with the external environment shape that person’s conceptions of the world (Wilson, 2002). According to Gibson, an affordance is the relationship between a person’s abilities and intentions with respect to features of their physical environment. For example, a person may view a chair as something which affords sitting, or perhaps even something with which to prop open a door. If that person had a body that was much smaller, or was limbless, he or she would have a different conception of the chair. Donald Norman popularized the affordance principle in design theory, introducing the term in his book “The Design of Everyday Things” (1988). Where Gibson considered affordance any and all potentially actionable properties of the physical environment, Norman’s definition concerns only the actionable properties consciously perceived by an individual.
According to Gibson, an affordance “is neither an objective property nor a subjective property; or it is both if you like” (1979, p. 129). This definition has led to great debate among scholars as they have tried to clarify his intentions. Reed (1996) describes affordances as resources, which suggests that they may exert selection pressure on the perceiver. Turvey’s (1992) definition considers affordances as dispositional properties of the environment, which depend upon the presence of animals who can actualize (make use of) them. In Turvey’s definition affordances do not exert selection pressure but they do depend upon the abilities (effectivities) of an animal to actualize them. Heft’s (1989) definition considers the role of body scale and addresses species-specific and culturally-significant aspects of affordances. Finally, Chemero (2003) describes affordances as a relationship between person and environment. This contrasts with both Reed’s and Turvey’s views of affordances as properties of the environment. As Chemero (2003) points out, there is agreement among the different definitions that affordances are “animal-relative.” The disagreement concerns whether affordances exist without people or other animals to perceive them. In other words, are affordances qualities of an environment or the relationship between a person and the environment? The second point of debate concerns relevant properties of the animal. Is it abilities (effectivities) or body–scale that is necessary for the perception and actualization of affordances?

There are four concepts in affordance theory that are particularly relevant for informing environmental design, the functional level of analysis, reciprocity, agency, and perception. Affordance theory takes as a first principle that person and environment are inseparable and thus must be analyzed together in order to understand human cognition and behavior (Heft, 2001; Reed, 1996). (Environment, in the Gibsonian sense, is similar to von Uexküll’s concept of Umwelt.) Thus the relationship between person and environment is the functional level of analysis. This suggests that to understand a person’s creative processes one must examine them within the context in which they naturally occur.

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35 Reed (1996) describes affordances as resources in the environment that exist independently of an organism (see pages 18 & 26).
Reciprocity refers to the adaptive relationship between person and environment, and is revealed in three ways. First, people seek our environments that fit their needs. Simply put, if I need to sleep, I seek out a quiet, dark place with furniture that affords reclining (such as my bedroom.) If I need to eat, I may stop by a restaurant on my way home from work. Second, people adjust their behaviors to fit an environment. This is the foundational principle behind Barker’s behavior settings theory. Third, people alter environments when they do not meet their needs. They may shut a door if they find an environment too noisy to be able to concentrate on work; or they may turn on a light when it is too dark to read. As described in Chapter II, people move furniture and even knock out walls in a building when it suits their intentions. Unique to humans is our ability to construct entire (designed) environments to serve our needs. As Winston Churchill is famously credited with saying, “We shape our buildings, and afterwards our buildings shape us.”

Although affordance theory describes how the environment exerts pressures on people, it breaks with the stimulus–response behaviorist model because it posits that people have autonomous agency (Heft, 2001; Reed, 1996). Knowledge is grounded in immediate experience as the result of self–initiated exploratory actions. Reed describes three characteristics, borrowed from Eleanor Gibson, that explain agency: prospectivity, retrospectivity, and flexibility (Reed, 1996, p. 12). Prospectivity describes how people have agency when they prospectively seek out information in their environments according to their goals and intentions. Retrospectivity concerns how a person learns from prior experiences to find meaning or relevance in current experiences. Flexibility refers to how people can devise multiple ways to achieve a goal or intention. Thus people’s experiences are an outcome of the information they select (perceive) and the opportunities for action they exploit (actualize.) Their actions do not need to be triggered by environmental stimulus.

The concept of perception in affordance theory has both benefits and limitations for informing environmental design. An advantage is that perception and action are intertwined in affordance theory. Perceiving is a “mode of activity” where actions promote information pick–up
and information obtained from the environment informs exploratory actions (Heft, 2001, pp. 176–177). This perception–action concept links cognitive processes with physical conditions, which may be particularly useful for understanding the role of the designed environment in individual creative processes. Things become problematic, however, with Gibson’s (1977) explanation that perception is direct, meaning it is unmediated by mental processes such as perceptual judgment and interpretation. The concept of direct perception has been the topic of intense debate in the literature (Chandrasekharan & Osbeck, 2010; Greeno, 1994; Noë, 2002; Vicente, 2003; Withagen, 2004). An advantage of the direct perception concept is that it does not rely on the central processing view of cognition described by Cognitivism. However, Gibson’s direct perception concern fails to account for processes like remembering and imagining that do not appear to rely on direct experience (Reed, 1996, p. 183). Hence, this may presents challenges for the suitability of affordance theory as a foundational framework for creativity.

**Strengths and Limitations of Ecological Psychology Theories**

The concept of behavior settings has been used to inform environmental design strategies with mixed results. A benefit of this theory is its emphasis on the setting (milieu) and activity as the structural system of interest. It also considers the fit (synomorphy) between people as a collective and features of the environment. These concepts transfer easily to the form (spatial) and function (programmatic) aspects of environmental design strategies. It also presents a predictive model of human behavior. Unfortunately that aspect of the theory has been problematic for environmental design strategies that suggest the setting (milieu) will determine human behavior. The most significant limitation of this theory is that it focuses solely on social behaviors. It does not account for the relationship between individuals and their environments. Nor does it examine the psychological implications of this structure. As Heft (2001) suggests, behavior setting theory would benefit from a more fine-grained approach that considers both the role of the individual in a behavior setting and the particular features (and affordances) of the milieu that support patterns of activities in the behavior setting.
Affordance theory offers some clear advantages over the behavior settings concept for informing environmental design strategies to support creativity. Most significantly, it focuses on the individual as an autonomous agent in the environment (as opposed to a social group), which aligns with the goals of this dissertation. Second, it considers the person and environment as one structural unit of analysis, emphasizing the interactions between them. This useful for environmental design, where settings are designed to support such interactions. Finally, affordance theory considers the psychological aspects of the person–environment relationship (as opposed to the eco–behavioral approach in behavior settings theory). This may prove particularly beneficial for considering the person–environment relationship during creativity — a psychological process. Thus affordance theory concepts of human agency, person–environment reciprocity, and perception-in-action make this theory more attractive than Barker’s behavior settings concept.

Affordance theory is not without its limitations, however. Its most significant drawback for informing environmental design is that it does not provide a means to predict how features of the designed environment might fit a person’s goals and intentions. First, Gibson and his followers have made no attempt to categorize environmental features in a way that could be useful to environmental designers. Further, as I will illustrate in the next section, people can rarely anticipate all of the activities they may need to complete a creative task, so they cannot be relied upon to specify in advance all of the environmental conditions desired to meet their goals and intentions. It is also unclear how affordance theory addresses imaginative experiences, which are so important for creativity. Finally, the theory suffers from a lack of any commonly accepted definition about what is an affordance (Chemero, 2003). Although affordance theory appears promising as the foundation for a new framework to link creativity and the designed environment, it is not sufficient by itself.

**Person–Environment Relationship: The Cognitive Science Perspective**

Gibson laid the groundwork for emerging research in cognitive science by helping to establish the foundation for modern theories of situated cognition (Clancey, 2009; Noë, 2004; D.
Ward & Stapleton, 2012). Situated cognition is a theory based on the premise that knowledge cannot be separated from context, that knowing is “inextricably situated in the physical and social context of its acquisition and use” (Brown et al, 1988, p. 1). There are four central ideas in situated cognition. First, the embodied thesis argues that cognition encompasses both the mind and the body (Clark, 1998; Reed, 1996). Second, the embedded thesis maintains that people exploit features of the physical and social environment to increase their cognitive capabilities (Clark, 2008; Hutchins, 2006; Noë, 2004). Third, the extended mind thesis states that cognitive processes are extended beyond the boundaries of a person’s body through “cognitive coupling” with artifacts in the environment (Clark & Chalmers, 1998; Clark, 2008). Fourth, the enaction thesis describes cognition as dependent upon a person’s actions in the world (Noë, 2004; D. Ward & Stapleton, 2012). Of these claims, the first two are fundamental for understanding how the designed environment may support creative processes. The third claim will be briefly considered, but is less significant for this dissertation than the other claims. Finally, I suggest that the fourth claim is the most useful of the four, because it encompasses the first two claims (and possibly the third claim) and also connects the cognitive science and ecological psychology literatures.

**Situated Cognition**

The terms situated cognition, embodied cognition, and embedded cognition are sometimes used interchangeably; however in the creativity literature situated cognition is a term used to refer primarily (and sometimes exclusively) to the social context (Robbins & Aydede, 2009). Embodied, embedded, and enactive cognition take the grounding of cognition in the physical environment as their central tenet, and thus generally are understood to refer to the physical context (Noë, 2004; Robbins & Aydede, 2009). Although, according to Robbins and Aydede (2009), situated cognition is the “genus” and embodied and embedded cognition the “ilk,” these terms are not always used this way in the literature. For clarity, when I refer to situated cognition in this dissertation I intend the “genus” meaning of the term and will specify if
I am speaking of only the social or physical context, whereas when I use the terms embodied and embedded cognition I will always be referring to the physical grounding of cognition.

**Embodied Cognition**

Embodied cognition maintains that cognition is deeply dependent upon the physical characteristics of the body (M. Wilson, 2002). This thesis argues that the sensory and motor capabilities of our bodies shape our mind to the extent that perception, thought, and action are co-constructed (Robbins & Aydede, 2009). Three streams of research have informed this hypothesis: linguistic, robotic, and philosophical. Linguistic research by Lakoff and Johnson (1980, 1999) considers the use of metaphor in everyday speech as evidence that mental representations are grounded in real world experiences. Artificial intelligence research by Rodney Brooks (1991a, 1991b) introduced the embodied approach to robotics as an alternative to the central processing view of artificial intelligence. His “bottom-up” approach to cognition mirrors Gibson’s work in ecological psychology, suggesting that knowledge is constructed through exploratory actions in the world. Finally, the philosophical approach is based in the phenomenological works of Edmund Husserl and Maurice Merleau-Ponty who maintain that the body is at the center of perception and experience (Gallagher, 2009; Pallasmaa, 2010; Varela, Thompson, & Rosch, 1991). Empirical support for embodied cognition has generally focused on either the relationship between abstract cognitive states and physical states of the body or how states of the body influence cognition (A. D. Wilson & Golonka, 2013). The relevance of embodied cognition theory for understanding person–environment relationships during creativity is considered with respect to three areas: creative places (environmental design), creative activities (tool usage), and creative processes (metaphor).

The philosophical approach is at the root of embodied cognition theory in architecture and environmental design (Holl, Pallasmaa, & Pérez Gómez, 2006; Pallasmaa, 2005, 2010, 2011). Juhani Pallasmaa is largely responsible for bringing an awareness of embodied cognition principles to the design of environments (Mallgrave, 2011). He criticizes the visual bias in
architectural design, blaming it for the creation of “impoverished environments” that create feelings of detachment and alienation in users (Pallasmaa, 2005). Instead, he advocates for a multi-sensory approach that engages the senses of hearing, smell, and touch (Pallasmaa, 2005, p. 70). Although he bases his argument largely on philosophical theory, personal experience, and observation, his more recent work references some empirical studies in embodied cognition (Pallasmaa, 2005, 2011). Mallgrave (2011) also examines the concept of embodiment in architecture and attempts to organize architectural theories with empirical evidence from neuroscience. Such efforts, however, are limited to basing architectural designs on scientific research and do not empirically examine the effects of architectural strategies. Based on the literature review in Chapter II, a phenomenological approach to architectural design may have some benefit for creativity. However, without a theoretical framework empirically grounded in scientific knowledge from embodied cognition, it is nearly impossible to know what architectural features may be beneficial and why. For now the embodiment thesis only provides some theoretical support that place matters to creativity.

The skillful use of tools and materials by the hand is often considered integral to creativity (Sennett, 2008). Pallasmaa (2010) wrote a book about “the thinking hand” in architectural design and the sociologist Richard Sennett (2008) refers to “the intelligent hand” of the craftsman (p. 149). They both describe an embodied view where creativity emerges from the connection between head, hand and the creative artifact. The “bottom–up” approach to embodiment advocated by Rodney Brooks (Brooks, 1991a, 1991b) and Andy Clark (A. Clark, 1999, 2001, 2008a) argues that the mind exists for action and that thinking depends on the work of the body. Clark (2008a) uses the example of a famous exchange between the physicist Richard Feynman and historian Charles Weiner to illustrate this principle. In the anecdote, Feynman argues with Weiner that a paper he wrote is not a record of his thinking, but actually is his thinking. Clark explains how Feynman’s use of pen and paper is “responsible for the shape of the flow of thoughts and ideas” (p. xxv). Empirical support for embodied cognition theory is often based on studies which demonstrate activation of motor processes in the brain when people 1)
think about using tools, 2) say words associated with tool use, or 3) watch someone else use a tool during experimental tasks (Mahon & Caramazza, 2008; Pulvermüller, Hauk, Nikulin, & Ilmoniemi, 2005). Embodied cognition theory may be particularly relevant for understanding how creative practitioners’ interactions with tools, materials, and other features of the environment may influence their creative thinking.

The relationship between embodied cognition and creative processes is the focus of a study about metaphor use conducted by Leung et al. (2012). The researchers consider how metaphors for creative thinking often reference physical actions and conditions, such as to “think outside the box,” consider a creative problem “on one hand, then on the other hand,” and “put two and two together.” They found that embodiment activates creative cognitive processes and increases creative productivity in a series of five experiments. The first study considered the “thinking on the other hand” metaphor. Participants in control and experimental groups completed two trials. In the first trial they were asked to come up with creative responses while standing and holding out the right hand. In the second trial they were asked to do the same thing, but the experimental group was told to hold out the left hand instead of the right. Creative fluency (number of ideas) was significantly higher for the “left hand” group only. The next three studies considered the “thinking outside the box” metaphor. Participants completed creativity tasks 1) inside and outside a 5 foot by 5 foot cardboard box, 2) while rectangular walking, free walking, or sitting, and 3) while “virtually” rectangular walking or free walking in a three-dimensional computer environment (Second Life.) The results found a positive effect on convergent thinking when outside the cardboard box, a positive effect on creative originality in both the free walking condition and the “virtual” free walking condition. The final study considered the “put two and two together” metaphor. Participants completed two repetitive tasks where they either moved coasters from one stack to another or from two stacks simultaneously to the center of the table. The second condition was intended to mimic an integrative hand gesture. There was a positive effect of the “integrative gesture” condition on rates of convergent
thinking but not divergent thinking. This research suggests some compelling evidence about the relevance of embodied cognition theory for creativity.

**Embedded Cognition**

Embodied and embedded cognition often go hand–in–hand, and thus are sometimes referred to collectively as embodied, embedded cognition (A. Clark, 2008b). Where embodied cognition considers how people use their bodies to help them think, embedded cognition theory considers how people use features of their environment to improve their cognitive abilities (Robbins & Aydede, 2009). A common theme in embedded cognition theory is how people off–load cognitive work to their environments (A. Clark, 2001). Andy Clark refers to this as the "007 Principle," which he explains means to "know only as much as you need to know to get the job done" (p. 46). In other words, he suggests that people will not store or process information that they can easily off–load to the environment.

People act on their environments to improve mental processes (epistemic actions), they alter their environments in specific ways to help them make decisions (niche construction), and they manipulate their environments to help them learn about complex situations (cognitive bootstrapping). Kirsh and Maglio’s (1994) research on epistemic actions uses the Tetris computer game to illustrate how players use epistemic actions to improve game play. Players physically rotate playing pieces as they drop to help them solve the puzzle faster than performing those rotations in their minds. Another principle in embedded cognition theory is niche construction where people exploit features of their environment to help them think (A. Clark, 2008a, p. 64). Kirsh (1995a) describes how people alter their environments, thereby making cognitive niches to 1) simplify choices (such as organizing things in a production line), 2) simplify perception (such as organizing puzzle pieces by color), and simplify mental computation (such as ordering Scrabble pieces to help remember words.) When problems are particularly challenging, niche construction can be used as a form of cognitive bootstrapping where learning is the process of “incremental cognitive self–stimulation” through feedback from environmental conditions. These
concepts are manifest within two embodied cognition theories that may be especially useful for understanding the person–environment relationship during creativity: Lucy Suchman’s (1987, 2007) situated action theory and Donald Schōn’s (1983) reflective practice theory.

**Situated action.**

Suchman’s (2007) situated action theory describes planning as an “imaginative and discursive practice” (p. 13). The concept of situated action describes how plans are not mental maps that determine actions; but rather they co–evolve with — and in response to — actions. Suchman uses the example of white water canoeing to describe how successfully navigating the rapids is not the result of a detailed plan laid out before the adventure started, but rather a series of strategies in response to embodied actions. The “plan” may best be described as a means to “orient you in the best possible position from which to use those embodied skills on which, in the final analysis, your success depends (p.18). Each plan is a strategy in response to actions in—situ, and a resource to guide the next situated action. Suchman’s conception of situated action thus appears to be a type of creative problem solving where the activities and processes required to reach a solution cannot be fully known in advance. They emerge through exploratory actions in the creative situation.

**Reflective practice.**

Donald Schōn’s (1983) reflective practice theory describes how professionals solve problems “in action.” His use of the term “action” refers both to the situated nature of reflective practice and references what he calls “the action present” (p. 278). Action present is the period of time in which an action can have an effect on the problematic situation (p. 62). Schōn’s theory describes the intertwined nature of thinking and doing through two complementary processes: knowing–in–action and reflection–in–action. Knowing–in–action is a tacit process of thinking through doing (p. 49-54). Schōn uses the example of a baseball pitcher who describes having a “feel for” the ball and trying not to “think” during a game. This tacit form of embedded cognition
is a kind of intuitive and improvisatory performance between the baseball player and the ball. Reflection–in–action is an explicit process that focuses on 1) the outcomes of the action (e.g. “That pitch didn’t go where I wanted!”), 2) the action itself (e.g. “I wonder if I over–rotated during the pitch?”), or 3) the intuitive knowledge implicit in the action (e.g. “There was something off about my stance. It just didn’t feel right.”) Reflection–in–action is triggered by a surprise, such as when intuitive performance yields unexpected results (p. 56). Although Schön does not describe his theory as a form of creative problem–solving, he developed it by examining the practices of creative professionals (such as engineers, architects and town planners).

**Extended Cognition**

Extended cognition is a concept that describes cognition as a system that can exceed the bounds of a person’s body (A. Clark & Chalmers, 2008). Andy Clark (2008a) is an advocate for the extended cognition theory, arguing that when people recruit neural, bodily, and environmental resources to solve tasks they extend their cognition between those things. This thesis has been hotly contested in the cognitive science literature (A. Clark, 2008a). Therefore, since the concept is not essential to this dissertation, I will merely give it mention as a point of possible future investigation.

A related concept that is not as controversial, however, is distributed cognition. Edwin Hutchins (1995) introduced the concept in his analysis of ship navigation systems and processes. A primary distinction between Clark’s concept of extended cognition and Hutchins’s theory of distributed cognition is that Hutchins’s theory relies on other people as the primary means of cognitive extension and distribution. He refers to this as “systems of socially distributed cognition” (p. xiii). Hutchins (2000) maintains the cognition is distributed in three ways: across people in a group — such as the ship’s crew members; between internal (mental) and external (material and environmental structures) — such as the ship’s navigational system; and across time – such as how historical events influence current events. Although the physical environment is part of this system (as referenced in his metaphor “cognition in the wild”), his distributed
cognition theory is more often recognized as a theory of social cognition. Distributed cognition theory may be useful for developing greater understanding about how group creativity may be not only a socially situated process, but also a physically situated one.

**Enactive Cognition**

The foundational principle behind enactive cognition is that perception and cognition depend upon a person’s interactions with the world. This theory is generally treated as separate from embodied, embedded, and extended cognition. However, some researchers have suggested that if cognition is enactive that it must also be embodied and embedded (and it might also be extended) (D. Ward & Stapleton, 2012). Enactive theory suggests that cognition emerges through autonomous agency and adaptive interaction with the environment (Di Paolo et al., 2010; Thompson, 2005; Varela et al., 1991). How, exactly, a person obtains sensory information is debated among researchers (Noë, 2004, 2012; D. Ward, Roberts, & Clark, 2011). Of particular interest for this dissertation are theses presented by Noë (2004) who emphasizes sensorimotor knowledge and Ward, Roberts, and Clark (2011) who align their work more directly with J.J. Gibson's to emphasize the visual system. The similarity between these two schools of thought is that they both appear to be addressing the problem of direct perception. How do people directly obtain information from the world without intervening mental processes?

The theories presented by Noë (2004) and Ward et al. (2011) attempt to avoid the problem of the “sandwich model” of cognition that assumes three stages of information processing: first perception, then cognition, and finally action. According the enactive approach, the human mind is embodied and embedded in the world and not reducible to these mental structures. Noë’s (2004) sensorimotor theory describes the direct relationship between perception and action. Perception is determined by what a person does, knows how to do, or is able to do. He refers to this as **sensorimotor knowledge**, a type of bodily self-awareness that may be intuitive. Perception, Noë suggests, is based on the body’s abilities. This concept helps to explain
how, for example, we are able to perceive the back of an object even though we cannot see it. Our perception of the object is shaped by our locomotive abilities.

The advantage of the sensorimotor model is that it both solves the problem of direct perception while accounting for imagination and remembering. At the biological level, the sensorimotor approach to perception is congruent with common coding theory (Chandrasekharan & Osbeck, 2010). Common coding describes how action and perception are functionally intertwined in the nervous system. Perception triggers the motor cortex when people anticipate performing an action, when they watch another person engage in an action, and when they imagine an action (Chandrasekharan & Osbeck, 2010). Conversely, action also affects perception. Action possibilities in the environment can restrict perception and imagination (such as demonstrated in the enactive metaphor study mentioned earlier.) Noë’s (2004) sensorimotor model of enactive cognition appears to be particularly relevant for understanding the role of the designed environment in creativity because it establishes a link between perception, action, and imagination.

Although there is considerable support for the sensorimotor approach in the enactivist literature, it is important to note that Ward, Roberts, and Clark (2011) argue that it does not effectively account for the level of abstraction required for reasoning and planning processes. These processes are clearly important for creativity, thus I will briefly highlight their position. Ward et al. propose an enactive model based directly on Gibson’s affordance theory. In this action–space model, people’s perceptions depend upon their plans, knowledge, and intentions with respect to the “currently enabled action space” (or environment). Ward et al. also maintain (like Gibson) that the visual system is the primary means of obtaining perceptual information. They base their model on the discovery by Goodale and Milner (1992) of two visual systems in the brain. The two streams hypothesis describes two parallel vision processes in the brain: a ventral stream (the “what pathway”) that is involved in object identification (i.e. vision for perception) and a dorsal stream (the “how pathway”) that is involved in spatial awareness and action guidance (i.e. vision for action) (Goodale & Milner, 1992; Milner & Goodale, 2008). Ward
et al. explain that the benefit of their approach is that it accounts for both direct perception as well as more abstract reasoning, planning, imagining and intention formation — and that these processes may run in parallel (D. Ward et al., 2011).

**Strengths and Limitations of the Cognitive Science Theories**

The main strength of the cognitive science theories of embodied, embedded, and enactive cognition is that they provide a more granular level of detail about the person–environment relationship than the ecological theories. The major limitation of these theories is that they do not provide a functional structure appropriate for informing design strategies at the scale of the designed environment. Although there has been some attempt by architects to incorporate finding from cognitive and neuroscience research (E. M. Sternberg & Wilson, 2006), these efforts are often criticized for attempting to link research at two significantly different scales of empirical analysis with "a bridge too far." Emerging research in enactive cognition, however, may hold the key to bridging the ecological affordance theory and the cognitive science theories of embodied and embedded cognition — thus providing the groundwork for a functional (i.e. useful) model of the person–environment relationship.

**Towards an Ecological and Enactive View of Creativity**

The most significant finding from this review of the ecological psychology and cognitive science theories is how the two bodies of literature are highly congruent and complementary. Barker’s (1968) behavior setting theory, which has historically had the most influence on environmental design strategies, would benefit from integrating a cognitive (social psychology) perspective that might be provided by integrating Hutchins's (2006) distributed cognition theory. Together these two theories would be more strongly positioned to describe the people–environment relationship for group (social) creativity. The embodied, embedded, and enactive literatures all describe how cognition is shaped by people’s interactions with their environments.

36 I borrow this phrase from Bruer’s (1997) criticism of brain–based education.
The embodied cognition literature could inform how creative thinking is shaped by the actions of the body. The embedded literature might illustrate the role of situated plans, actions, and reflection during creativity. Emerging research in enactive cognition directly references Gibson’s (1977) affordance theory as a model for understanding the role of the environment in human cognition. The enactive literature (and by association the embodied and embedded cognition literature) may begin to address the limitations of affordance theory by 1) shedding new light on Gibson’s concept of direct perception and 2) providing an additional perspective for how affordances might best be defined. Ultimately, however, the embodied, embedded, and enactive cognition literatures provide empirical support for the relevance of Gibson’s affordance theory for understanding the person–environment relationship during creativity.

I set out in this chapter to lay the groundwork for a theoretical framework to describe the person–environment relationship during creativity. This review of the literature reveals the benefits to adopting Gibson’s affordance theory framework and extending it with emerging and complementary research in enactive cognition to address its limitations. The goal of this new theoretical framework is to provide a functional structure, useful for informing environmental design. Towards that end, I propose that several key issues still need to be addressed. First, the term environment must be clearly defined. Second, this definition should delimit the structural unit of analysis for the theoretical framework. Third, the problem of direct perception must be addressed. Fourth, the term affordance must be defined with respect to the relevant properties of the person and the qualities of the environment. Finally, although the new framework is intended to describe the relationship between a single creative person and his or her environment, it should be a complement to behavior setting theory and a social (collective) view of creativity. It is generally accepted in the creativity literature that individual creativity and social creativity are unique phenomena and, to truly understand creativity, ultimately we need an account of the role of the designed environment for each.
Creative Spaces: Environments, Umwelts, Milieux or Niches?

There are many definitions to describe the place where creativity happens. In this chapter alone I have referenced four different terms: environment, umwelt, milieu, and niche. I elect to use the more general term “environment,” since this is already in common use in the environmental design literature. For the purpose of this dissertation, I adopt von Uexküll’s definition to describe the environment as the area around a person that is structured through that person’s senses, abilities and actions, and to which he or she is conceptually bound. I will refer to the collective environment of multiple people as either “their environments” (to describe the sum of the individually constructed environments) or “space” to describe the heterogeneous and socially–constructed quality of the collective environment. Finally, I will use the term “setting” to describe only the physical aspects of a place.

The Structural Unit of Analysis for a New Creativity Framework

The first step toward creating a theoretical framework bridging environmental design and creativity is to determine what scale of analysis is most useful for understanding the person–environment relationship during creativity. As I stated in Chapter I and illustrated in Chapter II, considering creativity as a social phenomenon has not been particularly useful for informing environmental design strategies. Gibson wrote in 1976 “architecture and design do not have a satisfactory theoretical basis” (1976, p. 413). This statement holds true today (Hensel, Menges, & Hight, 2009; Lang & Moleski, 2010). He went on to ask “Can an ecological approach to the psychology of perception and behavior provide it?” Although affordance theory has not yet provided a strong theoretical basis for environmental design, I suggest that by extending the theory with research from enactive cognition, it could. The concept of affordances provides the most appropriate foundation for a common theory linking creative cognition and the designed environment.
Direct and Indirect Perception

Murray (1938) describes two types of creative press, objective pressures (alpha) and perceived pressures (beta). Alpha press influences are those that are perceived through direct sensory stimulation and may not be attended to, whereas beta influences are the result of attention and personal interpretation. He explains that environmental factors may fall under both categories of press. For example, if a person directly perceives background music in a setting through the auditory system but does not specifically pay attention to it, it is an alpha press. But the music becomes a beta press if it is attended to and thereby may be perceived either negatively as a distraction or positively as a productive influence on creativity.

Some environmental design researchers take the position that the physical environment only affects behavior when it is perceived and transformed into social knowledge (Franck, 1984). As I illustrated in Chapter II, when the relationship between the designed environment and creativity is empirically investigated, it is generally with respect to people’s perceptions about and preferences for certain environments (Buttimer, 1983; Csikszentmihalyi, 1996; McCoy & Evans, 2002). There is some empirical evidence however, that alpha press (such as views of nature or ambient sound) may affect creative productivity (McCoy & Evans, 2002; Mehta et al., 2012). Franck (1984) argues that both types of press are worthy of investigation, and joins a small group of researchers who suggest that efforts to understand how the physical environment affects behavior must include both direct (beta press) and indirect (alpha press) influences. Gibson’s concept of direct perception in affordance theory is congruent with this perspective. Affordance theory describes how people directly perceive both alpha and beta press, even though they may only attend to the latter.

As I mentioned previously, the limitations of Gibson’s concept of direct perception for creativity, are that it does not consider how imagination and abstract reasoning – processes vitally important to creativity – fit with the model. Recent work in enactive cognition by Noë (2004) and Ward et al. (2011) demonstrate how these processes (which have typically been associated with a representational theory of mind) are understood through neuroscience research.
to be a form of direct perception. My intention here is not to incorporate neuroscience into my theoretical framework. I merely point out that what we currently understand about how the human neurological system works lends empirical evidence to the appropriateness of Gibson’s model as the foundational structure from which to build a theoretical framework of the person–environment relationship during creativity.

**My Definition of Affordance**

Gibson (1977) described an affordance as “equally a fact of the environment and a fact of behavior. It is both physical and psychical, yet neither. An affordance points both ways, to the environment and to the user” (p. 129). As I mentioned earlier, this definition has proven problematic for researchers who debate whether affordances are properties of the environment or instrumental relationships between people and features of their environments. For the purpose of this dissertation I will take the position supported by Chemero (2003) and Stoffregen (2003) that affordances are a type of relationship between person and environment. I define an affordance as an instrumental relationship between a person and features of his or her environment. Affordances are latent action possibilities that have intrinsic value to a person according to the person’s abilities, intentions, goals, and values. They are both real and perceivable, but are not a property of either the environment or the person. I also argue that perception and actualization of affordances is dependent upon both the physical abilities and cognitive qualities (e.g. intentions, goals, and values) of a person.

Affordances provide action opportunities for people and may be physical, social, or cognitive. For example, a doorknob offers a physical affordance, “ability-to-turn,” between a person and the knob. It provides latent opportunities for turning. Similarly, social affordances are opportunities for social actions and cognitive affordances permit cognitive actions (e.g. changes in modes of thinking). These affordances are not mutually exclusive. Enactive cognition theory explains how thinking and acting are intertwined. Thus an affordance may simultaneously provide both physical and cognitive opportunities. Because affordances encompass all possible action
possibilities in a situation, they are not always perceived or actualized (exploited). Affordances may also be hidden (when the person is unable to perceive them) or false (when a person perceives an affordance that is not real or does not actually provide the anticipated action opportunities) (Gaver, 1991). For example, if I walk into a room with the intention of sitting down, the affordances of that room are the latent action opportunities for sitting provided by the features of the room (with respect to my physical abilities). If I see there is a chair at the far side of the room, but I have not yet sat in it, it is a perceived affordance. If I cannot see that chair because it is located behind a column, it is a hidden affordance. When I sit in the chair it is an actualized affordance. However, if someone has removed all the fasteners between the frame and the seat of the chair, and it falls apart when I try to sit on it, it is a false affordance. Creativity, as I will illustrate later in this dissertation, relies on the detection and actualization of the affordances in a creative situation.

Creativity and “Potential Affordances”

I propose in this dissertation that creative practitioners develop expertise that helps them perceive non–obvious affordances.³⁷ Sometimes other people cannot perceive non–obvious affordances because they do not actually exist yet. These are potential affordances.³⁸ I suggest that the concept of potential affordances describes how creative practitioners perceive opportunities for action even though they are not yet available for them to actualize. They use their imaginations to help them perceive how an affordance might emerge from changes to either features of the environment or to some aspect of their own abilities or intentions. To use another chair example, if I walk into a room and see a pile of miscellaneous chair parts strewn around the

³⁷ This concept is introduced in Chapter IV and discussed in more detail in Chapters V, VI, and VII.
³⁸ Heft (1989) proposes the concept of potential affordances to describe qualities of the environment that might provide an affordance should a person have the appropriate skills and intentions to perceive and actualize the affordance. I propose that a potential affordance also exists when qualities of the environment do not yet provide an appropriate resource to meet a person's skills and intentions, but the person could imagine how the environment might be changed to create a new affordance. Kytτä (2003) refers to human–created affordances as “affordances that have been shaped” (p. 55).
room and nowhere else to sit, I might perceive the potential affordance for sitting in the chair parts. They do not presently afford sitting, but, with some effort, I could combine a few pieces to create a place to sit. In order to perceive this potential affordance, I would have to imagine assembling the parts into some form of new chair. This is, of course, a rather “uncreative” example of creativity. However, the very unusual materials from which chairs have been created in the past suggest that their designers uncovered hidden or potential affordances in things like sheets of corrugated cardboard (like the material in Frank Gehry’s Wiggle Chair) or notebook spiral binder springs (which form Yangsoo Pyo’s Afro Chair). The enactive cognition literature demonstrates how imagination can be explained as a form of direct perception. With this empirical support, I propose to extend Gibson’s affordance theory to include this concept of potential affordances.

**Next Steps Towards a New Theoretical Framework of Creativity**

At this point in the dissertation I have demonstrated the need for a new theoretical framework that describes the person–environment relationship during creativity. I have proposed that Gibson’s affordance theory provides the most appropriate foundation for this framework. I also addressed some of the limitations of Gibson’s affordance theory, such as how affordances are defined and how direct perception might account for the imaginative experiences that appear to be instrumental for creativity. I draw from cognitive science research in embodied, embedded, and enactive cognition to provide the empirical support for extending Gibson’s model to more effectively describe person–environment relationship during creative processes. This empirical evidence also provides support for my concept of potential affordances and the role they play in the person–environment during creativity. This preliminary work is illustrated in the following diagram (Figure III.1).
I define an affordance as an instrumental relationship between person and environment. Affordances may be perceived, actualized, false, hidden, or potential.

This diagram describes affordances as an instrumental relationship between a person and his or her environment. It does not yet describe the person–environment relationship during creativity, which I develop in the following three chapters. First, I will describe how the creative practitioners’ intentions and abilities are determined by their mode of creative thinking. This discussion begins in Chapter IV with a review of the creative process literature and continues in Chapter V with a proposal for a new Multi–modal Process Model of Creative Practice. Second, I will illustrate the nature of the reciprocal relationship between person and environment during creativity. The Creativity–in–Context Theoretical Framework introduced in Chapter VI illustrates how creative practitioners use features of their environment to engender, sustain, and inhibit different creative modes. They also change their environments in order to create new affordances in a creative situation. Third, I propose a new taxonomy of environmental features that considers the different scales of the designed environment. This is also introduced in Chapter VI. Heft (2001) argued that greater integration is needed between Gibson’s affordance theory and Barker’s behavior setting theory. Although bridging these two theories is beyond the scope of this dissertation, I will suggest in Chapter VII how future efforts might integrate my work with Barker’s behavior setting concept to better understand the role of the designed environment in group (social) creativity.
CHAPTER IV

THE CREATIVE PROCESS

A REVIEW OF CREATIVE STAGE MODELS AND COGNITIVE PROCESS LITERATURE
AND THEIR SUITABILITY FOR PHYSICALLY SITUATING CREATIVITY

Highlights

This review and analysis of the creative process literature presents the next step toward developing a new framework to bridge the creativity and environmental design literatures: the identification of the physically situated processes that are involved in different stages of creativity. The creative process literature consists of two streams of research: stage models that describe the sequence of steps involved in creativity and cognitive process theories that strive to identify the mechanisms behind the creative stages. An analysis of the creative process literature reveals that the stage models primarily describe purely mental processes. None of them sufficiently addresses the physical context of creativity. Nor do they describe the relationships between the stages. Although the models vary in the number of stages they describe, I suggest that when one organizes the stages around the physical activities in which people typically engage, five physically situated modes of creativity emerge: problem–finding, idea–generating, incubating, elaborating, and implementing. Next, I organize the cognitive process theories around these modes to identify those that best describe the physically–situated processes behind the modes. I suggest that Csikszentmihalyi’s (1990) theory of creative flow and Schön’s (1983) reflective practice model may together provide the nucleus for a new model of creativity as a physically–situated process.
Introduction

Review

Chapter II illustrated the need for a theoretical framework to bridge the environmental design and creativity literatures. In Chapter III, I presented a first step toward that goal, the identification of a preliminary framework to develop towards describing the person–environment relationship during creativity. Key issues from the ecological psychology and cognitive science literatures suggest that, first, people have different conception of their environments based on their personal abilities and intentions. Second, people are autonomous agents in their environments who exploit features of their environments to mediate and extend their cognitive abilities. They are not passive recipients of stimulus provided by design interventions. They initiate exploratory actions in their environments and make changes in their environments or move to new environments to better support their needs. Third, people have a reciprocal relationship with their environments. Their sensory and motor experiences in their environments shape their knowledge and behavior. Finally, although there is no single theory to sufficiently bridge the environmental design and creativity literature, ecological psychology may provide an appropriate preliminary structure when it is extended by the enactive cognition literature from cognitive science.

Thesis

Chapter IV provides an overview of the creative process literature. The intention behind this chapter is to identify the physically–situated processes involved in creativity. The creative process literature consists of two streams of research; stage models that describe creativity as a series of steps, and empirical studies that examine the cognitive processes used in the stages (like analogy and metaphor). I use theories of embodied, embedded, and enactive cognition reviewed in Chapter III to assess the process literature in terms of its applicability for developing a new framework to bridge the environmental design and creativity literatures. An analysis of the
literature reveals that 1) there appear to be five physically–situated modes of creativity: problem–finding, idea–generating, incubating, elaborating, and implementing, 2) these modes involve both intuitive and explicit cognitive processes, 3) the literature does not adequately describe relationships between stages or modes, 4) none of the stage models sufficiently addresses the physical context of creativity, and 5) although Csikszentmihalyi’s (1990) flow theory does describe the physically–situated nature of creativity, it only considers one mode (stage) of creativity. I suggest that Csikszentmihalyi’s (1990) theory of creative flow, when combined with Schön’s (1983) complementary theory of reflective practice introduced in Chapter III, might form the nucleus for a new, physically–situated creative process model.

**Significance**

This chapter provides the next step towards a new framework to bridge the creativity and environmental design literatures: the identification of the physically situated processes involved in the stages of creativity. Current research in cognitive science understands cognition to be embodied, embedded, and enactive, but for the most part the creativity literature does not take this perspective. It still reflects the influence of Cognitivism, emphasizing mental states instead of physically embodied and embedded activities. This helps to explain why the creative process literature has not been particularly useful for informing environmental design, where settings are intended to support physical activities. Ultimately this review of the creative process literature illustrates the need for a new creativity model that describes both the physically–situated modes of cognition involved in creativity as well as the relationships between these modes.

**Background**

How do we describe the process of human creativity as it happens in the world? What are the activities and events in which creative people engage – during dogged pursuit of an issue or problem – that help them eventually arrive at a solution that is both novel and
technically appropriate? The cognitive process approach to creativity seeks to address these questions by examining mental processes and constructs with the goal of identifying the intellectual skills and cognitive processes that are general to all creative people (Kozbelt et al., 2010). There are two main streams of research in this literature: the development of stage models to describe the steps in individual or group creative processes and the empirical examination of cognitive mechanisms that comprise creative thinking (Kozbelt et al., 2010).

Process theories have informed many of the prevailing ideas that people have about creativity (e.g. divergent thinking, associative thinking, and metaphorical thinking) and numerous strategies proposed to foster or improve an individual’s creative thinking abilities (Mark A. Runco, 2007a; T. B. Ward & Saunders, 2003). There is a general agreement in the literature that creativity consists of an interrelated series of stages involving both explicit and intuitive mental processes and both solitary and social behaviors (Kozbelt et al., 2010; Mark A. Runco, 2007a; Sawyer, 2012). This chapter addresses some of the issues in the process literature that are relevant to understanding creativity as a form of physically situated cognition by: 1) investigating the common sequences of activities and behaviors (i.e. stages) that occur during creativity, 2) examining the cognitive mechanisms behind these activities, and 3) identifying the theories of cognition implicit in current models of creativity and design. The aim of this chapter is to determine which (if any) stage models may serve as a framework for physically situating the cognitive processes of creativity.

**Creative Stage Models: A Critical Review and Analysis**

One of the earliest and most well-known stage models was developed by Graham Wallas (1926) and describes creativity as a sequence of preparation, incubation, illumination and verification stages. J.P. Guilford (1950) referenced Wallas’s model in his address to the American Psychological Association. This speech is credited with igniting the field of creative process research which was later fueled in the 1960’s and 1970’s by the emerging field of cognitive science (Feldman et al., 1994a; R. J. Sternberg & O’Hara, 1999; I. A. Taylor, 2007). The process
approach has since dominated the creativity literature, with a virtual explosion in development of various stage models informed by work across fields such as psychology, cognitive science, business, education, and design (Mark A. Runco, 2007a). I have selected a few of the most commonly referenced stage models to review in this chapter and organized them in a common framework for comparison (Table IV.1).

**Table IV.1 Stage Models of Creativity.**

<table>
<thead>
<tr>
<th>Model Author(s)</th>
<th>Creative Stages</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>problem–finding</td>
<td>generating</td>
<td>incubating</td>
<td>elaborating</td>
</tr>
<tr>
<td>Wallas</td>
<td>Preparation</td>
<td>Incubation, Illumination</td>
<td>Verification</td>
<td></td>
</tr>
<tr>
<td>Rossman</td>
<td>Observation, Analysis, Survey</td>
<td>Formulation, Critique, Invention</td>
<td>Experimentation, Selection, Perfection</td>
<td></td>
</tr>
<tr>
<td>Osborn</td>
<td>Orientation, Preparation, Analysis, Hypothesis</td>
<td>Hypothesis</td>
<td>Incubation</td>
<td>Synthesis, Verification</td>
</tr>
<tr>
<td>Gordon</td>
<td>Groundwork</td>
<td>Immersion, Divergent Exploration</td>
<td>Selection, Articulation, Transformation</td>
<td>Implementation</td>
</tr>
<tr>
<td>Bransford &amp; Stein</td>
<td>Identify Problem, Define Goals</td>
<td>Explore Approaches</td>
<td>Act on Plan</td>
<td>Look at effects</td>
</tr>
<tr>
<td>De Bono</td>
<td>White Hat / focus on information</td>
<td>Green Hat/ seek new ideas</td>
<td>Black Hat, Yellow Hat, Blue Hat, Red Hat</td>
<td></td>
</tr>
<tr>
<td>Barron</td>
<td>Conception</td>
<td>Gestation, Pasturation</td>
<td>Bring Up Baby</td>
<td></td>
</tr>
<tr>
<td>Evans &amp; Russell</td>
<td>Preparation, Frustration</td>
<td>Incubation, Insight</td>
<td>Working Out</td>
<td></td>
</tr>
<tr>
<td>Mumford et al.</td>
<td>Problem construction, Knowledge acquisition, Concept selection</td>
<td>Novel combinations, Ideation</td>
<td>Evaluation</td>
<td>Implementation and feedback</td>
</tr>
<tr>
<td>Finke</td>
<td></td>
<td>Generative</td>
<td>Exploratory</td>
<td></td>
</tr>
<tr>
<td>Van Gundy</td>
<td>Objective finding, Fact finding, Problem finding</td>
<td>Idea finding</td>
<td>Solution Finding</td>
<td>Acceptance finding</td>
</tr>
<tr>
<td>Feldman et al.</td>
<td>Inernalize domain</td>
<td>generate novelty</td>
<td>externalize ideas</td>
<td>Submit to field, Evaluate, Disseminate</td>
</tr>
<tr>
<td>Csikszentmihalyi</td>
<td>Preparation</td>
<td>Incubation, Insight</td>
<td>Evaluation, Elaboration</td>
<td></td>
</tr>
<tr>
<td>Sakaen et al.</td>
<td>Frame problems, Explore data, Construct opportunities</td>
<td>Generate ideas, Construct opportunities</td>
<td>Develop solutions</td>
<td>build acceptance</td>
</tr>
</tbody>
</table>

This overview of the creative stage models serves to illustrate the similarities and highlight the differences among them. The models share common stages that are similarly sequenced. I have organized these as five general phases: problem–finding, generating, incubating, elaborating, and implementing. Problem–finding entails all the stages prior to novel idea generation, including problem discovery, problem framing, knowledge acquisition, etc. The generating phase includes all stages involved in coming up with new ideas, including exploration, play, and creating novel combinations. The incubating phase is distinguished by periods of rest,
when a creative person is not actively working on a problem. Elaborating is characterized by stages of verification, articulation, selection, and refinement. Finally, the implementing phase conveys how the creative idea is tested and evaluated in a socio-cultural context.

A clear difference between the stage models is whether or not they include an incubating or implementing stage. Some models (particularly earlier ones) emphasize the relationship between the preparation phase and the incubation phase, a period when a person is not actively working on a problem (Barron, 1988; Csikszentmihalyi, 1996; Roger Evans & Russell, 1989; Osborn, 1953; R. J. Sternberg, 2006b; Wallas, 1926) These models convey the role of subconscious processes of creativity, and reflect the hypothesis that creativity cannot be fully directed. I will refer to this group as romantic models.39 Other models, which I will call rationalist, describe only the explicit (conscious) processes of creativity, emphasizing the relationship between generative and elaboration/articulation stages (Bransford & Stein, 1984; Gordon, 1961; Isaksen, Stead-Dorval, & Treffinger, 2000; M. D. Mumford, Mobley, Reiter-Palmon, Uhlman, & Doares, 1991; Rossman, 1931; Van Gundy, 1987). These stage models are founded on the hypothesis that creativity is a form of problem solving using ordinary cognitive processes. More recent models often include a stage (or stages) for implementation or externalization of the creative product in the public domain (Feldman et al., 1994a; Isaksen et al., 2000; M. D. Mumford et al., 1991; Van Gundy, 1987). This reflects the shift in thinking about creativity as a socially situated activity (Amabile, 1996; Feldman et al., 1994a). These three categories of the stage models will be examined in greater detail in the following sections.

The Romantic Stage Models and the Preparation–Incubation Stages

The most compelling stories of creativity often describe the moment of creative insight as coming from out of the blue (such as how Nikola Tesla’s idea for alternating current came to him during a walk), during a dream-like state (like Kekulé’s insight into the ring-like structure of benzene), or when the creative person was engaged in an unrelated activity (such as the famous

39 The terms rational and romantic are commonly used to distinguish between the different conceptions of creativity in the literature. See for example (Sawyer, 2012, p. 23).
myth of Archimedes’s “eureka” moment during a bath). This phenomenon is captured in the romantic stage models, which are generally characterized by a knowledge acquisition stage followed by a stage of rest or incubation from which ideation arises. Graham Wallas’s (1926) enduring four-stage model of creativity is an early example of a romantic stage model.

Based on introspective accounts from the German physicist Hermann von Helmholtz and the French mathematician Jules Henri Poincaré, Wallas observed that the creative process is comprised of both conscious (explicit) and subconscious (intuitive) stages. An explicit process occurs when a person is aware of his or her own cognitive state and the influences affecting it (Reingold & Ray, 2003). An intuitive process refers to influences that affect a person’s perception, memory, and learning without his or her awareness (Reingold & Ray, 2003). Often what distinguishes intuitive from explicit cognition is the person’s inability to communicate or describe the process. Intuitive processes often happen informally, so while creative people may not be completely unaware of the process, they are typically not self-reflective about it and thus may have trouble articulating it (VandenBos, 2006). Poincaré hypothesized that creativity consists of conscious work on a problem, followed by a period of rest when the mind works subconsciously until an idea emerges into conscious thought. Then, because subconscious work does not supply the idea “ready-made,” a period of verification follows to test and develop it (Wallas, 1926, p. 81).

Wallas’s model is so prevalent, it is sometimes referred to simply as the four–stage model of creativity (Mark A. Runco, 2007a, p. 19). The first stage, preparation is the conscious stage where knowledge is acquired. Next is incubation, a subconscious stage, where the problem is not consciously addressed but the knowledge acquired during preparation is restructured. Wallas describes incubation as a period of “voluntary abstention” from a problem that occurs during times of rest or when a person is engaged in work on other problems or activities (1926, p. 86) Ideation is manifest from subconscious processes during incubation when new associations or novel combinations of information previously obtained in the preparation phase are formed and evaluated. The illumination stage follows incubation and is sometimes referred to
as the "aha!" stage of the creative process. It is the moment of revelation where what was previously subconscious becomes a conscious idea. The final verification stage is when the idea is evaluated (and possibly applied.) Other romantic models extend Wallas’s four–stage model, either by dividing one of his stages into additional steps to the preparation (Osborn, 1953; R. J. Sternberg, Kaufman, & Pretz, 2002) or evaluation stages (Csikszentmihalyi, 1996; R. J. Sternberg et al., 2002), or by suggesting a new stage altogether, such as Evans’s and Russell’s (1989) frustration stage or the new first (redefine problems) and last (sell idea) stages proposed by Sternberg (2006b).

Criticisms of the romantic models generally center around the debate in the field of psychology regarding whether subconscious processes are appropriate topics for scientific investigation (Reingold & Ray, 2003). Even when deemed appropriate for empirical investigation, there are numerous methodological challenges to studying intuitive processes, because people cannot simply say what they are thinking. This may explain why subconscious stages have been de-emphasized in some cognitive models and why the literature often fails to distinguish between purely subconscious processes and tacit (semi-explicit) processes.

The Rationalist Stage Models and the Generation-Elaboration Stages

The rational models are characterized by their omission of subconscious stages (e.g. incubation) in the creative process. These models reflect the belief that creativity is a rational process that is comprised of “ordinary” cognitive activities (Finke, Ward, & Smith, 1992, p. vii). Creative insights in these models are also understood to happen throughout the various stages of the creative process as opposed to a single moment of illumination (Gruber, 1988). Most of the rational stage models include stages at the beginning of the creative process that describe problem–finding, problem–framing, and goal–setting (Bransford & Stein, 1984; Isaksen et al., 2000; M. D. Mumford et al., 1991; Rossman, 1931; Van Gundy, 1987) They are particularly distinguished, however, by the emphasis on idea generation and elaboration stages, generally
reflecting the view of creativity as a combination of divergent thinking and convergent thinking (Finke et al., 1992; Gordon, 1961; Rossman, 1931; Van Gundy, 1987).

Creativity is often understood to entail divergent and convergent mental processes. Divergent thinking is associated with the ability to come up with many potential solutions to a problem, whereas convergent thinking is the ability to “converge” on a single optimal solution (Sawyer, 2012, p. 46). Convergent thinking is typically affiliated with a generating stage (such as ideation, exploration, formulation, etc.) and convergent thinking is associated with an elaborating stage (like verification, articulation, selection, synthesis, etc.) William J.J. Gordon’s (1961) early “synectics” stage model makes extensive use of divergent thinking, particularly through analogy and metaphor. Finke’s (1992) later “geneplor” model is based on the premise that divergent thinking is at the root of creative processes. He organizes creativity into two stages: generative and exploratory. During the generative (“gen-”) phase people generate mental structures, called pre-inventive forms, through strategies like conceptual synthesis and transformation. These pre-inventive forms are then examined for meaning and purpose during the exploration (“-plore”) phase during a process of elaboration, testing, and evaluation (T. B. Ward & Saunders, 2003).

The Socially–Situated Stage Models

Many of the rational stage models consider creativity a social process. This perspective is particularly prevalent during the elaborating and implementing stages, reflecting the belief that creativity is ultimately determined by consensual assessment (De Bono, 1985; Feldman et al., 1994a; Isaksen et al., 2000; M. D. Mumford et al., 1991; Van Gundy, 1987). De Bono’s (1985) popular lateral thinking, “six thinking hats” model of creativity describes the role of social processes in different stages of social elaboration of a creative idea. Four of the “hats” are associated with the elaborating stages, and describe processes that include looking for the benefits of an idea (yellow hat), looking for the problems in an idea (black hat), focusing on emotional and intuitive responses to an idea (red hat), and thinking about thinking (blue hat). The implementing stages include evaluation and feedback from both users as well as critics and
experts in the field (Feldman et al., 1994a; M. D. Mumford et al., 1991). The need to gain social acceptance in order for an idea to be deemed creative is articulated in a number of the rational stage models (Isaksen et al., 2000; Van Gundy, 1987).

Social aspects of the creative process are not restricted to the rational models. Osborn’s (1953) early stage model included both an incubation phase and introduced his famous concept of brainstorming for idea generation through social processes. Brainstorming is a group divergent thinking strategy that entails four principles, “criticism of ideas must be withheld,” “the wilder the idea the better,” “quantity is wanted,” and “combination and improvements are sought” (Osborn, 1953, pp. 300–301). Despite the wide popularity of this method, research suggests that groups are less effective at generating creative ideas than the same number of people working alone (Diehl & Stroebe, 1987, 1991; Mullen, Johnson, & Salas, 1991; D. W. Taylor, Berry, & Block, 1958).

Limitations of the Stage Models

There are two significant limitations of the creative stage models. First, they are primarily explanatory and thus do not predict creativity. Second, they describe creativity as a progression of stages without any explanation for the relationships between stages. Although stage models have been used as a means to improve creative productivity, there is little empirical evidence that following any particular stage model actually yields higher creativity. As described earlier, empirical investigation into the effectiveness of certain creative stages has been limited primarily to social processes, such as brainstorming. Although people often feel that social processes during creativity increases their productivity, empirical evidence points to the opposite effect. This is a concept known as the illusion of group effectiveness (N. J. Allen & Hecht, 2004; Paulus, Larey, & Dzindolet, 2001; Paulus, Larey, & Ortega, 1995; Rowatt, Nesselroade, Beggan, & Allison, 1997). Although these findings suggest that social processes do not improve creativity, this may be due to a lack of coherent understanding about when social processes are beneficial to creativity and when they are detrimental. Ultimately the usefulness of the stage models to
predict creativity is limited by the fact that they focus almost exclusively on mental processes, failing to suggest any practical tools for applied creative thinking. They largely ignore the physically–situated activities and behaviors in which people engage during the different stages. This underscores the inappropriateness of the stage models to inform environmental design. They do not describe what people do in the world; thus they have no direct implications for the design of physical spaces.

The second criticism of the stage models concerns the lack of explanation about the relationship between the different stages in a model. The stage models are commonly illustrated as a linear process, with each stage occurring in a particular order. When organized into a common framework, it is clear that there are significant similarities in both the types and sequencing of stages between the different models (Table IV.1). Yet there is agreement in the literature that creativity is iterative – suggesting that stages may occur multiple times, or even out of sequence (Armbruster, 1989; Csikszentmihalyi, 1996). How this happens remains largely ignored by the process models. A few of the rational models do begin to suggest the intertwined nature of ideation and elaboration — a foundational concept in Finke’s (1992) genoplore model, for example — but how and when these stages are implemented remains unresolved. The mechanisms that trigger, sustain, or inhibit the different stages of creativity are not addressed in the models. Creative cognition theories, however, do attempt to understand the mechanisms involved in creative cognitive processes. In the following section, I will organize this stream of creative process literature to identify physically–situated cognitive processes involved in the stage models.

**Mechanisms Behind the Stages: Creative Cognition Theories**

Although this chapter has addressed only a few of the most referenced stage models, there are a number of cognitive processes that are common to many of the theoretical models: problem finding, knowledge acquisition, strategies for forming new mental schemas, intuition, incubation, and evaluation. Some of these processes describe explicit cognitive strategies that
might be practiced until one gained expertise whereas others seem to necessitate sub-conscious or semi-conscious cognition that might be fostered by affective states or environmental conditions. This may explain why people typically describe “fostering,” “facilitating,” or “engendering” creativity. The following creative cognition literature is loosely organized around the problem–finding, generating, incubation, elaborating, and implementing stages of creativity. The intention behind this review is to identify creative process theories that describe physically–situated processes of embodied, embedded, and enactive cognition.

**Problem–Finding**

It may seem obvious that the creative process cannot begin without first identifying a problem or issue to pursue, but this stage may actually be more critical to the creative process than it might at first appear. In creativity research, problem finding is defined as “a question raised or to be raised for inquiry” (Jay & Perkins, 1997, p. 259). Problems may be either “presented” or “discovered,” but they always need to be structured and defined as part of the creative process (Getzels & Csikszentmihalyi, 1975; M. D. Mumford, Baughman, Maher, Costanza, & Supinski, 1997). Creative problems are typically complex and ill–defined (M. D. Mumford et al., 1997). Rittel and Webber (1973) distinguish “wicked” creative design problems from “tame” problems by the fact that the problem definition is, itself, another creative problem. Research on the role of problem finding in creative processes indicates that some creative people are better at finding problems and others at solving them. Of these two abilities, problem finding has been found to have the greatest impact on the quality of the creative product, because the nature of the problem definition determines the solution (Mark A. Runco, 2007a). Albert Einstein (1966) explains this role of problem finding in a frequently quoted remark:

> The formulation of a problem is often more essential than its solution, which may be merely a matter of mathematical or experimental skill. To raise new questions, new possibilities, to regard old problems from a new angle, requires creative imagination and marks real advance in science (p.92).

Although Einstein wrote this observation in the 1930’s, it wasn’t until much later that researchers began to confirm the importance of problem finding in creative processes.
**Problem formulation.**

Investigation into the role of problem finding in creativity began in earnest following a study conducted by Getzels and Jackson in 1962 (Getzels & Csikszentmihalyi, 1975). Getzels and Jackson compared intelligence and creativity in children and revealed that children in the high I.Q. group differed from children in the high divergent group in the way that they used picture stimulus to write a story (Getzels & Csikszentmihalyi, 1975). The high IQ children tended to use the picture stimulus to closely focus the stories they developed, using conventional categories of relationships within the plot development. The high divergent group, however, deviated strongly from the stimulus, using it primarily as a point of departure in their stories. The stories from the high divergent group were generally more creative and rich with self-expression. This study provided the basis for the seminal work of Getzels and Csikszentmihalyi (1975) where they investigated problem finding with a group of 179 third and fourth year art students.

The study by Getzels and Csikszentmihalyi (1975) reveals a high degree of correlation between the level of problem finding behavior (interacting with and altering still life compositions) and the degree of creativity exhibited in the final product (originality and aesthetics of the drawing produced). Like the children in the prior study, all the participants completed tests of intelligence and divergent thinking. The art students who touched or changed the objects in a still life model prior to beginning their painting had significantly higher levels of creativity. This problem finding behavior of the artists who interacted with the object was also found to predict their career success seven and eighteen years after the initial study (Jay & Perkins, 1997). The results from this study ignited interest into the role of problem–finding in creativity.

A meta-analysis of problem finding research by Jay and Perkins (1997) indicates that problem finding includes several sub-processes: conceiving of the question or issue to pursue, defining and structuring the problem, regularly assessing the quality of the problem statement, and reformulating the problem statement in pursuit of the problem. Further, an analysis of the significant body of research conducted in the two decades following Getzel and Csikszentmihalyi's
semenal art student study reveals that context and disposition determine why creative people
problem solve, but cognitive abilities and processes do not appear to play a role in problem
finding because they do not promote the ability of a person to raise questions (Jay & Perkins,
1997). A review of the literature indicates that problem finding is a critical stage in the creative
process, that problem finding ability is predictive of creativity, and that problem finding ability is a
factor of both personality and environmental conditions. This suggests that problem–finding may
be a physically–situated process — where a person’s interactions in a situation help them
perceive questions to pursue and formulate goals and intentions toward the creative situation.

Knowledge acquisition.

Knowledge acquisition is often included in the early stages of the creative process models
(Gordon, 1961; M. D. Mumford et al., 1991; Osborn, 1953; Van Gundy, 1987; Wallas,
1926). There is agreement in the literature that a certain amount of knowledge is required in
order to be creative (Jay & Perkins, 1997). It is also widely believed that creative people must
have adequate domain–specific knowledge (Brower, 2001; Hayes, 1989), however “too much”
domain-specific knowledge may actually inhibit creativity (Mark A. Runco, 2007a). The
relationship between general knowledge and domain-specific knowledge remains unclear
(Brower, 2001). When knowledge acquisition occurs during the creative process, an
understanding of how much knowledge is necessary and sufficient also remains up for debate
(Mark A. Runco, 2007a).

The majority of the research on knowledge acquisition in creativity has focused primarily
on the role of domain-specific knowledge (Mark A. Runco, 2007a). Studies that examine the
creative processes of experts and novices indicate that domain knowledge is particularly critical
for the problem finding stage (Hayes, 1989; Jay & Perkins, 1997; Mark A. Runco, 2007a).
Without adequate knowledge of the domain it would be impossible for a person to recognize
problems, frame them, and understand what will be necessary to go about solving them. Yet
expertise can also cause barriers to creativity. As mentioned in Chapter II, there is a cost to
expertise. Experts have large knowledge bases that are organized in sophisticated schemas with multiple interconnections between knowledge. Unlike novices, their knowledge tends to be highly organized and structured by years of experience. Although this complex knowledge structure may facilitate creativity, it may also lead to problems developing creative insights (Runco, 2007).

Experts tend to make assumptions and rely on tacit understandings instead of questioning the way knowledge is structured in their own domain (R. J. Sternberg, 2006b). Novices, on the other hand, have much looser systems of knowledge, making it easier to restructure schemas to develop novel insights (Mark A. Runco, 2007a).

The ability to radically restructure schemas within a particular domain is prerequisite for making creative leaps in the knowledge base within the domain. In his book, *The Structure of Scientific Revolutions*, Kuhn (1996) refers to this shift in the underlying assumptions associated with a particular model of scientific inquiry (including the rules and standards of practice) as a paradigm transformation. It is perhaps for this reason that many creative people move from one field to another creating what Runco (2007a) refers to as “professional marginality.” Some of the most creative minds have used knowledge from other disciplines to transform domain knowledge in their own field including Piaget (who used biology to transform cognitive development,) Freud (who used physiology to transform psychoanalysis,) and Darwin (who used geography and geology to transform evolutionary biology) (Dunbar, 1995).

A glimpse into Darwin’s life reveals how he was able to combine knowledge from different disciplines as he developed his theory of natural selection (Johnson, 2010). Fresh out of college, Darwin was invited to join Robert FitzRoy on a five-year trip to chart the South American coastline. Along the journey, Darwin made detailed notes of his observations including the rich biodiversity that occurs in coral reefs, the significant number of finch varieties in the Galápagos Islands, and evidence about the formation of atolls. While on his travels he read Lyell’s *Principles of Geography*. Many of his notes and theories about his observations reveal Lyell’s influence. In other words, his abilities to perceive affordances in the environment appear to have been influenced by the way Lyell’s theory framed his goals and intentions. Later, as his ideas and
theories were developing, Darwin read Thomas Malthus’s theory about population growth. In his autobiography Darwin attributes Malthus’s theory for the insight needed to formulate his theory on the origins of species. Darwin applied Malthus’s ideas about conditions that are favorable or unfavorable for population growth to the evolution of species and natural selection. The influence of different disciplinary knowledge and theories allowed Darwin to re-frame and re-consider his observations in support of a new theory of evolutionary biology.

As Steven Johnson (2010) points out in his book about the origins of innovation, what becomes clear from Darwin’s story is that the places he visited and the things that he did there all influenced the way he thought about the evolution of species. Would Darwin have conceived of his theory if he had not met FitzRoy? What if he had not spent five years traveling around South America? If he had only read the works of Lysell and not Malthus would he still have realized a new theory was needed to explain his observations? Stories like Darwin’s indicate that environmental context plays a role in both knowledge acquisition and formation (or re-formation) of conceptual frameworks. Knowledge acquisition is a physically–situated process. Just as “professional marginality” helps the expert develop a “novice” mindset, a new physical context may also allow the creative person to see things “in a new light” by becoming a novice in the environment.

**Generating Ideas**

Some of the early creativity researchers equated creativity with insight (I. A. Taylor, 2007). Insight is defined as “a sudden solution to a problem” (Mark A. Runco, 2007a, p. 201). This view of creativity is based on gestalt theory of holistic thinking that claims the human perceptual system is designed to create meaningful wholes from partial bits of information (Mark A. Runco, 2007a). This perspective has largely influenced the romantic stage models and describes the ideation process as almost entirely implicit. Today insight is often explained by the concept of restructuring information (Brower, 2001; Mark A. Runco, 2007a; T. B. Ward & Saunders, 2003). Researchers theorize that creative people employ specific strategies to
restructure schemas in order to lead to creative insight. These strategies involve using
association, conceptual combination, mental imagery, and analogical reasoning (Mark A. Runco,
2007a; T. B. Ward & Saunders, 2003). These strategies appear to require a certain amount of
expertise and involve both intuitive and explicit cognitive processes. What is unclear from this
stream of research, however, is how creative activities typically associated with idea–generating
processes — like sketching, writing, diagramming, constructing, etc. — fit with these schema–
restructuring strategies. The physically–situated nature of generating ideas is really only
addressed in one creative process theory: Csikszentmihalyi’s (1990) theory of creative flow. In
the following sections I will first briefly review the mental strategies associated with creative
insight. Then I will describe the role of expertise and intuition during idea generation. Finally I
will explain how Csikszentmihalyi’s (1990) flow theory provides a physically–situated account of
idea generating processes without necessarily excluding schema–restructuring mental strategies.

**Association.**

Associative strategies are commonly employed in divergent thinking processes (such as
brainstorming) to come up with a large quantity of creative ideas (Osborn, 1953; Mark A. Runco,
2007a). Association employs primarily explicit cognitive processes where people use different
categorical structures (associations), to come up with many diverse ideas. Associative theory is
influenced by tests of divergent thinking that measure fluency (number of ideas), flexibility (types
of ideas) and originality (unique ideas), such as the Torrance Test of Creativity (Mark A. Runco,
2007a). Research on associative thinking suggests that association does help people increase
fluency and flexibility of ideas. Original ideas, however, are often remote and generally are
arrived at after coming up with an extensive number of unoriginal or conventional ideas (Mark A.
Runco, 2007a).
Conceptual combination.

Koestler’s (1964) bisociation model of creativity incorporates combinatorial thinking into an explanation of the creative process. He maintains that creativity is the intersection of different “frames of reference.” Two conceptual systems (or mental schemas) are reversed, fused together with a direct mental mapping, or juxtaposed to reveal a paradox in order to form a new creative idea or product (Deacon, 2006). This model developed from Koestler’s discovery that creativity in both the arts and sciences was frequently caused by “a sudden fusion of schemata” (Welling, 2007, p. 176). Darwin appears to have used this strategy when he credits his exposure to Malthus’s population theory with his insight into his theory of natural selection. He combined the theory of population growth with his own theories of species evolution. Darwin’s journals reveal drawings and notes that indicate he was close to arriving at the theory before he was exposed to Malthus’s work, but it was exposure to the population theory that provided insight into his own observations (Johnson, 2010). Koestler felt that visualization and mental imagery were particularly important for bisociation and he argued that conscious thought and language inhibited creative insights (Deacon, 2006).

Mental imagery.

Jung (1923) claimed that mental imagery is the means by which information can be carried to and from the unconscious mind. A well-known example of this strategy is the story of Friedrich Kekulé and his discovery of the benzene ring. The visual imagery of snakes allowed Kekulé to realize that the structure of the chemical bond was not in a straight line, but instead formed in a ring. Kekulé’s account of his experience is as follows:

I was sitting writing on my textbook, but the work did not progress; my thoughts were elsewhere. I turned my chair to the fire and dozed. Again the atoms were gamboling before my eyes. This time the smaller groups kept modestly in the background. My mental eye, rendered more acute by the repeated visions of the kind, could now distinguish larger structures of manifold conformation; long rows sometimes more closely fitted together all the twining and twisting in snake-like motion. But look! What was that? One of the snakes had seized hold of its own tail, and the form swirled mockingly before my eyes. As if by a flash of lightening
I awoke; and this time also I spent the rest of the night working out the consequences of the hypothesis (Andreasen, 2005, p. 45-46).

A number of studies have explored the ways in which imagery contributes to creative insight (Finke, 1997). Mental images often have the same perceptual qualities as visual objects, thus allowing for mental manipulations to explore movement and spatial relationships (Finke, 1997). This may help people visualize complex relationships that might be difficult or time-consuming to physically model or to quickly construct spatial analogies. Mental images may also contain details of an object that were not explicitly noted (Finke, 1997). This allows a person to recall and examine details from memory, providing them freedom to pursue a creative idea in any time or space. Mental images are believed to facilitate mental transformations, combinations, analogy, and reinterpretation (Finke, 1997). Mental imagery may be used explicitly as a strategy for divergent thinking, but it also seems to be instrumental in implicit processes – as is revealed in Kekulé’s description of how his mind seemed to unconsciously form the image of the snake.

**Analogy.**

Analogy is another frequently described cognitive process of creativity (Mark A. Runco, 2007a). Welling (2007) compared the use of associations, combinations, and analogy as strategies to achieve creative insight. He found that analogies are unique because “no new cognitive structure is required” (Welling, 2007, p. 175). Analogy involves transferring the cognitive structure from one context where it is well established to a new context where it had never been used. Dunbar (1995) describes three types of analogical thinking that he identified through his research with scientists: selective comparison, local analogy, and regional analogy. These processes differ in the domain distance between the two contexts. Selective comparison uses different cognitive structures from within the same domain. Local analogy involves application of a cognitive structure from one domain to a related domain. Regional analogy involves transferring the cognitive structure between completely dissimilar domains. Kekulé’s
story is an example of the use of regional analogy because he applied the cognitive structure of the snake’s physical form to the structure of benzene.

**Expertise.**

Welling (2007) hypothesizes that the distinction between processes like analogy (which do not form new cognitive structures) and processes like combination (which do) may help us understand why some people are eminently creative whereas others only exhibit everyday creativity. His research indicates that “everyday creative” people tend to rely solely on the direct application of knowledge (such as is found in craftsmanship) or the use of analogy. These findings remain controversial because it is difficult to distinguish between the different processes people use since most creativity is produced by using combinations of strategies (Mark A. Runco, 2007a). Welling (2007) also points out that for all of the creative strategies identified thus far – association, combination, imagery and analogy – no new knowledge is required. Knowledge acquisition occurs prior to these processes. Simonton (1997) found that scientists spend, on average, 10 years of work before they provide any significant contribution to their field and they typically need 20 years to make a major creative contribution. This supports the idea that creativity is slow to occur even though the moment of insight may seem dramatic and sudden (Mark A. Runco, 2007a). Creative “experts” may employ intuitive knowledge – acquired through years of experience – to make dramatic leaps in insight, thus giving the impression that it is a gestalt phenomenon.

**Intuition.**

According to the literature, intuition is a subconscious (or sometimes semi–conscious) process that is commonly linked to the creative (Jay & Perkins, 1997; Mark A. Runco, 2007a). The definitions of intuition vary in the literature, but generally describe the process as “a form of foresight” and “a vague anticipatory perception that orients creative work” (Eubanks, Murphy, & Mumford, 2010, p. 171). Perhaps most significantly, intuition is a process that seems to occur
while the creative person is pursuing a problem. The relationship between intuition and insight is
evidenced by research on phenomena such as the “feeling of warmth” and “tip of the tongue”
experiences that people have when they feel they are close to having insight into a creative
problem (Dorfman, Shames, & Kihlstrom, 1996). Intuition may be a key factor in the ability of
creative people to make paradigm shifts in conceptual knowledge structures because the process
appears to take precedence over the rational argumentation that focuses on internal consistency
and coherence (Jay & Perkins, 1997; Miller, 2007). Miller (2007) hypothesizes that working
memory may be important for creative intuition in his “network thinking” model of creativity. He
argues that the motivation that creative people have to solve a problem “holds” that problem in
the unconscious. Over a period of time they unconsciously combine knowledge and experiences
from different domains and contexts. These unconscious combinations are not “bound by logic”
and so eventually lead to new knowledge structures and creative insight (Miller, 2007, p. 48).

The relationship between expertise and intuition has been a topic of discussion
throughout history (Langan-Fox & Shirley, 2003). Historically, intuition has been considered an
important topic in philosophy and science, with the philosopher Baruch Spinoza even referring to
it as the “highest form of knowledge” (Langan-Fox & Shirley, 2003, p. 208). The 18th century
scientist Thomas Reid advocated a “common sense” approach to scientific exploration that
embraced intuition and reflection. Modern theories also address the important role that intuition
may play in human cognition. Both Lucy Suchman’s (2007) situated action theory and Donald
Schön’s (1983) theory of reflective practice, introduced in Chapter III, describe creative problem–
solving as a combination of intuitive and explicit processes. Csikszentmihalyi’s (1990) theory of
creative flow also describes the value of intuitive processes to idea generation.

**Idea generation as situated action.**

Creative flow theory describes a physically–situated process of intuitive immersion
employed to generate ideas during creativity (Csikszentmihalyi, 1990). The theory arose from Csikszentmihalyi’s observations that creative people would become so immersed in their work
during the generative process that they sometimes would forget to eat or sleep. Flow involves undivided focused attention on a creative situation to the point where the creative practitioner becomes completely immersed in a task at hand (Csikszentmihalyi, 1990, p. 49). It is a time when people often feel the most creative and ideas seem to flow easily. Csikszentmihalyi (1990) describes flow as a “phenomenological model of consciousness” (p. 25) that depends upon events, experiences and perceptions. Creative flow requires several things. First the creative practitioner must have clear goals and intentions prior to engaging in a creative situation. It is assumed these are formed during the problem–finding stages. Second, the creative practitioner must sustain undivided focus on the task at hand. An appropriate balance of task challenge and personal skill level helps to sustain attention. Finally, creative practitioners must be able to perceive clear feedback from the results of their actions, and use these to inform new intentions.

Flow theory resembles Suchman’s (1987, 2007) concept of situated action and, like it, appears to be a form of embedded cognition. Flow also suggests an enactive approach to creative cognition. Each new action is an intuitive response to feedback from a prior action, thus suggesting the action and perception are intertwined. Because flow is an intuitive process, it may account for mental strategies like association, combination, imagery, and analogy only when they occur intuitively or tacitly. This suggests that explicit application of these strategies may run contrary to flow, and thus may not be part of the generative stage. A few of the stage models do suggest this possibility, listing these some of these strategies during the elaborating stage (Osborn, 1953; G. Scott, Leritz, & Mumford, 2004; R. J. Sternberg, 2006b).

**Incubating**

Incubation is a subconscious stage that occurs when the creative practitioner intentionally stops explicitly and consciously pursuing the problem at hand (Armbruster, 1989). According to the *Encyclopedia of Cognitive Science*, a common theme among most anecdotes about creativity is that they describe:

*a solution sequence in which the thinker devotes considerable deliberate effort towards solving a problem, reaches an impasse, withdraws temporarily, and is*
then struck with a sudden realization for a problem solution (Ward & Saunders, 2005).

The term “incubation” is a biological metaphor that attempts to convey the often extraordinary leaps in creative problem solving that occur during the unconscious stage between explicit pursuit of the problem at hand and the moment of insight (Olton & Johnson, 1976). The fact that Kekulé was dozing by the fire and not actively pursuing the problem of the benzene structure when he had his moment of insight makes his story one of the frequently cited stories about creative incubation (T. B. Ward & Saunders, 2003). Although it is the topic of many anecdotes about creativity, the incubation stage has been the subject of the least amount of empirical investigation (T. B. Ward & Saunders, 2003).

There are a number of different theories that attempt to explain the phenomenon of incubation: conscious work, unconscious work, forgetting, recovery, and assimilation (T. B. Ward & Saunders, 2003). Most of the theories describe incubation as the subconscious process it is commonly understood to be, but the conscious work hypothesis provides a rival explanation. The conscious work hypothesis states that the creative person is still thinking about the problem at hand even while engaged in other, more mundane, activities and – due to the distraction of the intervening activities – simply forgets the conscious thoughts that led to the moment of insight (T. B. Ward & Saunders, 2003). The unconscious work hypothesis states that subconscious work continues on the problem at hand but remains inaccessible to the conscious mind until the moment of insight (T. B. Ward & Saunders, 2003). The forgetting hypothesis states that the incubation stage allows creative people to forget the unfruitful ideas and strategies they previously pursued and therefore frees the mind to focus only on productive concepts (T. B. Ward & Saunders, 2003). The recovery hypothesis states that a resting state allows the creative thinker to recover from the fatigue caused by actively pursuing the problem (T. B. Ward & Saunders, 2003). Finally, the assimilation hypothesis states that the creative thinker remains sensitive to environmental cues even while not actively pursuing the problem at hand (T. B. Ward & Saunders, 2003). A key principle that distinguishes these different theories is whether the role
of the subconscious is passive – as in the forgetting and recovery hypotheses – or active – as in the unconscious work and assimilation hypotheses.

It is clear that much more research is needed to understand the mechanisms behind incubation. Anecdotal support for the importance of incubation is well documented in the literature, but experimental research has yielded little insight into this stage of the creative process (Patrick, 1986; T. B. Ward & Saunders, 2003). According to a review of experimental research on incubation, to date only 39 studies have been conducted since the first attempt to examine incubation in 1938 (Dodds, Ward, & Smith, 2012). Of these studies approximately 75% did demonstrate an incubation effect, yet no single theory of incubation was supported (Dodds et al., 2012). Meta-analyses of the literature do indicate some factors that affect incubation. Greater preparation and expertise appear to increase the benefits of incubation (Dodds et al., 2012; Patrick, 1986; Sio & Ormerod, 2009). Work on mundane (or low-cognitive load) tasks during periods of incubation also appears to increase the benefits of incubation whereas rest and high-cognitive load tasks have either little effect or prove detrimental (Dijksterhuis & Meurs, 2006; Sio & Ormerod, 2009). Divergent thinking tasks (as opposed to convergent thinking, linguistic, and visual insight tasks) seem to benefit the most from periods of incubation (Dijksterhuis & Meurs, 2006; Sio & Ormerod, 2009). Finally, environmental cues encountered immediately before or during incubation may either benefit or hinder the creative process (Sio & Ormerod, 2009). These results suggest that incubation may be affected by the environmental conditions under which it takes place. Yet creativity research has thus far failed to address the role of the physical context where incubation naturally occurs.

**Elaborating**

Historically the final stage of creativity has been considered the evaluation or verification stage. Many process models, however, now include implementation as the final stage, following evaluation. I suggest that “elaborating” may be a more appropriate title for the evaluation stage, because it better reflects the role this stage plays in creative ideation. People reflect, select,
evaluate, and refine ideas throughout the creative process (Jay & Perkins, 1997; Schön, 1983). The literature in this area, however, focuses on the role of evaluation in creativity. The evaluation process has long been associated with convergent thinking, which may account for why it has been typically described as a discrete stage that occurs late in the creative process (Guilford, 1950; Mark A. Runco, 2007a). Yet current research indicates that not all evaluative processes entail convergent thinking. Evaluation may include both explicit processes that employ convergent thinking as well as intuitive processes that correspond more closely with divergent thinking (Mark A. Runco & Chand, 1994).

It is evident from the prior examination of the various stages and cognitive processes of the creative act that some type of evaluation is ongoing throughout the creative process. Kozbelt and Serafin (2009) refer to this continuous process as “dynamic evaluation,” Schön (1983) calls it “reflection-in-action” and Runco and Chand (1994) describes the process as “valuation.” McCall (2013) describes evaluation and ideation as being “intertwined” — with evaluation often serving as a catalyst for creativity. Kozbelt (2008) also hypothesizes that evaluative processes may be central to creativity. Despite the fact that evaluation is alluded to so frequently in the cognitive literature, there is surprisingly little empirical investigation of evaluative cognition in the creativity literature (Mark A. Runco & Chand, 1995; Mark A Runco, 2003). Runco and Chand (1995) argue that to more effectively understand the mechanisms behind the evaluation process, future research should distinguish between evaluation (critical) and valuation (appreciative) as well as between intrapersonal evaluation (personal reflection) and interpersonal evaluation (evaluation that involves interaction with other people.)

**Intrapersonal valuation and idea generation.**

Intrapersonal valuation occurs throughout the creative process (Mark A. Runco & Chand, 1994), and “is used when an individual looks for the worth of an idea or appreciates a specific direction of thought” (Mark A. Runco & Smith, 1992, p. 296) During the valuative process, the creative practitioner is looking for strengths or desirable features of a creative idea as opposed to
looking for critical weaknesses – and using valuation to guide decisions throughout the creative process. Intuitive valuation thus appears to play a role, for example, in Csikszentmihalyi’s creative flow — a generative process. When people are in the flow state, they make dynamic, intuitive, valuative judgments about the outcomes of their actions in the creative situation (Csikszentmihalyi, 1990, pp. 54–58). These valuations help them determine the next course of action. Divergent thinking models often emphasize the need to separate ideation and evaluation because it is believed that evaluation is a convergent process that inhibits divergent productivity.

Divergent thinking emphasizes the fluency of original ideas and recommends suspension of any judgment or evaluation until the divergent thinking process is exhausted (McCall, 2013; Osborn, 1953). Yet the premise on which these principles are based may be false. Runco and Chand (1994) have demonstrated through empirical research that intrapersonal valuation skills correlate with divergent thinking abilities. People who are skilled in divergent thinking are also skilled in valuation. This suggests that although valuative processes may occur at any stage of creativity, they may be particularly significant to the idea generating stages.

**Critical reflection and idea elaboration.**

Runco and Chand (1994) state that intrapersonal (critical) evaluation is sometimes referred to as reflective thinking – and there are many parallels between their theory of intrapersonal evaluation and Donald Schön’s (1983) theory of reflective practice. Schön’s theory consists of two related processes: knowing–in–action and reflection–in–action. Schön describes knowing–in–action as a form of tacit performance like Csikszentmihalyi’s (1990) flow. Although judgments are made during this process, they are spontaneous, intuitive, and valuative (Schön, 1983, p. 54). Reflection-in-action occurs when there is a mismatch of expectations and observed results during knowing-in-action (Schön, 1983, p. 305). In other words, reflection–in–action happens when intuitive performance breaks down and the creative person thinks explicitly and critically about the creative situation. Schön explains that reflection–in–action is a way for the creative person to “surface and criticize the tacit understandings” of the problem (p. 61). A
distinguishing feature of Schön's concept of reflection–in–action is the role of feedback from the creative situation. Schön (1983) describes the process of reflection–in–action as a conversation with a situation (p. 151). It is evaluation as a form of physically–situated cognition (McCall, 2013). This evaluative response to feedback from the creative situation is also described in Kozbelt and Serafin's (2009) theory of “dynamic evaluation,” which they use to describe the evaluative process employed by artists as they work on a painting. Intrapersonal evaluation is a physically–situated process that is central to creative productivity, plays a significant role during the elaborating stages of creativity, and is intertwined with idea–generative processes like flow and knowing–in–action.

**Interpersonal evaluation: off–hand and deliberative judgments.**

Rittel (1972) describes two processes of interpersonal evaluation: “off–hand” (intuitive) and “deliberative” (explicit.). He considers these complementary processes - although he does not describe off–hand judgments as purely appreciative or deliberative judgments as purely critical. He explains that all design decisions involve both off–hand and deliberative judgments. People rely primarily on off–hand judgments during creative evaluations and convert them to deliberative judgments for two reasons: either because they do not trust the intuitive judgment or because they need to explain the judgment to someone else. He describes the latter process of making the intuitive judgment explicit as “objectification.” Ultimately, Rittel argues, all final design decisions are intuitive, because creative problems are so complex that all issues cannot be conceived of, never mind deliberated.

**Evaluation and ideation intertwined.**

Findings from the creative cognition literature indicate that evaluation and ideation are intrinsically intertwined throughout the creative process. Intrapersonal valuation, in particular, may be closely related to the divergent thinking skills necessary for creative ideation and appears particularly instrumental during the idea–generating stages. Furthermore, reflective evaluation
occurs when the creative person consciously stops to consider the problem – often as a result of feedback from the situation caused by an unexpected development in the creative process. Both intrapersonal and interpersonal evaluation of the creative situation may be intuitive or explicit – but even explicit evaluation involves intuitive judgments. Whether intrapersonal or interpersonal, intuitive or explicit, it appears that the situation of the creative problem may "talk back" to the evaluators – thus informing their judgment. This suggests that the process of evaluation is often (and perhaps always) physically and socially situated in a particular context.

**Implementing**

It is generally agreed that creativity social consensus determines if a creative idea is truly novel and appropriate for furthering a field of knowledge or practice (Amabile, 1996; Csikszentmihalyi, 1996; Feldman, Csikszentmihalyi, & Gardner, 1994b). The final stage in the creative process, therefore, involves implementing the creative idea or product in the world (Bransford & Stein, 1984; Feldman et al., 1994b; Gordon, 1961; Isaksen et al., 2000; M. D. Mumford et al., 1991; Van Gundy, 1987). This stage involves the ability of the creative practitioner to disseminate and "sell" the creative idea or product to a larger audience (R. J. Sternberg, 2006b). It also entails evaluation by members of the creative practitioner’s field (Csikszentmihalyi, 1996; Feldman et al., 1994a). Although this stage is considered the end of the creative process, it also may facilitate creative ideation (McCall, 2013). When a creative practitioner obtains feedback from members of the field, critics, and users, it may trigger reflection–in–action and creative ideation (McCall, 2013). Schön (1983) also refers to a process of reflection–on–action that is triggered by feedback from implementation and use, but occurs when it is too late to make changes to the particular creative situation (p.62). Reflection–on–action may also promote novel ideas that engender problem–finding or idea–generating stages. This intertwined nature of evaluation and ideation corresponds to the belief shared by some creativity researchers that creativity evolves through incremental insights and a network of creative
enterprises (Gruber, 1981a, 1981b, 1988; Kozbelt et al., 2010). Thus the creative process is much more iterative than the stage models describe.

**Key Findings from the Creative Cognition Theories**

A key finding from this review of the creative process literature reveals the incongruence between the ways creativity is described in stage models and “mental” theories of creative cognition, versus observations of creativity in–situ such as those conducted by Csikszentmihalyi (1990; 1975) and Schön (1983). The idea–generating stages that are typically associated with mental schema–restructuring processes like association, conceptual combination, mental imagery, and analogy do not consider the activities in which creative people typically engage to generate ideas — such as writing, diagramming, sketching and model–building. The concept of creative flow, however, does address these situated activities. It also reveals that explicit mental strategies like association, combination, and analogy are not congruent with the intuitive processes of flow. Instead they are more appropriate to the elaboration stages and the process of reflection–in–action. Evaluation, typically associated only with the final stages of creativity, actually entails different intuitive, explicit, intrapersonal, and interpersonal processes that support different creative stages. Valuation (intuitive, intrapersonal evaluation) appears particularly important for the idea–generating phase. Reflection (explicit, intrapersonal evaluation) is instrumental to the elaborating stages of creativity. Intrapersonal evaluation is useful during elaborating stages, and essential for the implementing stages, which rely on feedback from critics and users. It becomes clear from this review that certain creative processes are intertwined in a way that is neither described nor explained in the stage models. This suggests that stage models that describe a sequence of idea–generating, incubating, elaborating may not reflect the natural sequencing of these activities by creative practitioners. The creative process literature, it appears, would benefit by examining creativity as a physically–situated process.
Towards a Multi–Modal Model of Physically–Situated Creativity

The intention behind this chapter is to identify the physically–situated processes involved in the stages of creativity as the next step toward developing a new framework to bridge the environmental design and creativity literatures. This review of the creative process literature reveals that there is no appropriate stage model to adapt for this framework because they are incompatible with a physically–situated view of creativity. First, they do not adequately account for what people do when they are creative in–the–world. Second, they do not describe the conditions under which the creative stages are engendered, sustained or inhibited. Third, they do not consider the relationships between stages that might explain how creativity is an iterative process. Further, a review of the creative cognition theories reveals that the mental processes believed to occur during certain stages of the creative process contradict observations of “real–world” creativity. It appears that only a single creativity theory, Csikszentmihalyi’s (1990) concept of creative flow, accounts for the physically–situated nature of creativity. It, however, describes only a single mode of creativity, a state of enactive cognition that people engage when they are immersed in the creative task at hand. I suggest that flow theory should form the nucleus for a new model of physically–situated creativity. I also propose that Schön’s (1983) complementary theory of reflective practice can provide the basis for a second mode of creativity, because it describes the intertwined relationship between the intuitive immersive processes of flow and the explicit evaluative processes of reflection–in–action. Together these two theories create the foundation from which to develop a physically–situated model of creativity that describes five enactive modes of creativity.

A multi–modal process model of creativity has some clear benefits over the stage models. Each mode describes a state of enactive cognition. An enactive state may entail different physical, social, and mental processes, but the quality of the state is fairly constant, and it is engendered, sustained, or inhibited by consistent environmental conditions. A modal process model will therefore be useful for aligning creative processes with environmental conditions. It also reflects the ecological psychology and enactive cognition perspective that the relationship
between person and environment is reciprocal and must be considered as one structural unit of analysis. Although the stage models profess to be iterative, they describe creativity as a series of mental steps. A modal approach describes enactive states, as opposed to mental steps, which can account for the sub-processes within a particular mode as well as the various creative activities and behaviors in which people engage during a mode. The stage models do not describe the relationship between stages, whereas a modal process model considers the conditions under which a mode is engendered, sustained, or inhibited, which may clarify how people transition between modes of creativity. The review of the creative process literature does suggest that there may be five discrete modes of creativity: problem-finding, idea-generating, incubating, elaborating, and implementing. This organization is further supported when one considers the activities and behaviors in which people engage during these five modes. I have compiled a preliminary list of these derived from first person accounts of creative processes, my personal observations and experiences, and empirical studies of creativity and design, presented in Table IV.2. Using the five-mode organization, along with the theories of creative flow and reflective practice, I will develop in the next chapter a new multi-modal process model of creativity.
Table IV.2 Preliminary List of Creative Modes and Creative Activities.

<table>
<thead>
<tr>
<th>Problem–finding Mode (Questioning)</th>
<th>Generating Mode (Diving In)</th>
<th>Elaborating Mode (Stepping Back)</th>
<th>Incubating Mode (Walking Away)</th>
<th>Implementing Mode (Trying It Out)</th>
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<tr>
<td>arrange</td>
<td>act (role-play)</td>
<td>analyze</td>
<td>bike</td>
<td>appraise</td>
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<td>adapt</td>
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<td>articulate</td>
<td>dream</td>
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<td>apply</td>
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<td>envisage</td>
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<td>devise</td>
<td>dismantle,</td>
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CHAPTER V
THE MULTI–MODAL PROCESS MODEL OF CREATIVE PRACTICE

Highlights

In this chapter I present my proposal for a new process model of creativity. Through the lenses of ecological psychology and cognitive science, I examine and extend Csikszentmihalyi’s (1990) theory of creative flow and Schön’s (1983) work on reflective practice to illustrate how creativity is a physically embodied, embedded, and enactive process that entails distinct yet interrelated sub-processes (modes) of creativity. I develop the Multi-Modal Process Model of Creative Practice to describe five creative modes (problem–finding, intuitive immersion, explicit reflection, adaptive rumination, and evaluation) and the relationships between them. Using this model, I illustrate how the creative practitioner uses features of the physical environment as a resource to engender, sustain, inhibit or curtail the different creative modes. I also demonstrate how the Creative Practice Model serves to organize the seemingly varied and idiosyncratic behaviors in which people may engage during the creative process. Finally, I discuss how the model reveals that creative people are autonomous agents who can be empowered by their environments.

Introduction

Review

In Chapter IV I illustrated how existing creative stage models are not appropriate for informing a new theoretical framework describing the person–environment relationship during creativity. The stage models describe creativity either as a purely cognitive process, or only socially (not physically) situated. They fail to account for 1) the physically situated processes in
which people engage during creativity, 2) the environmental conditions under which the different creative stages are supported, and 3) how the different creative stages interact in an iterative creative process. The review of the creative cognition theories reveals incongruence between the mental processes typically associated with certain creative stages and physically situated theories of creativity and design based on observations of what creative practitioners do in the world. I suggested that two of these physically situated theories, Csikszentmihalyi’s (1990) theory of creative flow and Schön’s (1983) reflective practice, together may provide the nucleus for a new multi-modal process model of creativity.

**Thesis**

In this chapter I present a proposal for the Multi-Modal Process Model of Creative Practice which extends the two modes of creativity described in Csikszentmihalyi’s (1990) flow theory and Schön’s (1983) reflective practice theory to illustrate the full creative process from problem–finding to evaluation. This new model describes the physically–situated nature of creativity through five interrelated modes that entail embodied, embedded, and enactive cognitive activities. I begin by examining how the flow and reflective practice theories compare to the theories of situated cognition (and related theories in ecological psychology by Uexküll (2010) and Gibson (1977)). This examination reveals how flow and reflective practice systematically describe embodied, embedded, and enactive activities as instrumental to creative processes. Together they describe two intertwined creative modes of *intuitive immersion* and *explicit reflection*, but they are inadequate for explaining the full creative process. In particular they fail to account for what happens when explicit reflection breaks down. I then propose a third mode, the semi-explicit mode of *adaptive rumination*, which serves to repair a breakdown in explicit reflection. This forms the third component in a new breakdown–and–repair process model of creativity. Finally, I complete the Creative Practice Model by including the modes of *problem–finding* and *evaluation*. In conclusion I illustrate how by examining creativity as an interrelated series of modes, it becomes apparent that there are necessary environmental preconditions
required to engender, sustain, and inhibit them. This begins to lay out the argument for how features of the designed environment are instrumental to creative practice.

**Significance**

Environmental design professionals need a theory upon which to base their design strategies for settings intended to support creativity. The Multi-Modal Process Model of Creative Practice provides the next step toward that end by illustrating how creativity is a physically situated process. Process models describe a sequence of events and the relationships between them (Suter, 2006, p. 346) They are important for visualizing relationships and communicating this information to others (Suter, 2006, p. 346). The Creative Practice model plays a necessary part in surfacing examples of how features of the designed environment are instrumental to the different modes of creativity — and conveying this information both to environmental design professionals and creativity researchers. Ultimately, the model completes the first step toward a new theoretical framework to bridge the environmental design and creativity literatures.

**Creative Practice**

Central to the argument presented in this chapter is the idea that the creative person is an experienced practitioner who initiates actions in the world in service to a creative goal, intention, or concern. This concept is pervasive in the work of Uexküll (2010) and Gibson (1977), introduced in Chapter III, and is foundational to the principles of embodied, embedded, and enactive cognition (Robbins & Aydede, 2009). This chapter also takes the position accepted among creativity researchers, that creativity involves ordinary cognitive processes (T. B. Ward & Kolomyts, 2010). Variations in creativity may be attributed to individual differences in the ways that people implement these processes, their mental capacities, and acquired knowledge and skills (T. B. Ward & Kolomyts, 2010). Creativity thus appears to be a practice — the result of accumulated knowledge and situated experiences that are crafted and refined over time. In the following sections I will use first–person anecdotes about creativity to illustrate how creative
practitioners engage in five different modes of creative cognition. Many of the illustrative examples come from the memorable stories of extraordinarily creative practitioners. These anecdotes often capture our imagination because we can personally relate to them. I capitalize on the familiarity the reader may have with some of these famous stories to focus attention on how they serve to explain key components of the Creative Practice Model.

**Situated Creative Practices: Flow and Reflection-in-Action**

There is a significant body of literature about the first (problem-finding) and last (evaluation) stages of the creative process. When the design of the physical environment is considered, it is generally with respect to these two stages. What happens between problem-finding and evaluation — where investigation, exploration, and ideation occur — is less clearly defined. As discussed in Chapter IV, although there is no single theory of creativity that is sufficient for examining the interactions between people and their environment, Csíkszentmihalyi’s (1990) flow theory does describe how the physical environment sustains intuitive immersion during the generative phase of creativity. Csíkszentmihalyi describes flow as the ability of a person to 1) initiate actions in service to a clear goal, and 2) to immediately perceive information from the environment about the results of those actions. The flow state is thus sustained through interactions between creative practitioners and their environments. Schön’s (1983) theory of reflective practice illustrates how the physical environment engenders a complementary mode of creativity, a process of explicit and situated reflection which he calls reflection-in-action. Schön describes how unexpected feedback from the environment during intuitive immersion will cause a breakdown in immersion, triggering the explicit process of reflection. The physical environment is thus instrumental to both of these cognitive modes.

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40 Refer to Chapter II for an overview of the environmental design literature as it relates to creativity, and the focus of environmental design strategies on socially situated problem-finding and evaluation processes.
Breakdown and Repair During Creative Ideation

Particularly interesting about Schön’s theory is that it examines closely the relationship between two different modes of creative thinking and their roles in the incremental process of creative ideation. This is largely missing from the creative process literature where stage models primarily describe creativity as series of steps, and the experimental methods commonly used in relation to the creative cognition theories that examine cognitive processes in isolation (Kozbelt et al., 2010). When people are creative they often describe cycles of productivity and frustration, and ideation appears to occur as a series of incremental insights (Gruber, 1981a). Creative processes seem to break down periodically. Schön’s theory elegantly describes how two such processes — one that is intuitive and one that is explicit — function together in a breakdown and repair relationship that leads to the generation of insights about a creative problem. This perspective on the interrelatedness of different creative modes may more clearly represent the realities of creative practice — where ideation is typically a protracted process (Gruber, 1981a; Johnson, 2010; Simonton, 1997) — than are evident in current creative stage models.

Immersion: The Flow of Intuitive Investigation

You stop thinking,
you just look at the piece of foam and you try to make it beautiful,
you cut.
Sometimes you slice something,
and then another thing,
and ou-u-u-p-p-p something is there.
And you think:
‘Oh, that’s interesting;‘ it’s there. (Yaneva, 2009, p. 57)

Common phrases such as being “in the groove,” “in the zone,” “in the game” or “present in the moment” all describe how people feel when investigating a creative idea (Csikszentmihalyi, 1990; Schön, 1983). This quote from Olga Aleksakova, an architect at The Office for Metropolitan Architecture, describes her own immersive process of intuitive investigation (Yaneva, 2009). The process begins when she stops “thinking” and is focused only on making the piece of foam beautiful through the intertwining of action and perception. It ends when she is surprised by the
outcomes of her actions, causing her to reflect on the "interesting" aspects of the design. Csikszentmihalyi (1996, pp. 110–113) refers to this as "flow" and Schön (1983, pp. 49–54) as "intuitive performance" or "knowing-in-action." Both describe a state of total immersion in creative investigation – where understanding is gained through unselfconscious participation and direct experience in a creative situation. For clarity I refer to this mode of creativity as intuitive immersion, or simply immersion in its abbreviated form.

Common features of creative immersion include: overcoming barriers to initiate onset of the process; maintaining undivided attention to the task at hand; initiating actions in anticipation of satisfying clear intentions or goals; perceiving immediate feedback from exploratory actions or strategies; and feeling a sense of personal enjoyment while engaged in the experience (Csikszentmihalyi, 1996, pp. 110–113). The improvisational jazz performer anticipating each new note as he hears the last one played (Schön, 1983, pp. 55–56), the painter responding to the texture of the paint and the colors of pigment on a canvas as she positions the brush to make the next stroke (Csikszentmihalyi, 1996, p. 208), and the scientist working through the structure of DNA by manipulating and reconfiguring a physical model of machined parts (Watson, 1968, pp. 193–197) are some examples of immersive investigation. In all of these cases there is fluid intertwining of action and perception, and understanding comes from first-hand experience in a physical context.

As discussed in Chapter IV, intuitive immersion is a form of situated action where each new action is in response to the current set of circumstances. Immersion may thus be characterized as an activity involving continual reciprocal causation, where the creative person is

41 I have selected here some examples that I felt would generalize to a larger audience and so have focused around processes that involve typical creative activities like writing, drawing, and model construction. However anecdotes about immersion can be found across domains. In a quote by choreographer Mary Wigman (1952) she describes how feedback from both the music and other dancers help sustain her intuitive creative process. "Working with a group my effort is to seek out a common feeling. I present the main idea, each one improvises...I must find some common denominator from these different emanations of personality. Thus, on the rock of basic feeling, I slowly build each structure." (p. 76).
simultaneously affecting a situation and being affected by it (A. Clark, 2008a, p. 24). In their seminal work Rumelhart et al. (1986) argue that people regularly do three things: 1) imagine the results of their actions thereby generating expectations, 2) manipulate the physical environment as a way to think through complex problems, and 3) perceive patterns in the environment; thereby enabling the transfer of knowledge gained from past experiences to a new situation. All of these activities are key to immersive investigation. The process is initiated and sustained by a state of congruence between expectations and the perceived results of one’s actions (Csikszentmihalyi, 1996, pp. 118–120). When congruence exists, creative people are able to solely attend to the situation at hand, they perceive but do not attend to the tools in their hands or the items in their workspaces (Csikszentmihalyi, 1996, p. 112).

**Sustaining Immersion**

Three conditions sustain intuitive immersion: 1) focused attention on the creative task, 2) an appropriate match between skill level and the difficulty of the task at hand, and 3) congruence between expectations and the outcomes of actions during the creative task (Csikszentmihalyi, 1990, pp. 54–58; Schön, 1983, p. 56). The designed environment may provide the resources to support these three conditions. First, it can help people sustain attention on the task at hand by helping them avoid distractions (Csikszentmihalyi, 1996, p. 120). Features of the designed environment protect creative practitioners from interruptions by outside influences, such as noise or undesired social interactions. Furniture, materials, and tools may also help people attend to the creative task — when they do not require attention in order to make them functional or comfortable. Second, resources in the designed environment can make difficult tasks easier by enhancing creative practitioners’ abilities, such as through tool use. Familiar tools may become part of the body schema to enhance intuitive performance (Carlson, Alvarez, Wu, & Verstraten, 2010). Hutchins (1995, p. 172) refers to this as *cognitive bricolage* and Clark (2008a, p. 63) calls

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42 The psychologist Carl Jung (1952) illustrates this process through his explanation of the relationship between Goethe and his work writing Faust in the following quote: "The work in process becomes the poet’s fate and determines his psychic development. It is not Goethe who creates Faust, but Faust which creates Goethe." (p. 230).
it bootstrapping — both describe how people use tools to assemble functional cognitive systems in order to accomplish a challenging task. Third, designed environments may provide the means for people to change the way they perceive affordances of a creative situation. Nakamura and Csikszentmihalyi (2002) state a person’s experience (i.e. whether or not they feel they are in flow) depends upon their subjectively perceived challenges and experiences. Because their experiences are shaped by what people attend to, features of the designed environment may help creative practitioners to perceive hidden or potential affordances (A. Clark, 2008a, pp. 64–66; Kirsh, 1995b). Ultimately creative practitioners may use their environments as creative thinking spaces by becoming particularly adept at exploiting environmental features to help them focus attention, handle difficult tasks, and perceive opportunities in a creative idea or product — all in service to sustaining immersive investigation of a creative idea or product.

**Focusing attention on the creative task.**

Focused attention may be sustained when environmental resources become part of a person’s cognitive system by acting as transparent equipment, a term coined by Martin Heidegger (A. Clark, 2008a, p. 10). Artifacts of the environment are considered transparent when they are perceived but not attended to. For example, I perceive my hand reaching for a doorknob, and I perceive a pen in my hand, but I typically do not pay attention to these things — unless the pen in my hand is preventing me from opening the door. If they do not attract my attention when I open the door or jot my thoughts down on a page, the doorknob and the pen are for me transparent equipment.

Creative people often describe strong preferences for particular tools and materials with which they prefer to work (Fig, 2009; Kipling, 1937). They can be very particular, sometimes even seeming superstitious, about the roles they believe such items play in creative performance. Rudyard Kipling famously described the key to his creativity as the brush and the ink he used.

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43 Csikszentmihalyi (1996) quotes Barry Commoner discussing how his favorite fountain pen allows his ideas to flow, whereas a ballpoint pen does not offer the same experience for him (p. 119).
"Take a well ground Indian Ink as much as suffices and a camel-hair brush proportionate to the inter-spaces of your lines. In an auspicious hour, read your final draft and consider faithfully every paragraph, sentence and word, blacking out where requisite... The magic lies in the Brush and the Ink. For the Pen, when it is writing, can only scratch; and bottled ink is not to compare with the ground Chinese stick. Experto crede.” (Kipling, 1937, p. 208).

The brush and ink are Kipling’s favorite tools. He uses them regularly (they are customary) and he has developed substantial expertise in their use (they are familiar) and so do not distract him from his writing. Tools, as transparent equipment, must be familiar, customary and comfortable so that their use becomes intuitive for the creative practitioner (Schön, 1983, p. 52). Kipling recognizes that the pen and ink are part of his creative process, and affect the way he perceives his writing.

There is evidence to suggest that external objects may become part of the body’s schema through customary use (Carlson et al., 2010). This concept can be traced back to the work of William James (1890) in his discussion of “the empirical self or me” and is instrumental to modern theories of situated cognition, such as the work of Clark (1999, 2008a) and Noë (2009). People have long felt that tools become an extension of themselves, serving to organize their creative experiences (Pallasmaa, 2010; Sennett, 2008), and modern science is beginning to explain how this might be the case. Thus tools may “craft” intuitive experiences during creativity (Sennett, 2008, p. 213). It is important to note, however, that tools only sustain intuitive immersion so long as they remain transparent to the creator. A tool that fails to perform will demand attention, thereby inhibiting immersion (Pallasmaa, 2010; Sennett, 2008). When the tool is transparent equipment the user sees through the tool to the task at hand (A. Clark, 2008a, p. 10).

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44 Refer to Chapter III for a more detailed discussion of this concept.
Matching skill and task difficulty.

Intuitive immersion occurs in an optimal zone where there is balance between skill level and task difficulty (Nakamura & Csikszentmihalyi, 2002). If the task is too challenging for the creative practitioner’s skill level, anxiety is experienced instead of immersion. If a task is too easy, creative people may lose focus due to boredom, thus making intuitive immersion difficult to sustain. Since creative problems are typically challenging, creative practitioners often resort to cognitive bootstrapping to sustain immersion by exploiting environmental resources when a task becomes too difficult. Tool usage is a typical example of this. When employed, a tool becomes a cognitive artifact, a man–made object that affects human performance (Norman, 1991). It structures the experiences of the creative person who uses it (Norman, 1993; Pallasmaa, 2010; Sennett, 2008). Tools, as cognitive artifacts, function to mediate the actions between the person and the thing being created. They may buffer against, amplify, or filter particular types of experiences while creating.

Tools both scaffold creative abilities and change the way the user experiences the creative situation (Sennett, 2008, pp. 194–213). For example, in architectural design education there is frequently a tension between professors who emphasize hand sketching and drawing over those who advocate for the use of computers and particular software packages (Sennett, 2008, pp. 39–45). Proponents of hand drawing may suggest that imaginative thoughts flow more directly when one puts pencil to paper. The pencil allows a student to be more tentative about ideas, minimizing commitment to them. The computer, they argue, filters out the tactile, intuitive experiences of drawing, and is a barrier to tentative sketching so easily achieved on paper. The computer advocates may argue that specialized software can reduce the barriers created by limited drawing skills, amplifying the ability of a student to document and refine their imaginative thoughts in three dimensions. Although this is a very simplified version of a fierce pedagogical

45 This concept is similar in principle to the theory developed by J. McVicker Hunt (1961) called optimal match. Hunt felt that learning occurred when there is an optimal fit between learner and environment. If the environment is too challenging the learner will feel anxious and if it is not challenging enough the learner will be bored.
debate, architectural educators often have very strong opinions about the tools students should use based upon their perceptions of how they affect students’ creative experiences.\textsuperscript{46}

**Perceiving congruence between actions and outcomes.**

While it is important for tools and other environmental resources to remain transparent, the creative idea must in some way be externalized to sustain intuitive immersion because people must be able to perceive feedback from their actions (Csikszentmihalyi, 1996, pp. 118–120)

Architect Alvar Aalto describes how sketching plays an important role in sustaining this creative mode for him.

> "I forget the whole maze of problems for a while, as soon as the feel of the assignment and the innumerable demands it involves have sunk into my subconscious. I then move on to a method of working that is very much like abstract art. I simply draw by instinct, not architectural synthesis, but what are sometimes quite childlike compositions, and in this way, on an abstract basis, the main idea generally takes shape, a kind of universal substance that helps me to bring the numerous contradictory components into harmony." (Aalto, 1997, p. 108)

The process of externalization is intertwined with the way the creative practitioner thinks intuitively about the creative situation. For Aalto, drawing seems to help him intuitively reconcile the complex and contradictory requirements of an architectural design. Cross (2006, p. 37) describes the role of sketching in design as method to 1) “handle different levels of abstraction simultaneously,” 2) “enable identification and recall of relevant knowledge,” 3) “assist problem structuring through solution attempts,” and 4) ”promote the recognition of emergent features and properties” of the design idea. Externalization is a way of thinking about a creative idea, where actions and perceptions merge (Csikszentmihalyi, 1996, pp. 118–120).


\textsuperscript{46} See Sennett (2008, pp. 37–45), Cross (2006, pp. 34–38) and Gänshirt (2007, pp. 113–123) for further discussion about this debate between hand drawing and computational representation in architecture and the design fields and see Cook (2008) for further discussion on the role of drawing in architectural design.
Each confirmation or denial brings you closer to the object, until finally you are, as it were, inside it: the contours you have drawn no longer marking the edge of what you have seen, but the edge of what you have become.

Poet Amy Lowell describes the importance of externalization and feedback in her creative process. “I seldom compose in my head. The first thing I do when I am conscious of the coming of a poem is to seek paper and pencil” (p.112). Feedback from the externalized idea helps the creative person know how they are doing, and perceptions of progress made feeds motivation to maintain attention on the creative task (Csikszentmihalyi, 1996, pp. 115–116).

The term feedback may suggest that a person is an impassive receiver of information, however this is not the case. As discussed in Chapter III, people are active agents, explorers of their environment who habitually scan the world for information that is relevant to them in service to the task at hand (Reed, 1996, pp. 18–19). As Noë (Noë, 2004, p. 2) aptly describes it, there is “action in perception.” This concept of enaction describes how people create their own experiences by acting in the world. For example, people’s perceptions differ when viewing an artifact from a new angle, touching or manipulating an artifact, or taking it to a new setting. Their perceptions are informed by what they do, how they do it, and what they anticipate doing (Noë, 2004). During immersive investigation, the way that an idea is externalized and experienced will affect the type of information that a person is able to perceive in the creative situation.

**Environmental conditions that sustain immersion.**

Creative immersion is best supported by environmental conditions that do not distract the creative practitioner’s attention away from the task at hand. As suggested earlier, it maybe useful to extend the concept of transparent equipment from tools to all the features of the designed environment that enable the creative practitioner to sustain focus on the task at hand. These environmental features become part of the creative practitioner’s cognitive system during immersive investigation when they function without drawing attention away from the task. For example, if I am immersed in a creative activity while inside my office with the door shut, I pay
no attention to the door. Yet the door becomes part of my cognitive system during intuitive immersion. When someone touches the door — and it swings open because it failed to latch — the organization of my cognitive system disintegrates, intuitive immersion breaks down, and my relationship to the door changes. I notice that it failed to provide a barrier to interruption.

The physical settings where creativity happens — the spaces where creative people do their work — must function as transparent equipment in the creative practitioner’s creative cognitive system in order for the immersive system to remain intact. They are places that provide the necessary resources to support the creative process, but do not draw attention from the task at hand. A room may function in the immersive cognitive system as a filter, buffer, or barrier to particular experiences. A window may filter out sound while allowing light and view. A door provides a buffer from surprise intrusions on one’s privacy. Walls and roofs provide a barrier to cold, wind, and rain. We only attend to these aspects of place when they fail to perform as we expect: the window breaks, the doorknob fails to latch, or the roof leaks. During immersion, the setting functions as part of the cognitive system only by remaining transparent to the creative practitioner.

Engendering Immersion

Conditions in the designed environment may serve as a stimulus to engender intuitive investigation (Csikszentmihalyi, 1996, pp. 354–357). The sustained and focused attention required for immersion takes significant effort (Csikszentmihalyi, 1990, pp. 30–33, 54). People often feel that they need to overcome psychological barriers in order to begin the process (Csikszentmihalyi, 1996, pp. 344–346). They commonly develop a ritualistic or habitual process of mental preparation that is triggered by features in the environment (Csikszentmihalyi, 1990, pp. 354–357). The tower view from his writing table seems to have served this purpose for Kant, as he is reported to have become distraught when his neighbor’s tree obscured his view and insisted that it be cut down (Wasianski, 1902). For Proust, who purportedly suffered from allergies and asthma, his cork-lined room may have provided the ideal conditions to engender intuitive
investigation (Fuss, 2004). Friedrich Schiller is said to have used the smell of rotten apples to spur his creativity (Spender, 1985, p. 114). At first impression, these stories may seem like the type of idiosyncratic behavior historically associated with eminently creative people, but views, rooms, objects, may play an important role as a stimulus to beginning the process of immersive investigation.

The aesthetic qualities of a setting may also play a role in intuitive investigation, either as a stimulus to focusing attention or as a means to help sustain attention by making the process more enjoyable. People commonly claim to draw inspiration from beautiful settings during creativity (Csikszentmihalyi, 1996, pp. 133–139; McCoy & Evans, 2002). They also perceive certain architectural features to be more conducive to creative immersion. As discussed in Chapter II, people feel that complex visual detail, views of nature, daylighting, and natural materials are important for a creative workplace (Ceylan et al., 2008; McCoy & Evans, 2002). Documented positive effects of natural views and daylighting on attention suggest that these environmental features may support intuitive immersion — where focused attention is instrumental for sustaining the creative mode — although the relationship between these features and creativity remains unexamined.47 There is emerging research, however, that suggests some environmental conditions, such as ambient noise, may increase creative productivity even though people do not perceive them as beneficial to their creative process (Mehta et al., 2012). Clearly the challenge of identifying such features lies in the fact that people do not directly attend to them during intuitive immersion. Csikszentmihalyi (1990) describes flow as an autoletic experience, meaning that the process is itself enjoyable for people (p. 67).

Although people may not pay attention to particular features of their environment when they are immersed in intuitive investigation, the places that creative practitioners find enjoyable may help engender and sustain an autoletic experience. In this case, qualities of the environment may fall

47 One study, by Shibata and Suzuki (2004), compared creative productivity in three rooms (with a plant, with a magazine rack, and with no decoration). They found that participants used features of the room as environmental cues to help them come up with creative ideas.
under Murray's (1938) definition of *alpha press*, as it is commonly understood that people perceive more than they attend to (Noë, 2004).

**When Immersion Breaks Down**

The process of intuitive investigation breaks down when there is a mismatch between ability and task (either from boredom or from frustration) or from an unexpected situation (e.g. a surprise, interruption, or distraction caused by an unexpected outcome or event) (Schön, 1983, p. 56). When breakdown results from incongruence between expectations and the outcome of actions, the creative person typically engages in a different type of cognitive activity: explicit reflection. Schön (1983) refers to this process as “reflection-in-action” with “action-present” designated as the time frame in which changes can affect the creative product (p. 62). Creative people frequently alternate between these modes of immersion and detachment throughout the creative process (Schön, 1983, pp. 49–69). The renowned dancer and choreographer Twyla Tharp describes alternating between the two processes as “the yin and yang of my work life:


During reflection people do not disengage from creative exploration, rather they try to take a more critical perspective on the creative process and product than was the case during intuitive investigation. The relationship between immersion and reflection is shown in Figure V.1.
Figure V.1 The Nucleus of the Creative Practice Model.
The relationship between Intuitive Immersion and Explicit Reflection is a breakdown and repair processes.

Reflection: Making the Intuitive Explicit

"To express is to drive. And when you want to give something presence, you have to consult nature. And there is where Design comes in.

And if you think of Brick, for instance, and you say to Brick, "What do you want Brick?" And Brick says to you "I like an Arch." And if you say to Brick "Look, arches are expensive, and I can use a concrete lintel over you. What do you think of that?" "Brick?" Brick says: "... I like an Arch""

- Louis Kahn, Architect
This famous quote by the architect Louis Kahn illustrates a process of reflection during creativity. He seems to be having an imaginary conversation with a brick, the material of an architectural design. He is questioning how the brick should be expressed through the construction of the building exterior — whether it should sit on a concrete lintel above an opening in the building envelope (e.g. a door or window) or if the bricks themselves should form an arch to support additional brick rows above the opening. He allows the brick to “talk back” to him by expressing what it “wants.” This imaginary conversation, a form of critical deliberation, appears to help him perceive the affordances of the brick in relation to his intentions for the design of a building.

Schön (1992) describes reflection as “a conversation with materials of the situation” (p. 175). The conversation metaphor illustrates the shift — from intuitive immersion to an explicit process of deliberation — that the creative person takes with respect to the creative problem. Externalizing a creative idea, process, or product allows the creative practitioner to perceive affordances in the *creative situation* (e.g. the tools, materials, processes, and product of ideation.) The materials “talk back” to the creator as he or she scans the situation for information (i.e. feedback) relevant to the task at hand (Schön, 1983, p. 79). By Schön’s (1983) account, reflection encompasses both surfacing the assumptions underlying a person’s actions (i.e. the problem frame) and interpreting (or critiquing) the situation produced by those actions (p. 61). The person then uses strategies to perceive opportunities to bring expectations and outcomes back into congruence, such as 1) changing the conditions of the situation to match goals and intentions (i.e. to fit the frame), 2) changing goals or intentions to be congruent with the situation (i.e. reframing the creative problem), or 3) changing the way the situation is experienced to find congruence where it was not previously perceived (i.e. uncover hidden or potential affordances) (Schön, 1983, pp. 128–133). This new understanding is then used to guide future intuitive investigation.

The goal of explicit reflection is to bring back into congruence the creative situation with the goals and intentions of the creative practitioner in order to “keep inquiry moving” on the
creative problem (Schön, 1983, p. 136). This mode repairs the breakdown that occurred during immersive investigation so that the practitioner may resume intuitive immersive work on the creative problem. Thus reflection is both deliberative and generative.\textsuperscript{48} It is an experimental mode of creativity that is intertwined with the process of intuitive investigation. According to Schön (1985) it “consists in actions that function in three ways, to test new understandings ('What's going on here?'), to explore new phenomena ('What else looks odd here?'), and to affirm or negate the moves by which the practitioner tries to change things for the better ('How can we get this under control?')” (pp. 25-26). Reflection is a form of subjective judgment that ultimately depends upon the ability of the creative practitioner to perceive hidden and potential affordances in a creative situation.

**Direct Feedback and the Rhetoric of Tools and Materials**

During reflection creative practitioners perceive feedback through the use of different tools and materials. This feedback may be direct, which Schön (1983) describes as the materials of the situation talking back (pp. 78-79), or indirect, a process he describes as *seeing-as* (pp. 139-140). During direct feedback, the tools and materials seem to “push back,” guiding form according to the affordances and constraints of the structural properties and material qualities they possess (Schön, 1992). For example, painters may find that the consistency of a type of paint does not lend itself to the particular techniques they intend to use. They may then reflect on their intentions with respect to the affordances that they perceive in the paint. They may choose to change the conditions of the situation to match personal goals (by altering the paint) or change personal goals to match the situation (by altering the painting technique to work with the properties of the paint medium.)

People also use tools and materials to externalize their creative ideas in different ways with the intention of uncovering hidden or potential affordances in a creative idea or product. Diagramming, drawing, and model building are a few commonly used ways people use to change

\textsuperscript{48} Refer to Chapter IV for a more detailed discussion regarding the roles of valuation and evaluation in the creative process.
their perceptions of a creative situation (S. Allen, 2009; Gänshirt, 2007; Pallasmaa, 2010).

Diagrams are a visual method of abstracting and compressing information (Garcia, 2010, p. 18). They may be used to understand or analyze relationships (e.g. temporal, spatial, or organizational) or as a method for generating a form through conceptual representation, capturing the relationship between the creator and the object of creation (S. Allen, 2009, pp. 41–69; Eisenman, 2010). Although diagrams generally focus more on describing structural relationships than meaning making (S. Allen, 2009, p. 50), their abstracted nature may facilitate deeper understanding about a creative problem or idea through metaphor and conceptual combinations (Kazmierczak, 2003). In architecture, orthographic projection, montage/collage, and perspectival drawings are all used to obtain information about different spatial relationships in a building design (S. Allen, 2009, pp. 3–40; Robin Evans, 2000). Models are also used in environmental design as well as a number of other disciplines, including mathematics and science. Models are a form of abstraction like diagrams and drawings, however they may help people better understand three-dimensional relationships. The model was instrumental, for example, in helping Crick and Watson discover the structure of DNA (Watson, 1968). Just as tools organize the creative imagination, so too do the materials used to externalize a creative idea. The rhetoric of these objects influences how the creative practitioner perceives affordances in the situation.

**Indirect Feedback: Using Things to Think With**

When feedback from a creative situation is not direct, people resort to different strategies to perceive affordances in a situation. Schön (1983, pp. 182–187) describes two ways that people use a process of seeing-as: by seeing one case as another previously experienced case (e.g. this church is like one I’ve designed before), or by comparing their experiences in one situation with their experiences in a different, unrelated situation through use of analogy (e.g.
the structure of this church’s roof is like a crab shell. 49) Analogy involves transferring the cognitive structure from one context where it is well established to a new context where it had never been used (Welling, 2007). People employ these two methods of “seeing-as” to focus on particular aspects of the creative situation, filtering out any detail that may obscure or confuse their ability to perceive feedback, or affordances in the situation.

**Feedback From Others**

Social interactions may also help the creative practitioner perceived affordances in the creative situation. Feedback may come from informal discussions, critiques by experts, or observations of users (such as during prototyping or preliminary testing of a creative idea.) Schön (1983) describes mentor/mentee relationships in architecture and psychotherapy to illustrate the reflective process. Mentors, as expert critics, have a larger repertoire of experiences that may allow them to surface affordances or constraints of a situation more easily. *Reflective communities*, domain–specific groups of people who form a collective intelligence around particular types of creative problems, may help the creative practitioner overcome “the limitations of the individual human mind” (Fischer, 2005b). Informal conversations with peers, colleagues, or professionals from other disciplines can also provide indirect feedback on a creative situation. Charles Darwin credited his exposure to Thomas Malthus’ theory about population growth with allowing him to perceive the affordances in his developing theory about the origin of species and natural selection (Johnson, 2010, pp. 78–82). 50 Users can provide a form of feedback to creative practitioners that differs from the speculation about outcomes inherent in other forms of social reflection (McCall, 2013). In this case the creative practitioner perceives new affordances by

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49 According to the architect Le Corbusier, his design for the roof of Notre Dame du Haut was inspired by a crab shell he had picked up on the beach and that happened to be laying on his drawing board, next to the building sketches (as published in Le Corbusier, *Texts and Sketches for Ronchamp.*) (Groat & Wang, 2002, p. 102)

observing use during prototyping activities (e.g. direct feedback from the creative situation) or questioning users about their experiences (e.g. indirect feedback from the situation.)

**Reflection and Imagination**

The strategies described thus far that people use to perceive feedback from a creative situation all address the situation *as presented*, assuming all the real world constraints of its particular context. Schön (1983) restricts his discussion of reflective practices to this area. Yet people also use their imagination to change the way they experience a situation. Creative people temporarily augment reality by imagining — alternating between suspended and grounded rationality (Csikszentmihalyi, 1996, pp. 63–64). During periods of suspended rationality, they use their imaginations to employ methods of *empathic identification* and *mimcry* (Csikszentmihalyi, 1990, pp. 73&148). Empathic identification is illustrated in Louis Kahn’s quoted imaginary conversation with a brick. He is empathically identifying with the brick in order to perceive heretofore hidden affordances. As discussed in Chapter IV, suspended rationality is a valuative strategy, a form of appreciative critique that allows the creative practitioner to appraise certain features of an idea without subjecting it to all the real world requirements it might eventually need to meet (Mark A. Runco & Chand, 1994). This allows the creative idea to develop resilience before undergoing rigorous evaluation, which might cause it to be abandoned prematurely.

Mimicry is a term used to describe the type of game play that occurs where fictional contexts have real-world rules (Caillois & Barash, 2001, p. 19). Creative people may suspend certain aspects of reality (such as gravity) in order to imagine new experiences. Imagination may facilitate novel combinations by allowing conceptual play. Unlike analogy, novel combinations require new conceptual structures or schemas – a skill thought to distinguish highly creative people from the general creative population (Welling, 2007). Imagination may also help creative people experience the situation from a new point of view, allowing them to conceptually distance themselves from the situation.
Sustaining Reflection: Externalization and Reframing.

Explicit reflection is sustained through methods, tools, and settings that allow the creative practitioner to perceive new affordances in a situation. The perception of affordances depends on the possession and exercise of knowledge as well as an ability to acquire information in the environment that could be relevant to the task at hand. As described previously, creative people may use tools and methods to externalize a creative idea in different ways to help them perceive new information about the situation. They may also alter settings to change the context of a creative situation or to change the way they experience the situation by using features of their environments as things to think with. In her autobiography, choreographer Twyla Tharp describes how she constantly uses the world around her as a resource to think about her choreography.

Everything that happens in my day is transactional between the external world and my internal world. Everything is raw material. Everything is relevant. Everything is usable. Everything feeds my creativity. But without proper preparation, I cannot see it, retain it, use it (Tharp & Reiter, 2003, p. 10).

The relationship between the creator and the creation is transactional (Schön, 1983, pp. 150–151). Creative practitioners shape their own creative situations, but these situations also shape the creator’s experiences and the affordances they are able to perceive.

Creative people make changes both to the way they externalize their creative ideas and to their settings in order to help them perceive new affordances (i.e. different feedback.) Even minor physical adjustments may help change the way they experience a creative situation, such as by changing the lighting levels on a model or pinning a drawing up on the wall so they can step away from it. Some changes in the setting may invite social interactions, helping to sustain reflection through conversation about the creative idea and through feedback from use of a creative product (McCall, 2013). Changes in the environment can help the practitioner perceive new affordances based on underlying assumptions about the situation or they can help the practitioner revise assumptions (i.e. reframe them) in order to perceive previously hidden affordances (Schön, 1983, pp. 165–166).
The environment is often a rich resource for analogy, which may also sustain reflection by helping the practitioner reframe assumptions about the creative situation. The architect John Utzon used experiences in his environment to help him think about his design for the Sydney Opera House (Peltason & Ong-Yan, 2010, pp. 91–97). He watched large ships being built with ribs in the shipyard outside his office building. He considered how the fruit of an orange is organized in sections. He imagined how space inside a building was like music. All of this information he acquired from the environment changed the way he perceived the design for the award-winning building and influenced its form, organization, and structure. Accounts like these from Tharp and Utzon suggest that creative practitioners develop expertise at using their environments as resources to sustain reflection.

**Engendering Reflection: Breakdowns, Critiques, and Feedback From Use**

Explicit reflection is triggered by a breakdown in the process of intuitive immersion. This breakdown is often caused by a perceived mismatch between expectations and outcomes (Schön, 1983, p. 305). The feedback from the situation, whether positive or negative, surprises the creator (Schön, 1983, p. 56). Surprise then engenders reflection on the creative situation. Surprise does not arise only from a breakdown in expectations, however. Any environmental conditions that interrupt the creative practitioner during intuitive immersion may engender reflection. For example, when the lead breaks in the pencil a creative practitioner has been using, or someone enters a room unannounced, it also causes a breakdown in immersion — which may give the practitioner occasion to reflect on the creative situation.

Reflection is not entirely dependent upon a breakdown in immersion. Other environmental conditions may engender the process. Creative practitioners may use unfamiliar tools as a way of reflecting on a creative problem. Social interactions can also engender reflection — such as when a critic surfaces underlying assumptions about a creative situation of which the creative practitioner was unaware (Fischer, 2005b), or a user interacts with a creative product in unanticipated ways (McCall, 2013). Reflection may thus be engendered by changes in
environmental conditions that consequently change the way a creative situation is experienced by the creator.

**When Reflection Breaks Down**

Explicit reflection ends when a person achieves congruence between goals or intentions and the perceived affordances of the situation at hand (Schön, 1983, p. 68). The process is therefore inhibited by conditions where people have difficulty perceiving the information necessary to help them conceive new strategies to bring expectations and outcomes back into congruence. Schön (1983, p. 305) describes three ways this occurs. First, when intentions towards the creative situation are imprecise, it becomes impossible to test the outcomes against intentions. Second, when understanding of the problem is incomplete or inconsistent, such as due to lack of expertise, the outcome may seem simultaneously congruent and incongruent with expectations. Third, when explicit intentions run contrary to intuitive intentions, the outcome may be congruent with one set of intentions and incongruent with the other. It is also possible that reflection may be inhibited when creative practitioners are not able to obtain adequate sensorimotor information from the situation — such as when they do not have the resources they need to externalize and test the idea in different ways. If the creative practitioner fails to establish congruence between the situation and his or her goals, reflection breaks down.

Although Schön does not discuss the breakdown in reflection, creative people often describe periods where they feel they have hit a roadblock. They may stop explicitly reflecting on the creative problem while outcomes and expectations remain incongruent. Although it is possible that a person may give up as a result of a breakdown in explicit reflection, more often they let the problem simmer in the back of the mind, ruminating or mulling over the situation as they leave its context to pursue other activities. This suggests that there is a third mode of creativity that is not accounted for in the theories presented by Csikszentmihalyi (1990) and Schön (1983), which I refer to as semi–explicit (adaptive) rumination.
Semi–Explicit (Adaptive) Rumination

The following morning I felt marvelously alive when I woke. On my way to the Whim I slowly walked toward the Clare Bridge, staring up at the gothic pinnacles of the King’s College Chapel that stood out sharply against the spring sky. I briefly stopped and looked over at the perfect Georgian features of the recently cleaned Gibbs Building, thinking that much of our success was due to the long uneventful periods when we walked among the colleges or unobtrusively read the new books that came into Heffer's Bookstore.

—James D. Watson (1968, p. 199) on discovering the structure of DNA

There are many anecdotes about how people appear to have some of their most creative ideas when they are not actively working on a creative problem. In this quote by James Watson (1968), he attributes the time spent walking on campus and browsing the bookstore as instrumental to his and Francis Crick’s efforts to identify the structure of DNA. This is sometimes referred to as the bed–bath–bus phenomenon (Dart, 1989), because ideation often seems to happen in these types of interstitial spaces during periods of suspended work on a creative problem.\(^{51}\) Termed “incubation” in the creative process literature, findings from empirical studies on the phenomenon are inconclusive about what cognitive processes actually occur during this period.\(^{52}\) The main debate in the literature concerns whether the role of the sub–conscious is passive (e.g. responsible for forgetting problematic issues that cause unproductive fixation) or active (e.g. involved in forming new conceptual combinations) (T. B. Ward & Saunders, 2003).

Studies suggest that incubation may be a way to address creative fixation, a common problem where people fixate on unproductive lines of inquiry that limit their ability to make progress on a creative problem (Sio & Rudowicz, 2007; S. M. Smith & Dodds, 1999; S. M. Smith, 1995; T. B. Ward & Saunders, 2003). In contrast with the creative incubation perspective, there is some emerging research in psychology that suggests the process of rumination, typically associated with a negative psychological fixation on a problem, may actually be beneficial when people use it “adaptively” to work on very complex problems (Ciarocco, Vohs, & Baumeister, 2010; Cohen & Ferrari, 2010; Verhaeghen, Joorman, & Khan, 2005). Finally, anecdotes by creative people

\(^{51}\) This phenomenon was introduced in Chapter II, along with some examples about the types of interstitial places where people feel they have their most creative ideas.

\(^{52}\) Refer to Chapter III for a more detailed review of the incubation literature.
describe this process as more active and self-directed than the incubation literature might suggest. In the following sections I will briefly explain the concepts of creative fixation and adaptive rumination, and illustrate how this third creative mode is not the passive, subconscious, purely mental process often described in the creative incubation literature.

**Repairing Creative Fixation: The Potential Role of Defocused Attention**

One reason that explicit reflection may break down is due to the well-recognized problem of fixation. Creative fixation is a counterproductive, blind adherence to a plan, set of concepts, or target solution that limits the output of novel and useful ideas. Although causes of fixation vary, it is generally understood that contextual cues and extensive domain knowledge can both contribute to fixation in creative problem solving (S. M. Smith, 1995; Wiley, 1998).

Creative practitioners appear to resort to strategies that distract them from fixating on a creative problem. As mentioned in Chapter II, many creative practitioners find going for a walk particularly beneficial for promoting creative breakthroughs. Elsbach and Hargadon (2006) recommend that workplaces incorporate time for "mindless work" to enhance organizational creativity. They define mindless work as tasks involving low cognitive load and low performance pressure.

Creative practitioners seem to divide their attention between unrelated and undemanding activities and work on the creative problem. In other words, they appear to benefit from defocusing attention during periods of creative fixation. Investigation into the role of defocused attention in creativity began with the work of Mendelsohn (1976) who proposed that more highly creative people are characterized by a greater tendency toward defocused attention than less creative people. This work informed the hypothesis that defocused attention is a stable state in highly creative people (Eysenck, 1995; Mendelsohn, 1976). An alternative hypothesis, and one that is gaining support in the literature, is that creative people are particularly adept at varying

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53 This concept is also commonly referred to as *design fixation*. 
their attention throughout the creative process (Ansburg & Hill, 2003; Martindale, 1999; Rawlings, 1985; Vartanian, Martindale, & Kwiatkowski, 2007).

The term “incubation” implies a passive period of development; however there is both empirical and anecdotal evidence to suggest that creative practitioners are much more intentional about exploiting this mode to increase creative productivity (Altamirano, Miyake, & Whitmer, 2010; Ciarocco et al., 2010; Cohen & Ferrari, 2010; Dietrich, 2007). The incubation literature also suggests that cognitive work is primarily subconscious. Empirical and anecdotal evidence suggest that this is sometimes the case, but frequently creative practitioners appear to be semi–aware of the process (Buttimer, 1983; Dart, 1989; Sio & Rudowicz, 2007; Törnqvist, 2004). They often describe “mulling over” ideas in the back of their head while working on an unrelated activity (such as taking a shower) (Dart, 1989) — a type of reflective pondering generally described as rumination.

**Adaptive Rumination and Creative Problems**

Research from psychology strongly suggests a relationship between a particular type of rumination and creativity (Ciarocco et al., 2010; Cohen & Ferrari, 2010). Rumination has historically been associated in psychology with mental inflexibility that often leaves people stuck in an unproductive and depressive mindset (Altamirano et al., 2010; J. M. Smith & Alloy, 2009). There is a stream of research in this literature, however, that suggests rumination can also be a beneficial process that plays an important role in creative processes (Cohen & Ferrari, 2010; McGee, 2012; Verhaeghen et al., 2005). This research typically falls under the *goal–progress model* of rumination, which suggests that it involves a repetitive thought process that is triggered by goal disparity (such as a breakdown in reflection) (Martin, Tesser, & McIntosh, 1993). This model does not link rumination directly to depression, but rather suggests that the process can lead to either beneficial outcomes (e.g. goal attainment) or negative outcomes (e.g. fixation on failure and depression) (J. M. Smith & Alloy, 2009). Empirical findings based on this model have shifted the focus of rumination research away from focusing exclusively on depression, towards
understanding it as a multi–faceted process (J. M. Smith & Alloy, 2009). To distinguish this new multi–faceted conception of rumination from the historical association of the term with psychological depression, researchers sometime refer to the positive form of the process as *adaptive rumination* and the neutral form as *self–reflective rumination*. For the purpose of this dissertation, I will limit the discussion of rumination to the adaptive form, based on the goal–progress model of rumination developed by Martin et al (1993).

This fairly recent development in rumination research has some significant implications for better understanding the mechanisms behind the period of creativity often referred to as incubation — as well as the relationships between it and other modes of creativity. Adaptive rumination involves repetitive thinking about a problem or idea that may occur “in the background” while people engage in unrelated activities. It sometimes involves intrusive thoughts that “surface” and interrupt the unrelated activities (J. M. Smith & Alloy, 2009). Empirical investigation into the relationship between adaptive rumination and creativity reveals two key findings. First, rumination is important for maintaining goal–directed work on a difficult problem (J. M. Smith & Alloy, 2009). People who have a tendency to ruminate are able to maintain task goals despite distractions (Altamirano et al., 2010). Rumination is most beneficial if it is action–oriented and focused on maintaining goals, as opposed to fixating on failures (Ciarocco et al., 2010). Second, rumination appears to be particularly useful when a creative person is at an impasse on a creative problem. When it occurs during periods of indecision, adaptive rumination has been found to significantly increase creativity (Cohen & Ferrari, 2010). This process appears to be a way of working through very complex problems (which creative problems, by their very nature, are) (J. M. Smith & Alloy, 2009). Ultimately, the literature suggests that highly creative people are very good ruminators, and that rumination may help them persevere through the complexity of working with creative problems (Cohen & Ferrari, 2010; McGee, 2012; J. M. Smith & Alloy, 2009; Verhaeghen et al., 2005).
Enactive Cognition and Semi–Explicit (Adaptive) Rumination

The role of action–oriented thinking in adaptive rumination suggests that this term is a more appropriate than incubation (which suggests a passive process) for the third mode of creativity in the Creative Practice model. During the ruminative mode, people become actively engaged in behaviors that are not directly related to the creative idea. At the same time (as the rumination research suggests) they are engaged in action–oriented, goal–directed thoughts about the creative problem. They intuitively (both subconsciously and semi–explicitly) work on the creative situation as opposed to explicitly pursuing it — letting their thoughts meander while engaged in activities such as taking a walk, biking, or swimming (Csikszentmihalyi, 1996). During the ruminative mode they 1) forget unproductive lines of inquiry, 2) become sensitive to more productive ideas through repetitive thought, and 3) generate novel conceptual combinations or analogies in response to contextual cues by holding action–oriented, goal–directed thoughts in their head. In the following sections, I will describe how the mode of semi–explicit (adaptive) rumination may be engendered, sustained, or inhibited.

Engender Rumination

Rumination is triggered by a breakdown in explicit reflection. This breakdown leaves the creative practitioner in an unresolved state of indecision about the creative problem, where the present state of the creative situation does not align with the creator’s goals and intentions. Rumination is also engendered by environmental conditions that cause a person to stop exploration and engage in another activity. This mode is particularly productive if work is suspended at a moment of indecision – such as during explicit reflection. In a study conducted by Cohen & Ferrari (2010), the creativity of 85 adults was predicted by rumination, with higher levels of indecision significantly increasing the positive effects of rumination. There is some evidence that environmental cues encountered immediately before or during rumination also may benefit or hinder the creative process, suggesting that incubation may be affected both by the environmental conditions under which it takes place and also by conditions recently experienced.
prior to its onset (Hutchins, 2009; Sio & Ormerod, 2009). Hutchins (2009) suggests that prior
enacted multimodal experiences (such as those from exploratory activities) combine with new
experiences, leading to creative insight. (The story of Archimedes and his discovery of
displacement while drawing a bath is an example of this theory.) It is possible that environmental
conditions during rumination may lengthen periods of creative indecision by distracting attention
from the task at hand and provide sensorimotor information that is implicitly combined with
existing cognitive structures leading to the powerful “aha moment” often associated with insight.

**Sustaining Rumination**

Rumination is sustained by action–oriented goals about a problem, maintaining indecision
about how to meet those goals, and work on mundane (or low-cognitive load) tasks. People have
reported the highest levels of creativity as a result of rumination when walking, driving, or
swimming – semiautomatic activities that involve some physical exertion and take only a small
amount of attention (Csikszentmihalyi, 1996). Perhaps most importantly, these conditions are
sufficiently pleasurable that they distract people’s attention from explicitly attending to the
creative situation.

**Inhibiting Rumination**

Environmental conditions that are too demanding of a person’s attention may inhibit
rumination. High-cognitive load tasks and high–stress environments have been found to
negatively impact and, in some cases, completely curtail creative rumination (Csikszentmihalyi,
1996; Dijksterhuis & Meurs, 2006; Elsbach & Hargadon, 2006; Sio & Ormerod, 2009).
Conversely, although periods of sleep or dreaming are sometimes associated with creative
insight, empirical investigations suggest that these activities generally do not sustain productive
rumination or positively impact creative productivity (Csikszentmihalyi, 1996; Dijksterhuis &
Meurs, 2006; Sio & Ormerod, 2009). This type of rest does not appear particularly beneficial for
creativity, although it is probably not detrimental. Being too busy, however, inhibits a person’s
ability to ruminate by reducing the time they spend in periods of indecision and rumination – and generally leads to a decrease in overall creativity (Csikszentmihalyi, 1996; Elsbach & Hargadon, 2006)

Summary of Relationships Between Three Creative Modes

The modes of immersion, reflection, and rumination provide the core of a new physically–situated process model of creativity. This model reveals how creativity entails breakdown–and–repair processes between different modes of creativity. Breakdowns serve to shift the way creative practitioners think about a difficult problem, yielding better creative insight and improved creativity. It appears that creative practitioners develop expertise at moving between different modes of creativity, thus helping them to avoid the problem of creative fixation. The relationships between these three modes are illustrated in Figure V.2.

Figure V.2  Three Creative Modes: Immersion, Reflection, and Rumination.  
Schön failed to account for the breakdown of explicit reflection in his theory of reflective practice. I have extended his theory to describe another “repair” mode of creativity: Adaptive Rumination.
Three Creative Modes and Environmental Conditions

The discussion thus far about the immersive, reflective, and ruminative modes of creativity suggests that each involves a particular type of attentional process with respect to the creative situation, and each is engendered, sustained, and inhibited by different environmental conditions. Intuitive immersion is engendered and sustained by conditions that help the creative practitioner focus and maintain attention on the task at hand. Explicit reflection, on the other hand, is sustained and engendered by conditions that allow the creative practitioner to uncover hidden and potential affordances in a creative situation. This process requires a broader attentional net, as creative practitioners seek physical and social affordances in the environment to extend their cognitive abilities. Thus, although the two modes are closely intertwined, they require very different environmental conditions to support them. Rumination, a mode instrumental for dealing with the complexity of creative problems, is sustained by yet another set of environmental conditions.

With Table V.1 I have illustrated how the different modes of intuitive immersion, explicit reflection and semi-explicit (adaptive) rumination necessarily require different environmental conditions to support them. These environmental conditions provide physical, social, and cognitive affordances that people may actualize to engender and sustain the various creative modes. Creative practitioners, when engaged in a particular mode of creativity, may exploit these physical, social, and cognitive affordances available in the designed environment to extend their creative abilities. In this way the designed environment may be instrumental for extending a person’s creative abilities and improving creative productivity.
Table V. Three Creative Modes and Environmental Conditions.

Features of the designed environment provide physical, social, and cognitive affordances that help the creative practitioner engender, sustain, or inhibit different modes of creativity.

<table>
<thead>
<tr>
<th>Designed Environment (performance characteristics)</th>
<th>Affordances (physical)</th>
<th>Affordances (social)</th>
<th>Affordances (cognitive)</th>
<th>Creative Process (modes of creativity)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Predictable and comfortable settings and artifacts are used as a stimulus to begin creative work. Settings with a high degree of user control and provide tools and materials that are ready-at-hand, predictable, and customary are used to sustain attention on creative production. Settings and artifacts that provide opportunities for unpredictable situations and social interactions (such as interstitial spaces and “third places”) are used to perceive new affordances in a creative product or idea. Flexible and resource rich settings and artifacts are used to change the environment (or move environments) to gain new feedback about a creative product or idea. Settings and artifacts that provide for enjoyable, low cognitive-load, sensorimotor experiences can distract from fixation on an unproductive line of creative reasoning.</td>
<td>Overcoming physical distractions/barriers (transparent equipment)</td>
<td>Disengaging from direct social interactions</td>
<td>Focusing attention on the task at hand</td>
<td>Intuitive Immersion</td>
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<td>Sustains</td>
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<tr>
<td>Changing the way the situation is experienced through critique or feedback from use</td>
<td>Changing goals and intentions, or temporarily suspending rationality, to find congruence between outcomes and expectations</td>
<td>Engage in mental meandering about the creative idea</td>
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<tr>
<td>Work on mundane tasks or engage in semi-automatic activities unrelated to the creative idea</td>
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<tr>
<td>Encountering an unexpected outcome or situation related to the creative product or idea.</td>
<td>Engaging in an unanticipated critique or feedback from use</td>
<td>Intuing incongruence between expectations and perceived outcomes</td>
<td>Explict Reflection</td>
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<td>Engenders</td>
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<tr>
<td>Changing the conditions of the situation such as by using different tools, materials, vantage points, or moving to a new context.</td>
<td>Changing the way the situation is experienced through critique or feedback from use</td>
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<td>Engenders</td>
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<tr>
<td>Intuitive Immersion</td>
<td>Undivided and sustained attention to the task at hand</td>
<td>Evoke continuous reciprocal causation by acting in anticipation of satisfying clear intentions or goals, and obtaining immediate feedback from exploratory actions and strategies</td>
<td>Interpretation (or critique) of the situation produced by prior actions.</td>
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<tr>
<td>Engenders</td>
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<td>Terminates</td>
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<tr>
<td>Explicit Reflection</td>
<td>Strategies to bring outcomes and expectations into congruence, such as by surfacing assumptions underlying actions, and invoking methods to perceive additional affordances</td>
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<tr>
<td>Semi-Explicit Rumination</td>
<td>Broadened attentional net and abstraction of the situation allow for the development of novel combinations and environmental cues to benefit creative insight</td>
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</tbody>
</table>
Completing the Creative Practice Model

To complete the Multi-Modal Process Model of Creative Practice, I will briefly describe in the following sections how the first (problem-finding) and last (evaluation) modes of creativity relate to the immersive, reflective, and ruminative modes. The completed model is shown in Figure V.3 at the end of this section.

Problem-finding

People generally pursue creative problems that are presented or discovered (Csikszentmihalyi & Getzels, 1970). Presented problems are those that either exist within a creative practitioner’s discipline (such as how to cure cancer) or are adopted from another discipline. Sternberg’s (2006a) investment theory of creativity describes how creative people may be particularly accomplished at adopting more obscure or unpopular problems (i.e. “buying low”). Creative people also discover new problems to pursue, often as a result of surprising observations that ignite curiosity. Creativity historically has been associated more strongly with discovered problems (R. J. Sternberg, 1999), and exceptional creativity has often resulted from problems that were not clearly specified in advance (Sawyer, 2012).

Shekerjian’s (1990) investigation into what inspired the creativity of MacArthur Award winners reveals that creative people often have a particular set of values or concerns that frame the types of problems they pursue over a lifetime. In other words, their ability to perceive problem-finding affordances in their environments are influenced not only by their domain knowledge, but also by personal values and intentions that developed from prior experiences. A particularly striking example of this is the story of Andy McGuire, a MacArthur Fellow, trauma prevention specialist, and advocate for healthcare issues. McGuire was severely burned as a child when his pajamas caught fire from his family’s kitchen stove (Shekerjian, 1990, pp. 12–13). As an adult he was working as a machinist when he learned, through an announcement in his local newspaper, about a group that was being formed to lobby for new legislation to require all sleepwear be flame resistant. He attributes that newspaper article as the start of his career in
advocacy and filmmaking (Shekerjian, 1990, p. 13). Stories like McGuire’s illustrate how environmental conditions may provide the catalyst for the problem–finding mode of creativity.54

**Engendering problem–finding.**

Problem–finding is triggered by an environmental catalyst — a situation that impels the creative person to act on prior goals, concerns, or intentions. This catalyst might be the result of a conversation with another person or an observation of a process or event. Sometimes the catalyst occurs during another mode of creativity, where an unexpected outcome engenders problem finding. Isaac Asimov is commonly credited for saying “the most exciting phrase to hear in science, the one that heralds new discoveries, is not, “Eureka!” (“I found it!”) but rather, “Hmm... that’s funny...” Creative practitioners have the domain knowledge and expertise necessary to perceive a creative problem–finding opportunity that others may miss (Csikszentmihalyi, 1996; Hayes, 1989; Jay & Perkins, 1997).

**Sustaining problem–finding.**

The problem–finding mode involves a variety of processes including: observation; analysis; knowledge acquisition; problem identification, construction, definition, and framing; and identifying goals, objectives and intentions (Bransford & Stein, 1984; Gordon, 1961; Isaksen et al., 2000; M. D. Mumford et al., 1991; Osborn, 1953; Van Gundy, 1987; Wallas, 1926). The mode is sustained by conditions that allow the creative practitioner the freedom, support, and resources to seek out new experiences that might develop into a creative problem to pursue. Amabile (1996, 1998) has spent much of her career examining how the social workplace environment can support or inhibit creativity. Several of the workplace conditions she identifies also help to sustain the problem–finding mode. The first condition is freedom, which concerns giving creative practitioners autonomy over their creative processes. The second condition is

54 There are many similar anecdotes by creative people. Richard Feynman’s story of how winning the Nobel Prize began with the environmental catalyst provided by a wobbling plate is described in Chapter VI.
social support and encouragement, which can give the creative practitioner the motivation to sustain the problem-finding process. The third condition is resources. Amabile suggests that sufficient (but not limitless) time and money are important for supporting creativity. More than sufficient resources, however, do not improve creativity, but insufficient resources will inhibit it (Amabile, 1998).

**Curtailing and inhibiting problem-finding.**

Problem-finding ends when the creative practitioner has defined or framed the problem and established goals and intentions towards solving it. The mode is inhibited by conditions that put pressures on creative practitioners that may cause loss of motivation or impel them to spend their time and effort in other areas. Problem-finding can also be inhibited by lack of access to knowledge or experiences that allow the creative practitioner the opportunity to identify a creative problem to pursue.

**Evaluation**

As discussed in Chapter IV, the creativity literature about the elaboration stage describes processes that occur throughout the creative process. For the purpose of this new physically situated Creative Practice model, I define the evaluation mode to include the processes of implementation, feedback from users and critics, and intrapersonal and interpersonal evaluation of this feedback. Creative products and ideas are often developed with a particular implementation setting or context in mind. For example, David Byrne (2012) illustrates how music has evolved over time according to the type of venue for which it was intended. He describes how African percussion music fits the acoustics of the outdoor setting where it is performed. The reverberations created by the cave-like spaces of the gothic cathedral are the perfect accompaniment to Bach’s compositions for the pipe organ. Symphonies work well in places like Carnegie Hall, but rock-and-roll music, composed for the vinyl album or compact disk, often does not translate effectively to such grand settings. Creative ideas and products are not
“creative” until they are implemented in their intended context and receive social consensus that they are both original and appropriate (Amabile & Pillemer, 2012).

**Engendering evaluation.**

Evaluation is engendered when the creative practitioner implements the creative idea or product in its intended setting or context and is able to obtain feedback from implementation. The process of evaluation involves not only the creator, but also users and other stakeholders from within and outside the creative practitioner’s field. For example, the evaluation mode for a playwright may be engendered on opening night when the audience views the performance and professional critics arrive to make their assessments of the production. The playwright may observe and evaluate the performance, the audience members’ reactions to it, and perhaps even ask patrons and colleagues for their opinions about the production. Later this feedback may be synthesized and compiled with the published feedback from professional critics.

**Sustaining evaluation.**

Evaluation is sustained by continuous feedback from users and critics about the creative product or idea. The creative practitioner may work to sustain evaluation by publicizing or “selling” the creative idea (R. J. Sternberg, 2006a, 2006b). Sternberg (2006a) emphasizes the fact that creative ideas do not sell themselves. He argues that creative practitioners must have the skills to persuade others that their ideas or products are valuable. He also suggests that creative practitioners should tailor their efforts by selling their idea to particular audiences. Studies suggest that evaluators of similar age and background to the creator tend to evaluate a product or idea more favorably (Lubart & Sternberg, 1995; R. J. Sternberg, 2006a). Thus marketing a creative product or idea to cohorts may help to sustain beneficial evaluations.

**Curtailing and inhibiting evaluation.**

Evaluation ends when consensual assessment by the field has been reached and the idea or product has been deemed creative or not. The problem with consensual agreement, however,
is that it may not be reached until after the creator’s lifetime. Evaluation may also end when the creative practitioner is surprised by feedback from implementation. This surprise may engender another mode of creativity, such as rumination or problem-finding. Surprise may be negative, in which case the creative practitioner may try to re-work or revise the creative idea or product (if possible.) Positive surprise might engender a new creative problem to pursue, which is framed by the successful experiences of the previous creative process.

Evaluation is inhibited by a lack of feedback on a creative product or idea, or the inability to successfully implement it in its intended setting or context. For example, if a composer writes a symphony for Carnegie Hall, but is only able to perform it in an outdoor amphitheater, the feedback from implementation may not be sufficient to sustain evaluation because the acoustic qualities of the intended setting versus the implementation setting are quite different. Suppose that the performance in the outdoor amphitheater is also poorly publicized. Then the creative practitioner also has a lack of feedback from users (the audience) and critics. In this case, implementation limitations inhibit the creative practitioner’s ability to evaluate the creative product; and it may be nearly impossible to obtain social consensus regarding the creativity of the idea or product due to poor dissemination of the product.
Figure V.3 The Multi–Modal Process Model of Creative Practice
The five modes of creativity are shown as an iterative series of breakdown and repair processes. Unexpected outcomes during Evaluation, the last mode of creativity, can trigger a breakdown that engenders the Problem–finding mode. Evaluation can also lead to insight on another creative problem, as is illustrated by Richard Feynman’s story in Chapter VI.

Propositions About the Person–Environment Relationship During Creativity
Throughout this chapter I have described different modes of creativity and illustrated how they are interrelated through the Multi–Modal Process Model of Creative Practice. I also explained how these modes describe processes of embodied, embedded, and enactive cognition. The view of creativity that I propose here is one that is physically situated, where features of the designed environment are instrumental to the different modes of creative cognition. I suggest that my Creative Practice model reveals three propositions about the person–environment
relationship during creativity. First, creative practitioners are autonomous agents in their environments who exploit, leverage, manipulate and alter features of the designed environment to enhance their creative ability and productivity. Second, environmental features serve different roles in engendering, sustaining, and inhibiting/curtailing the five modes of creativity. Third, changes in environmental features and changes in a person’s mode of creative cognition both alter the affordances of the person-environment relationship, thus affecting a person’s opportunities for action in the creative situation. These three propositions will be the focus of the next chapter, where I present the new Creativity–in–Context Theoretical Framework to describe the person–environment relationship during creativity.
CHAPTER VI

THE CREATIVITY–IN–CONTEXT THEORETICAL FRAMEWORK

DESCRIBING THE PERSON–ENVIRONMENT RELATIONSHIP DURING CREATIVITY

Highlights

This chapter is a discussion of how the Multi-Modal Process Model of Creative Practice proposed in Chapter V can be used to illustrate the relationship between the creative practitioner and the designed environment during creativity. I will introduce in this chapter a theoretical framework, based on the process model, that describes the physically situated nature of creativity. This Creativity–in–Context Theoretical Framework links the cognitive modes described in the Creative Practice model to categories of environmental features that play a role in engendering, sustaining, or inhibiting them. The framework illustrates how: 1) the creative person acts on and exploits features of the designed environment in pursuit of creative productivity; 2) environmental features serve different roles in sustaining, engendering, or inhibiting the five cognitive modes of creativity, and 3) changes in environmental features or cognitive modes affect a person’s perceived opportunities for action by changing the affordances of a creative situation. The intention behind the framework is to provide both a lens for scholarly discourse around the concept of creativity as a physically situated process and a structure to empirically ground environmental design strategies.
Introduction

Review

In Chapter V I proposed that a Multi-Modal Process Model of Creative Practice describes how features of the designed environment are instrumental to the creative process. The Creative Practice model extends Schön’s (1983) work on reflective practice and Csikszentmihalyi’s (1990) theory of creative flow to include five situated modes of creative cognition: problem–finding, intuitive immersion, explicit reflection, adaptive rumination, and evaluation. It also illustrates how the creative practitioner uses the physical environment as a resource to engender, sustain, inhibit or curtail these different creative modes. At the end of the chapter I explained how this model serves to organize the seemingly varied and idiosyncratic behaviors in which people may engage during the creative process. In Chapter VI I will position the Creative Practice model within a theoretical framework\textsuperscript{55} to describe the role of the designed environment in creativity. Where the previous chapter considered the creative process primarily through a cognitive lens, this chapter will focus on the environmental design perspective.

Thesis

The Creativity–in–Context Theoretical Framework provides a structure for understanding key factors and relationships that are relevant for environmental designers as they endeavor to plan and construct settings to support creative practitioners. The framework is informed by three theoretical propositions that emerged from the Creative Practice model. These propositions describe how people orchestrate their own creative process by exploiting features of the designed environment to help them transition between creative modes of thinking and surface new opportunities for action in a creative situation. The framework illustrates these propositions in terms of three variables: 1) the modes of creativity in which a person engages, 2) the features

\textsuperscript{55} The terms theoretical framework and analytical framework are often used interchangeably in the literature. They both illustrate causal relationships. The analytic framework is sometimes distinguished by its specificity to a particular study.
of the person’s environment, and 3) the affordances (or opportunities for action) that develop through the instrumental relationship between the person and features of the environment. This framework organizes issues of concern to environmental designers — such as what people do during the creative process and how the designed environment supports those activities — into a structure that may help them design and evaluate environments intended to support creative productivity.

**Significance**

The purpose of a theoretical framework is to link together concepts, processes, and classifications in order to understand “a sequence of events or constructs and how they relate” (Suter, 2006, p. 344). The Creativity–in–Context Theoretical Framework is intended to serve as a structure both for scholarly discussion around the concept of creativity as a physically situated process and to inform environmental design practices. It provides a resource to support basic creativity research in real world settings and authentic situations by linking the modes of creative cognition to features of the designed environment. It also describes the nature of the person–environment relationship during creativity, thus addressing a significant debate in the environmental design literature. As discussed in Chapter III, different opinions about the nature of the person–environment relationship have informed a range of environmental design approaches. This theoretical framework illustrates that two of these approaches (deterministic and free–will) are not empirically supported. By addressing this debate, the framework offers a structure to empirically ground environmental design strategies. It also provides a means to organize future, multi–disciplinary research around the relationship between people and their environments during creativity.

**The Designed Environment in Creativity: Three Theoretical Propositions**

From the Creative Practice model I constructed three theoretical propositions about the relationship between the creative person and his or her environment during creativity. In this
section I will briefly describe each proposition and its implications for the design of settings to promote creativity. This will set the context for the next section, where I will introduce the Creativity–in–Context framework. Implications for practice will be discussed in greater depth in the following chapter.

**Proposition 1.**

*Creative people are active agents in their environments who exploit, leverage, manipulate and alter features of the designed environment to enhance their creative ability and productivity.*

This first proposition describes the creative person as an experienced practitioner who strategically utilizes tools, materials, and settings to support and extend creative performance. As discussed in Chapter V, creative people are adept at using their environment as a resource to improve their creative abilities and manage their creative processes. They amplify psychomotor skills by employing artifacts as tools. They extend cognitive abilities when using aspects of their environment as things to think with. They manipulate settings (or move between settings) to engender, sustain, or inhibit different creative modes in an effort to maximize productivity. Environments that allow them to maximize their potential to exploit design features in pursuit of a creative problem or concern thus support creative practitioners.

**Proposition 2.**

*Environmental features serve different roles in engendering, sustaining, and inhibiting/curtailing five modes of creativity: problem–finding, immersion, reflection, rumination, and evaluation.*

The second proposition describes the roles that certain features of the designed environment play in the creative process. In the previous chapter I illustrated how *places* may
function as behavior settings when people use them to engender modes of creativity, *events* serve to trigger or curtail modes of creativity, and *processes* sustain or inhibit them. People use *objects* to organize, amplify, and extend their creative abilities. The *attributes* of an object and its *relationship* to the creative person are often instrumental to the person’s ability to perceive creative opportunities in a situation. These environmental features suggest that a part-whole structure may be useful for guiding environmental design strategies.

**A taxonomy of part-whole relationships of environmental features.**

The second proposition implies that a classification structure is needed to represent environmental features present at each scale of the designed environment — from tools to cities. In the following section I will illustrate how categorizing these environmental design features as places, events, processes, objects, attributes, and relationships will lead to greater understanding about the roles they play in creativity by providing the structure for systematic methods of empirical investigation. Places involve events and processes; events and processes involve objects and people; and attributes and relationships describe places, events, processes, and objects. This part-whole classification\(^{56}\) describes these features in terms of nested units of analysis, from the smallest (attributes) to the largest (places). The taxonomy facilitates a multiscalar examination of person-environment relationships during creativity, effectively linking Gibson’s affordance theory to Barker’s theory of behavior settings with the intention of using each theory to strengthen the other.\(^{57}\)

**Multiscalar design strategies.**

The part-whole classification of environmental features facilitates a multiscalar approach to design. Identification of common relationships and principles may occur equally across all scales of the designed environment (i.e. from tools to cities,) or predominantly at particular

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\(^{56}\) The classification structure is described in greater detail with respect to the theoretical model later in this chapter.

\(^{57}\) See Chapter III for a discussion of Heft’s (2001) recommendation that integrating these two theories will advance environmental psychology research and theory.
scales (e.g. product design.) This suggests that environmental designers may need to think beyond disciplinary bounds to determine 1) what aspect(s) of the creative process they wish to address with a design intervention, 2) what environmental features will best predict the intended outcome of the design intervention, and 3) what is the most effective scale of the designed environment for the intervention.

**Proposition 3.**

*Changes in environmental features and changes in a person’s mode of creative cognition both alter the affordances of the person-environment relationship, thus affecting a person’s opportunities for action in the creative situation.*

The relationship between a creative person and his or her environment changes in two fundamental ways: by changing features of the person’s environment (through reorientation, relocation or manipulation) or by changes in the person’s mode of creative cognition. In the first case, because people partially constitute their own environment, the actions they take during creativity simultaneously change their environment. This occurs when 1) people move from one environment to another, 2) they alter the physical objects (or the relationship between physical objects) in an environment such as by adding, removing, relocating, or reorienting furniture to reconfigure a room’s layout, and 3) they engage in particular actions (i.e. events and processes) within an environment.

In the second case, when people alter their mode of thinking about a creative problem, their goals and intentions with respect to the creative situation also change. Their intentions include both explicit goals and intrinsic values about the creative problem within a particular context. For example, creative intentions during a reflective mode will include some form of judgment or evaluation of an externalized creative idea (e.g. paper, diagram, model, etc.) and may welcome the involvement of others to elicit critique or other forms of feedback about the creative idea. During a ruminative mode, intentions are quite different because they will generally...
involve distracting oneself from a creative problem (e.g. by going for a bicycle ride). In this mode the creative person may value the freedom to not interact with others or to intensely focus on the creative problem. When a person’s intentions vary with the mode of creative cognition, the affordances of the situation also change. Thus the opportunities for action provided by a single environment (such as an office or studio) may be quite different during reflection and rumination.

**A Physically Situated Framework for Creativity**

The Creativity–in–Context Theoretical Framework (Figure VI.1) graphically depicts creativity as the physically situated process described in the theoretical propositions. The framework draws heavily from Gibson’s (1977) Theory of Affordances (introduced in Chapter II,) to illustrate the relationships between the creative person, the designed environment, and the affordances (action possibilities) of the creative situation.

![Diagram](image)

**Figure VI.1 The Creativity–in–Context Theoretical Framework.**

This framework illustrates how the creative person acts on his or her environment during creativity and is, in turn, affected by the changed nature of the affordances formed as a result of those actions. These three things — the creative person, the designed environment, and the
affordances of the creative situation — are each characterized by a variable\textsuperscript{58}: creative mode, environmental feature, and type of affordance. The transactional person-environment relationship describes how each of these variables is at times either independent (i.e. causes a change in another variable) or dependent (i.e. is affected by a change in another variable.) Relationships between independent and dependent variables are described by the direction of the arrows in the framework diagram, with independent variables pointing to (i.e. acting on) dependent variables. Three primary relationships, listed in no particular order, are:

1) The creative person, while engaged in a creative mode (independent variable,) perceives and acts on the designed environment (dependent variable.) The person’s actions depend on (and are mediated by) the creative mode.

2) The person engaged in a creative mode (independent variable) and features of the designed environment (independent variable) together constitute the affordances (dependent variable) of the creative situation. A change in the designed environment (such as initiated by a person acting on features of the environment) will change the nature of the sensory effects from the designed environment that can be perceived by the person. A change in the person’s creative mode will cause the person to have different intentions or abilities towards the creative situation. These intentions include goals aimed at developing a creative idea as well as environmental requirements instrumental to the task at hand. Changes in creative mode and changes in environmental conditions will both affect the affordances of that situation.

3) The affordances (independent variable) of the situation are intention-directed action possibilities latent in the situation that, when enacted (i.e. perceived and actualized,) 

\textsuperscript{58}A variable is a quality of something that changes over time or in different situations.
affect the person’s creative mode (dependent variable) by engendering, sustaining, or inhibiting it.

Each variable (creative mode, environmental feature, and affordance) has several different values that change throughout the creative process. There are five creative modes, six categories of environmental features, and five different types of affordance. The identification of these three variables and sixteen values may help to explain why it has been so challenging to understand the role of the designed environment in creativity – or to predict whether a particular environment may promote creativity. There are so many factors affecting the person-environment relationship that without a framework to identify and organize the significant factors, it is nearly impossible to explain — not to mention attempt to predict — causal relationships. It is how these values are defined, however, that makes this theoretical framework particularly useful for informing research and practice into the role of the designed environment in creativity.

**The Creative Person**

The creative person is graphically depicted in this framework by two concentric circles: an inner circle comprised of the person’s cognitive abilities, affective states and physical skills, and an outer circle representing the person’s mode of creativity. These concentric circles illustrate how the creative mode mediates a person’s interactions with the environment. Each creative mode is formed according to the cognitive, affective, and physical aspects of the person. These aspects change over the course of the creative process: knowledge is constructed; skills are practiced or learned; and emotions (e.g. frustration, elation, etc.) vary throughout the creative process. These cognitive, affective, and physical changes may be very difficult to quantify. However, since these changes are caused by activities that occur during the different modes of creativity, they correspond with changes in creative modes. For this reason, change in creative mode will serve as a proxy for other changes in the creative person.
The variable for the creative person in this framework is therefore defined as creative mode type. The intention here is not to disembodied cognition, but instead to illustrate how embodied cognition is influenced by the mode of thinking about a creative problem. As described in Chapter V, the intentions, perceptions, and actions of creative people change according to whether they are problem finding, immersed, reflecting, ruminating, or evaluating. In the Creativity–in–Context framework, the arrows pointing away from the creative person describe how the creative modes mediate both actions on the environment and intentions toward the creative situation. The arrow pointing toward the creative person describes how the creative mode mediates the way affordances are perceived. By isolating the creative mode as a variable of interest that has five values (one for each mode,) we can better understand how (and why) the creative person notices and exploits features of the designed environment to engender, sustain, or inhibit the different modes.

The Designed Environment

The designed environment refers to the range of artifacts and settings created by product designers, interior designers, architects, landscape architects, urban designers, and city planners – from tools to cities. In this way, the model encompasses natural settings (such as those produced by landscape architects) as well as manufactured settings. Settings that exist without design interventions – such as forests, prairies, shorelines, etc. – may also be appropriate for the framework, but are outside the focus of this dissertation. (Although views of natural settings are within the scope, since these may be created through environmental design features.) The framework categorizes features of the environment as places, events, processes, place-scale objects, attributes, and relationships. The environment is described in terms of its features, defined as follows:

**Place:** a geographic position, or setting, defined by real or implied physical, social, and cognitive boundaries. A geographic position becomes a place when a person gives
meaning to it – typically based on the events and processes that occur there (such as office, studio, café, etc.) Places can also have emotional or historical significance (e.g. the studio where Andrew Wyeth painted or the city where Leonardo da Vinci lived). Places may serve as behavior settings to engender certain activities and/or creative modes, as evident in stories of the way Proust felt about his cork-lined room and Kant felt about his tower view.⁵⁹

**Event:** a spatial-temporal occurrence that invokes a change of state in a place. Events involve processes, place-scale objects and/or people and may be nearly instantaneous (such as shutting a door) or temporally extended (such as a brainstorming session.) During creativity, events may engender or curtail different modes. For example, the event of putting my favorite pen to paper may engender immersion, whereas the event of someone unexpectedly entering my office will almost certainly curtail immersion.

**Process:** a series of actions, operations, or changes that involve place-scale objects and/or people. Processes may sustain or inhibit modes of creativity. For example, the process of model-making sustains immersion, but the process of examining the model under different lighting conditions inhibits immersion (but sustains reflection.)

**Place–scale (p.s.) Object:** a thing bound by the scale of the place where it is located that can be perceived by the senses. Place-scale objects may be animate (to include all living things such as plants or animals), inanimate (to include both man-made and natural physical objects), or cognitive artifacts (such as musical notations). Places, processes, and events all involve p.s. objects. A tool is one type of p.s. object that may extend a person’s creative abilities by functioning as transparent equipment during the creative process. A familiar and comfortable p.s. object can also engender or sustain

⁵⁹ See Chapters I and V for discussion of these two anecdotes.
modes of creativity such as immersion and rumination. Samuel Johnson is said to have kept an orange peel and a purring cat nearby as he wrote (Boswell, 1907). The cat and the orange peel are both p.s. objects that may have helped Johnson to sustain creative immersion during his writing. Materials are p.s. objects that may extend creative cognition by becoming things to think with. These objects alone typically do not engender, sustain, or inhibit modes of creativity, but are instead an integral part of an event or process. For example, drawing (process) with my favorite pen (p.s. object) engenders immersion. Even in the case of Kant’s tower view, the p.s. object (tower) is significant for engendering immersion, but does not trigger the mode until Kant looks at it (event.)

**Attribute:** a part or aspect of a place, event, process, or p.s. object. For example, the color and texture of obsidian ink are attributes that Kipling felt were significance for reflection on his writing. Attributes may be an integral aspect of something (such as edge, or texture) or a “part-of” something that is removable — such as knob which is part-of a door (p.s. object) or desk which is part-of an office (place.)

**Relationship:** the way two features of the physical environment are connected such as event-event relationships that are causal, correlational or dependent, or object-object relationships that are binary (e.g. bigger than, heavier than, etc.) “Part-of” is a type of relationship that may also be an attribute. In this framework an affordance is also a particular type of relationship between a creative person and an environmental feature that has instrumental value for the person.

**Affordance**

An affordance, as defined in Chapter II, is an instrumental relationship between people and features of their environment that provides action opportunities for people with respect to
their intentions (Gibson, 1977). Affordances may be hidden, perceived, actualized, false or potential.\textsuperscript{60} They may affect both a person’s perceptions about a creative problem and actions taken in pursuit of that problem. The Creativity–in–Context framework illustrates how affordances change with different modes of creative cognition and different features of the environment. For example, a feature may be perceived as desirable and that affordance actualized by a person in one mode of creativity, whereas the same feature may remain hidden (or perceived but not actualized) during a different mode. A key principle of this framework is that people change modes of creativity and features of the environment in an effort to uncover hidden affordances and perceive potential affordances that may lead to non-obvious, or creative, solutions to a problem. They do this both by using affordances to maximize creative productivity (to engender, sustain and inhibit creative modes) and by making changes to their environments that help them perceive and actualize new opportunities to further their work on a creative problem.

As previously introduced in Chapters II and further discussed in Chapter V, there are two general ways that people experience the affordances of the designed environment: as transparent equipment (when employed tacitly) or cognitive artifact (when employed explicitly.) As cognitive artifacts, people use objects in the designed environment as things to think with in order to extend their creative abilities. In this case, it is what they explicitly attend to that is important for their creativity and the affordances of these things become explicit. As transparent equipment, however, effective tools and settings by their very nature do not draw the creative person’s attentions away from the task at hand. This does not mean that people do not perceive the affordances of these things, only that they may not be able to make their perceptions explicit. People may recognize that an environment affords fostering certain modes of creativity (e.g. good at supporting immersion), but may not be able to correctly identify the design features that make it effective. They may fixate on one or two features (e.g. Kant and his tower view or

\textsuperscript{60} Refer to Chapters II and V for more detailed discussions of the types of affordance and a proposal for a new class of potential affordances based on the roles they play in creativity.
Kipling and obsidian ink) that have become explicit or have drawn their attention at one time — and these fixations can appear idiosyncratic. This suggests that some of what people do not attend to during the creative process may be as important (or potentially more important) than what they do attend to.

### Putting the Creative Modes in Context

In this section I will use the Creativity—in—Context framework to illustrate Richard Feynman’s famous anecdote about the event that eventually led him to win the Nobel Prize in Physics. This case will demonstrate how the framework may help to surface features of the designed environment that are instrumental to the creative process. The anecdote is also used as a point of discussion about how these environmental features engender, sustain, or inhibit particular modes of creativity. This will serve as a preliminary discussion about implications the framework has for environmental design strategies and methods.

#### Problem-Finding and Feynman’s Wobbling Plate

In his autobiographical book, physicist Richard Feynman (1997, pp. 171–174) recounts the day he was eating in a cafeteria on the Cornell University campus when someone threw a plate in the air. Feynman noticed the complex spin and wobble motion of the plate and decided to come up with an equation for it. He credits this incident as the beginning of a process that led to his calculation of electron orbits, and eventually the Noble Prize. I will draw parallels from sections of his story and relationships illustrated in the Creativity—in—Context framework.

**A breakdown in reflection.**

The Feynman anecdote is primarily an example of an event that triggers a creative mode. He sets up the story by describing his mindset prior to the event. He begins by explaining how he was in a state of breakdown. Reflection had failed to help him make progress on his research in physics. He was convinced that he was burned out and would never come up with any more creative ideas.
But when it came time to do some research, I couldn’t get to work...I simply couldn’t get started on any problem: I remember writing one or two sentences about some problem in gamma rays and then I couldn’t go any further. I was convinced that from the war and everything else (the death of my wife) I had simply burned myself out (p. 171).

Suspension of the problem leads to new intentions.

Feynman eventually decides to stop responding to the pressure to come up with new ideas in physics, which he felt was “impossible to live up to” (p. 172.) About this time, the head of the laboratory at Cornell, Bob Wilson, reassured him that the university was very happy with his teaching and told him not to worry about his research. Feynman described how this conversation “released [him] from the feeling of guilt” (p. 173.) This conversation helped him emerge from his state of breakdown when he suspends work on his research. Instead of reflecting on his research he begins to actively (i.e. explicitly) ruminate about his relationship with physics.

Then I had another thought: Physics disgusts me a little bit now, but I used to enjoy doing physics. Why did I enjoy it? I used to play with it...So I got this new attitude. ...I've got this nice position at the university teaching classes which I rather enjoy...[and] I'm going to play with physics whenever I want to, without worrying about any importance whatsoever (p. 172).

An event engenders problem-finding.

Once he had established his intention to “play with physics,” (which, as an accomplished scientist and academician, he had the opportunity to do) Feynman describes the event itself.

Within a week I was in the cafeteria and some guy, fooling around, throws a plate in the air. As the plate went up in the air I saw it wobble, and I noticed the red medallion of Cornell on the plate going around. It was pretty obvious to me that the medallion went around faster than the wobbling (p. 173).

It is important to note that Feynman changed his environment during what appears to be a period of passive (i.e. tacit) rumination. He did not enter the cafeteria with the goal of finding a physics problem there to pursue. Rather, he appeared to be ruminating about his idea to play
with physics. With the idea in the back of his mind when he entered the cafeteria, he became an observer of the seemingly irrelevant happenings in the cafeteria. It was because he was in the ruminative mode that he was able to perceive the affordance of the wobbling plate situation. The event of the flying object (plate) drew his attention and he perceived its attributes of spin and wobble because of the visual cues from the movement of the Cornell medallion. These visual sensory effects, combined with Feynman’s intentions and abilities allowed him to perceive the affordances (i.e. opportunities for action) the event provided for his intention to “play with physics.”

Once he perceived that the flying plate provided an opportunity to play with physics, his rumination mode was curtailed and he began problem–finding as he identified the motion of the rotating plate as a new physics problem to pursue. He eventually created a new equation to explain the motion.

*I had nothing to do, so I start figuring out the motion of the rotating plate. I discovered that when the angle is very slight, the medallion rotates twice as fast as the wobble rate—two to one.*[^61] *It came out of a complicated equation! (p. 174).*

The event of the flying plate engendered Feynman’s problem–finding mode and the discovery of his creative problem: how to devise a formula to predict the ratio of wobble to spin. His initial interest in the wobbling plate was based on his belief that it was not important to furthering his research or the field of physics. He pursued the problem of the wobbling plate because it was fun (and perhaps because it kept him from fixating on serving the progress of physics — although he does not state this directly.) Feynman’s anecdote is illustrated by the Creativity–in–Context Framework as follows:

[^61]: Feynman famously reversed the spin and wobble ratio in this account. It is two wobbles to one rotation of the plate.
Figure VI.2 Illustration of Richard Feynman’s Problem–finding Process.
Richard Feynman describes how, during a period of rumination about his “serious” research, the event of a plate flying through the air engendered a problem–finding opportunity to “play” with physics, which eventually led to a breakthrough in his “serious” research.

Rumination leads to a breakthrough.

Feynman described how the discovery of the wobbling plate problem got him out of breakdown mode and ultimately furthered his physics research, leading to his award of the Nobel Prize. Rumination — the suspension of his serious physics research to work on a seemingly unrelated task to play with physics — led to a breakthrough in his research.

... I went on to work out equations for wobbles. Then I thought about how the electron orbits start to move in relativity. Then there's the Dirac equation in electrodynamics. And then quantum electrodynamics. And before I knew it (it was a very short time) I was “playing” — working, really — with the same old problem that I loved so much... It was like uncorking a bottle: Everything flowed out effortlessly... There was no importance to what I was doing, but ultimately there was. The diagrams and the whole business that I got the Nobel Prize for came from piddling around with the wobbling plate (p. 174).

Although he had not been explicitly thinking about his physics research, he perceived an opportunity to work on a seemingly unrelated problem that led to a breakthrough in his (serious) research. Stories like this one may appear serendipitous, but the phenomenon is actually relatively common. Creative people often relate how they thought they were working on different problems only to discover later that they were related. Gruber coined the term network of enterprises to describe this phenomenon. He describes how creative people excel at concurrently working on seemingly disparate problems, yet exploit relations between them to further their...
creative work (Kozbelt et al., 2010). The process of passive rumination allows the creative practitioner to explicitly suspend work on a difficult problem when productivity wanes, while intuitively continuing to make progress on it through work on other problems or tasks.

**Environmental Features That Supported Feynman’s Problem–Finding**

In Feynman’s anecdote there were several different environmental features that ultimately worked together to engender problem–finding. Of most obvious significance is the event that occurred when a person threw a plate in the air. The event involved place-scale objects: the plate and the person that threw it (“a guy.”) The attributes of the plate are critically important to this anecdote. If a guy had thrown a pure white plate in the air, the event would likely not have engendered problem finding. That particular plate had on it the Cornell medallion, which allowed Feynman to see the ratio of wobble to spin. Additionally, Feynman’s relationship to the object was such that he could easily observe its motion. Thus event, object, attribute, and relationship were all features of the designed environment that played a role in this story.

Another aspect of the story is the place where this event occurred. Feynman was in the cafeteria – a setting often densely populated and generally considered by design professionals as a place of high activity and social engagement. This seems to have provided a stimulating environment in which Feynman could observe “real world” phenomenon from an outsider perspective. This particular cafeteria was located on a university campus. Feynman alluded to the culture of the university in his introduction to the story — he had a lot of freedom to pursue his interests, including great flexibility in where, when, and how he conducted his creative work.

Leading up to the anecdote, Feynman talked about the social pressures he was experiencing over having to come up with good ideas to pursue. He expressed how he loved the combination of teaching and research because if he was low on good research ideas, he still had work teaching — and new ideas sometimes came from revisiting topics that he knew well from preparing his lectures. Shortly before he experienced the cafeteria event, Feynman decided that he was “burnt-out” on his physics research. The conversation with Bob Wilson, the head of the
Cornell lab who reassured Feynman that he was happy with his teaching, released him from the pressures of pursuing his research.

Feynman's story encapsulates many of the socio-physical factors that comprise a creative problem–finding environment. He worked in a place (the university) that provided him an appropriate setting to conduct his work (his laboratory) and also provided a rich, flexible and varied environment which he experienced while he taught classes and moved about the campus for other purposes, such as eating lunch in the cafeteria. The socio-cultural environment fostered by Bob Wilson helped Feynman to alleviate some of his self-induced pressure to perform. This, in turn, gave Feynman a new mindset about how to approach his research — to consider it play. All of these aspects of place — physical, socio-cultural, and cognitive — combined to form the problem–finding environment, or context, for Feynman’s anecdote. This new problem–finding environment also seems to have grown in size due to the alleviation of social and cognitive constraints. As he broadened his idea about how to approach his creative work (as play) he consequently increased the size of his attentional net. Any setting could now become a resource for physics problems to pursue. This enabled him to exploit the university cafeteria as a problem–finding environment.

Anecdotes like Feynman’s may capture our imagination because, at first glance, they seem like the happy accident of good fortune. But, as Louis Pasteur famously quoted “Dans les champs de l’observation le hasard ne favorise que les esprits préparés.” (Where observation is concerned, chance favors only the prepared mind.) Feynman was looking at his environment with new eyes. He was open to opportunities that might allow him to play with physics. Creative people may talk about being lucky, but few leave serendipity to chance. They become experts at perceiving the opportunities afforded by their resource–rich environments.

**Conclusion: Implications for Practice**

The Creativity–in–Context framework clearly illustrates how features of the physical environment were in fact instrumental to Feynman’s creative process. Rumination was supported
by the socio-cultural freedom to play with physics and the physical freedom to walk about on the university campus. Problem–finding was supported by the opportunities he had to observe everyday physics phenomena in the dense and diverse spaces afforded by the university setting. His perception of the event of the plate flying through the air and the attributes of the spinning plate engendered the discovery of a new problem to pursue. This suggests that although the role of the designed environment in creativity is a difficult issue to examine, the Creativity–in–Context Theoretical Framework does provide a structure that organizes empirical investigation. I propose this framework as an alternative to Csikszentmihalyi's (1996, p. 135) claim that empirical investigation into the role of the physical environment in creativity is likely impossible.
CHAPTER VII
RICH ENVIRONMENTS: IMPLICATIONS FOR PRACTICE
EMPOWERING THE CREATIVE PRACTITIONER
THROUGH ENVIRONMENTAL DESIGN METHODS AND PRINCIPLES

Highlights

This chapter is a discussion of the practical implications of the Multi–Modal Process Model of Creative Practice and the Creativity–in–Context Theoretical Framework. I introduce the Rich Environments Design Principles and Methods as a foundational set of guidelines, based on the Creative Practice model and Creativity–in–Context framework, to assist environmental designers and users as they plan and evaluate settings to support creativity. The Rich Environments Design Principles provide a type of critiquing system to help environmental designers use the best available empirical evidence to inform their designs. The Rich Environments Design Methods suggest planning and post–occupancy evaluation strategies that support an evidence–based approach to environmental design. Together the Multi–Modal Process Model of Creative Practice, the Creativity–in–Context Theoretical Framework, and the Rich Environments Design Principles and Methods provide a preliminary structure to guide the development of future empirical and design–based research and theory around the role of the designed environment in creativity.

Introduction

Review

In Chapters V and VI I presented the Multi–Modal Process Model of Creative Practice and the Creativity–in–Context Theoretical Framework to describe the person–environment relationship during creativity. The purpose of the Creative Practice Model was to demonstrate
how creativity is a physically situated process and features of the designed environment are instrumental to the different modes of creativity. I proposed the Creativity–in–Context framework as a structure to organize empirical investigation around the role of the designed environment in creative processes. The framework is also a response to Csikszentmihalyi’s (1996, p. 135) claim that such empirical investigation is likely impossible. I explained how the theoretical framework illustrates three different propositions about the designed environment. First, creative practitioners exploit, leverage, manipulate and alter features of the designed environment to improve creative ability and productivity. Second, they use environmental features to help engender, sustain, inhibit and curtail different modes of creativity. Third, the affordances of creative situation are affected by changes in a person’s mode of creative cognition and changes in the designed environmental. The Creativity–in–Context framework also organizes features of the designed environment in a multiscalar taxonomy that is intended to be useful for informing environmental design processes and strategies for settings to support creativity.

Thesis

In this chapter I discuss some of the implications of the Creative Practice model and Creativity–in–Context framework for the design of settings intended to support creativity. I will do this through the introduction of the Rich Environments Design Methods and Principles. I describe how Rich Environments are settings that empower creative practitioners to exploit the rich variety of affordances the settings offer in order to improve the efficiency and effectiveness of their creative efforts. Rich Environments empower the practitioner to sustain productive modes of creativity and transition between modes as productivity wanes. They are settings that balance a predictable structure providing the necessary environmental preconditions to engender and sustain a user’s creative modes with opportunities for users to manipulate or change

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62 The term “enriched environments” is used in the neuroscience literature to describe complex environments associated with increased neural plasticity and neurogenesis in adult rats. This has spawned a growing sector of research examining implications for human brain health, particularly in aging adults. My definition is distinct from the neuroscience term; however future research may suggest whether there is a potential for synergistic overlap between these two sectors.
environments to elicit new modes or unanticipated (and potentially serendipitous) situations. This balance of structure and responsivity distinguishes Rich Environments from some of the strategies discussed in the review of creative environments presented in Chapter II.

**Significance**

The purpose of this chapter is to illustrate how the Creativity–in–Context Theoretical Framework provides a basis for the construction of explanations and predictions about how features of the designed environment support people’s creative work. The framework has practical implications for evidence–based environmental design strategies to support creativity. The Center for Health Design defines evidence–based design as a method for basing environmental design decisions “on the best available research evidence with the goal of improving outcomes and of continuing to monitor the success or failure for subsequent decision making” (Ulrich, Zimring, Joseph, Quan, & Choudhary, 2004). The Rich Environments Design Methods and Principles will illustrate how the Creativity–in–Context framework may be used as a foundation upon which to build a body of knowledge around the role of the designed environment in creative processes. The Rich Environments Design Principles are intended to serve as a preliminary structure to guide environmental design strategies. The Rich Environments Design Methods suggest how environmental designers can contribute valuable data from real world situations to inform and continue to develop the framework into a full theory about the role of the designed environment in creativity. As such, the Creativity–in–Context framework provides a structure from which environmental design strategies can be empirically grounded, tested, and refined.

**Rich Environments**

Environmental design is a creative endeavor and thus (like all creative endeavors) the final product cannot be fully anticipated at the onset of the creative process. Unlike some other forms of creativity, however, environmental designers cannot truly perceive the outcomes of their
creative actions until the final creative product is implemented (i.e. constructed and inhabited) — at which point it is generally too late to make changes. Rittel and Webber (1973) once wrote, “the planner has no right to be wrong.” The same could be said for the other environmental design professions. Environmental designers are responsible for the outcomes of their actions; and the stakes are often high. They may use significant resources (time, materials, money, etc.) to plan and construct a project, the consequences of which may significantly impact users and stakeholders. Their creative processes are conversations with the materials that simulate the creative situation: sketches, measured drawings, cardboard models, and digital images. Thus they rely on heuristics and prior experiences to help them make the best design decisions they can (Schön, 1983). I present the Rich Environments Design Principles and Methods as a resource to help environmental designers make empirically–based predictions about how their designs may impact users. The guidelines proposed here are intended as a system from which they can critique planning strategies and post–occupancy evaluation processes. These guidelines are also “living documents” to not only inform environmental designs, but to also be revised and developed in response to the outcomes of design–based research.

In the following sections I will outline some recommendations for methods and principles to guide the design of Rich Environments to support creativity. First, I begin by proposing general design principles that illustrate how environmental features may support the cognitive and social processes of creativity throughout each of the five creative modes. I will also explain how these principles differ from the design strategies reviewed in Chapter II. The design principles for Rich Environments described here should be considered a preliminary list (or “starter kit”) from which researchers and environmental design professionals may build a more developed body of knowledge. Second, I will explain how design interventions to support the different creative modes are multi-scalar in nature. This suggests that each of the environmental design disciplines must have an awareness of how design interventions at their particular environmental scale (e.g. product, interior, architecture, landscape, region, or city) fit within the context of the other design professions. Third, I discuss how Rich Environments must support both domain-specific
and individualized creative practices and recommend some methods to gather this information during the planning process. These methods are introduced in light of the fact that creative people may not explicitly know what environmental features could best support their practice. Finally, I describe how ultimately the success of a place intended to support creativity will hinge on its responsivity — its ability to adapt to the changing nature of individual and collective creative practices over time.

The transactional relationship between person and environment suggests that a variety of environmental features and settings may be required to fully support the entire creative process. Creativity happens over time and space, and not necessarily in a single room or even a single building. Environmental designers must consider the physical features needed to support multiple modes of creativity, both solitary and social activities, and design interventions at multiple scales — from tools to cities. Strategies for the design of settings to support creativity may include 1) tailoring spaces to support particular modes of creativity, 2) creating spaces that empower people to alter features of their environments, and 3) allowing people the flexibility to work amongst a variety of different settings. I will refer to such settings as Rich Environments. They are appropriate for the activities they support, informed by the best empirical evidence and user input, and encourage variation and flexibility to both empower and enrich the experiences of the creative practitioner.

Rich Environments provide structure and support for the entire creative process (from problem–finding to evaluation) and thus must consider the different preconditions necessary for engendering and sustaining each mode of creativity. This next section will discuss the implications for general design principles that apply to each creative mode. As illustrated in Chapter V, there appear to be five distinct modes that are involved in creativity. These five modes also seem to be common to all creative practitioners. The differences between people’s creative practices appear to arise from the domain specific activities in which they engage during these modes and the personalized (and sometimes seemingly idiosyncratic) ways in which they exploit features of the designed environment to engender, sustain, or inhibit modes. I suggest
that along with these individual differences, there are also some common and necessary environmental preconditions that design professionals should consider when devising settings to support creativity. A graphical summary of the Rich Environments Design Principles is provided at the end of this section, in Table VII.1.

**Design Principles for Problem–Finding**

Problem–finding is supported by a combination of cognitive (Hayes, 1989; Jay & Perkins, 1997), socio-cultural (Amabile, 1996; Csikszentmihalyi, 1996), and physical preconditions that form an environment which enables discovery and adoption of creative problems. A creative person must have adequate preparation in a particular domain and an identified area of concern in order to recognize a problem-finding opportunity (Csikszentmihalyi, 1996; Hayes, 1989; Jay & Perkins, 1997). In Feynman’s case, he had acquired significant knowledge of physics and recently developed a concern for opportunities to “play” with it (Feynman & Leighton, 1997, p. 172). The socio-cultural environment may support or inhibit creativity by its impact on a person’s motivation, freedom, and organizational pressures (Amabile et al., 1996; Csikszentmihalyi, 1996, pp. 36–50; Feldman et al., 1994b). This was also illustrated in Feynman’s anecdote as he described the socio-cultural freedom to broaden his research focus by looking for opportunities to play with physics (Feynman & Leighton, 1997, p. 172). This socio-cultural freedom arose through the combination of his decision to “give up” on his research and the assurance from Bob Wilson that his job would not be in jeopardy if he did so (Feynman & Leighton, 1997, p. 173). It appears Feynman was then able to expand his focus of attention to include creative opportunities that might otherwise have been beyond the periphery of his area of concern. Together cognitive and socio-cultural conditions form a socio-psychological environment providing the necessary preconditions to allow the creative practitioner the freedom to discover new problems.

The physical environment supports problem–finding by providing affordances that can arouse curiosity and enable problem discovery. Cornell University provided opportunities for Feynman through its diversity of settings within the university campus where he could observe
everyday physics phenomena (Feynman & Leighton, 1997, p. 173). His expertise in physics and his intention to “play” with it, when combined with the socio-cultural freedom to explore new opportunities, appeared to help him perceive affordances in the event of a plate flying across the cafeteria.

In Feynman’s (1997, pp. 172–173) anecdote he describes how the socio-cultural environment helped him to cast a wide attentional net to seek problem-finding affordances in his environment (i.e. opportunities to play with physics) when Bob Wilson reduced his pressure to produce “important” research. Feynman’s physics expertise and intentions to “play” with physics also likely helped him filter out sensory information from his environment that did not match his concerns. The socio-physical environment supports creative practitioners by enabling them to perceive problem-finding affordances, allowing them freedom to explore their interests and concerns in a variety of resource-abundant settings. As illustrated in Feynman’s anecdote, problem-finding frequently happens at the intersection of preparation, concern, and socio-physical opportunity.

**Problem-Finding Places: Serendipitous Settings**

Environmental design strategies to support problem-finding traditionally emphasize social density and diversity (Florida, 2002a; Johnson, 2010; Landry, 2000). As illustrated in Chapter II, this strategy is manifest in the links/nodes design pattern, and generally is found at larger scales of the designed environment: city planning policies, urban design strategies, and architectural designs for larger buildings or complexes (Florida, 2012; Landry, 2000; Lazzeretti, Boix, & Capone, 2008; O’Connor, 2004). These are places that attract and connect people in order to set the stage for serendipitous events. Richard Feynman’s problem-finding anecdote, as illustrated in Chapter VI, both provides support for this design strategy and highlights its limitations.

The links/nodes pattern suggests that creative environments should be designed to promote nodes (or areas) of social density, with links to connect diverse nodes (Florida, 2002a; Landry, 2000; Stolarick & Florida, 2006). The Cornell cafeteria described in Feynman’s story
would likely qualify in this pattern as a node of social density. University campus settings often facilitate easy connectivity between different nodes, such as departments, dormitories, and other support functions (libraries, dining halls, etc.) (P. V. Turner, 1984). The assumption behind the links/nodes pattern is that it will foster social interaction — people will interact by talking to each other and sharing ideas (Drake, 2003; Florida, 2003; O’Connor, 2004). This concept of facilitating problem–finding through social interaction (i.e. talking) is common in the creativity and environmental design literature (Florida, 2012; Johnson, 2010; R. J. Sternberg, 2006b). What is particularly interesting about the Feynman example, however, is that it illustrates a different type of interaction. One that is indirect.

Feynman was an outside observer of the plate-tossing event. Had he been directly involved in social interaction during this event, it is questionable whether he would have perceived the spin to wobble ratio of the plate as an opportunity to play with physics. While it is likely that some problem-finding modes are engendered through conversations with other people, there are many anecdotes where this is not the case. In these situations, problem–finding is triggered through observation of an event or process which peaks the creative practitioners curiosity. This suggests that socially dense and diverse environments are likely not sufficient for supporting problem finding modes, but may be combined with environments that are physically dense and diverse as well — to create settings rich with environmental affordances.

To more effectively design for the different types of conditions that support problem–finding, the links/nodes design strategy should be reconsidered. It may be extended to include physical density and diversity by adopting the concepts of “tight” and “loose” spaces developed by Franck and Stevens (2007). Tight space offers only specific types of programmed use, may include physical and social constraints or particular restrictions to limit (or prohibit) other uses, and is generally static (Franck & Stevens, 2007, pp. 16–28). Loose space offers opportunities for

See for example Cech’s (2010) account of his discovery of the enzyme properties of RNA, the story of Sir Isaac Newton’s observation of a falling apple as the inspiration for his universal theory of gravity (J. L. Epstein, 1979), or Alexander Flemings discovery of penicillin in a moldy petri dish (Bennett & Chung, 2001, p. 168).
different activities to occur simultaneously and enables activities not originally intended by the design of the space. Loose spaces must be easily accessible, allow for freedom of choice, and include objects that may be appropriated for different uses (Franck & Stevens, 2007, p. 2). Although Franck and Stevens apply the concept of loose space primarily to the domain of public settings (such as streets, sidewalks, and plazas,) the principle may be useful for supporting problem–finding at other scales of the designed environment as well. Loose spaces may occur both at linkages and at nodes (such as the Cornell cafeteria). They are settings that place fewer restrictions on people’s behavior, allowing for a wider range of opportunities, events, and processes than tightly programmed settings (Franck & Stevens, 2007).

Problem–finding is supported by settings that enable serendipity and discovery. These settings may be formed through design strategies that combine accessibility and variety: of links and nodes, of density and diversity, and of tight and loose spaces. They may be places of social density, which attract people to them, or places of experimentation where unexpected events may take place. Places that support problem–finding provide the structure to enable social interactions and unanticipated situations that may occur at the edges of domains or the periphery of the creative practitioner’s attentional field.

**Problem-Finding Events and Processes: Attractor/Reactor Spaces**

Event and processes support the adoption of existing problems or the discovery of new creative problems through social interactions and serendipitous situations (Burke, 2007; Mark A. Runco, 2007a, pp. 390–396). Burke (2007) introduces the concept of the “trigger effect” in creativity to explain how a single event can trigger a chain reaction of creative problem–finding opportunities. He describes how an accidental material failure led Thomas Newcomen to discover the powerful force of steam. This led to his invention of the Newcomen Steam Engine, which, in turn, triggered a creative “reaction” where a series of new products and processes ignited the industrial revolution. Burke’s work emphasizes the connectedness of creative discoveries, where one event can generate a ripple–effect of new problem–finding opportunities across domains.
Serendipitous events and processes engender the discovery of new creative problems (Mark A. Runco, 2007a, pp. 235–236, 390–396), but how does one design for serendipity? By adding the concept of loose space to the links/nodes design strategy, I suggest we may begin to form a structure for environments to support the types of events and processes that lead to discovery of creative problems. Loose spaces not only support a wide variety of events and activities, but they become “loose” through the events and processes that take place within them (Franck & Stevens, 2007). While this may appear to be a circular relationship, in reality it is another example of the intertwined relationship between the physical and the social in the formation of environments to support creativity. Physical settings that support serendipity allow possibilities for diverse and sometimes disorderly events and processes. The space, however, is not “loose” until people appropriate it (Franck & Stevens, 2007), thus both the social–cultural and the physical environment must allow appropriation of space. Loose spaces are typically not unprogrammed (Franck & Stevens, 2007). They are designed for particular uses, but do not place high constraints on unanticipated activities that might also occur within them (Franck & Stevens, 2007). In other words, loose spaces empower people to initiate unplanned–for events and processes (triggers) and offer settings where people can encounter unexpected situations that might spark problem–finding opportunities (reactions).

**Problem-Finding (Place-scale) Objects: Loose Parts**

Loose spaces need loose parts — objects that may be usurped in unplanned–for events and processes (Nicholson, 1971). The concept of “loose parts” is attributed to Simon Nicholson’s (1971) theory of the same name. According to Nicholson, “in any environment, both the degree of inventiveness and creativity, and the possibility of discovery, are directly proportional to the number and kind of variables in it” (1971, p. 30). He based his theory on research with children in settings such as natural and designed outdoor play areas, discovery learning classrooms, and science museums where they had access to many moveable and re-configurable objects. Loose parts are place–scale objects that can be moved, transported, disassembled, combined, and
reconfigured in multiple ways (Nicholson, 1971). The plate in Feynman's story was a "loose part," an object in the cafeteria that was appropriated in the unplanned–for event of throwing it across the room.\textsuperscript{64} Loose parts are instrumental for people (both creative practitioners and other actors in the environment) to choreograph events and processes that may enable the discovery of creative problems. They provide increased opportunities for variety in the activities that might occur in a setting (Nicholson, 1971).

**Problem-Finding Relationships: Participant/Observer**

The relationship between the creative practitioner and the events and processes that support problem–finding fall into two general categories: observer and participant. Feynman’s (1997) anecdote is about his role as an observer of an event (p. 173). He is not directly involved in the plate throwing activity and this appears to help him see the situation from the context of physics, his domain of interest. Were he directly involved in the event he might, for example, have seen the situation from the perspective of someone trying to catch or avoid the flying plate. Because he was not an active participant in the event, he had freedom (and time) to perceive the problem–finding affordances of the situation.

Active participation can also lead to problem–finding. The chemist Tom Cech (2010) discovered a scientific problem that led to the Nobel Prize through his active participation in experiments that were driven by “simple curiosity about how does RNA splicing occur.” Cech begins his story by describing how this experimentation was particularly significant for him because he did it “with my own hands.” He set out to uncover the protein that was causing catalyzation in his experiments on a single-celled pond organism only to realize (after numerous experiments over the course of a year) that it was the RNA itself that was the catalyst. Prior to his discovery, scientists believed that only proteins could act as catalysts (Cech, 2010; “HHMI,” 2012). The unexpected outcomes of his experiments (i.e. breakdowns) caused a shift in the way

\textsuperscript{64} The event was “unplanned for” in terms of the architectural design of the setting, as a cafeteria is not typically designed for plate throwing. I do not refer here to the intentions of the person who threw the plate, since this cannot be known from the available information.
Cech thought about the problem of the catalyst (Cech, 2010). Cech’s story illustrates how situated deliberation can lead to problem finding (McCall, 2013). It was through a breakdown in reflection that Cech discovered the problem of the catalyst in his experiments. Creative practices involve exploration, and unexpected events can sometimes yield new and exciting problems to pursue.

**Problem-Finding Attributes: Apertures and Thresholds**

The attributes of places, events, processes and objects support problem–finding by facilitating different relationships between creative practitioners and the events or processes that may lead to problem adoption or discovery. Many of the attributes that support creative problem–finding have already been introduced in the previous sections. Some of these attributes include density, diversity, and connectivity to support problem discovery or adoption through social interaction. Loose spaces also support opportunities for serendipity. Attributes for place-scale objects that support problem–finding include movability, transportability, and re–configurability. There are also attributes, such as apertures and thresholds, that may mediate relationships between the creative practitioner and the events and processes that engender or sustain problem–finding.

Apertures are openings that negotiate the type and level of engagement between the creative practitioner and an event or processes. Doors and windows are common apertures in buildings. For example, a door may be open to foster visual and auditory engagement between a creative person and others in an adjacent space. Or the door may be ajar to provide only an auditory relationship, or closed to muffle or distort the interactions between a person and the events that occur on the other side of the door. Thresholds are transitions between settings. Windows, doorways, hallways, changes in flooring materials, and even the implied division between areas of high and low lighting levels may form thresholds between people and events or...
processes. The nature of the threshold affects the context of these relationships. For example, a creative person may be a participant in an event or process when there is no threshold separating them. As a participant–observer, the creative practitioner might stand in an open doorway, alternating between watching as an observer and contributing to the conversation as a participant. Finally, a participant might watch an event from behind a window or door in order to sustain observation.

In Feynman’s story, he found a creative problem by observing the event of the flying plate (Feynman & Leighton, 1997, pp. 173–174). Even in a public cafeteria, the features of the room can create thresholds that support different relationships between creative practitioners and the events and processes that may enable problem–finding. For example, sitting at a table where an event occurs supports participation in that event, whereas sitting at a different table supports observation of the event. Although we do not know the specifics of the room configuration, we may assume that Feynman observed the plate-flying event from a distance (or he might be been busy ducking instead of observing.) Yet he was close enough for it to capture his interest and allow him to perceive the attributes of the plate. In this case some combination of the features and attributes of the place, where he was positioned in the room with respect to the event, along with the distance between him and the event, formed a threshold that enabled him to be an observer and not a participant in the situation. Settings support problem–finding through social interaction and serendipitous situations by attracting and connecting people, and enabling them to observe or participate in unplanned activities.

**Design Principles for Intuitive Immersion**

While problem–finding is engendered by a creative practitioner’s interactions with other people and unexpected situations, the immersion mode is inhibited by surprising situations (Csikszentmihalyi, 1996, p. 120; Schön, 1983, p. 56). Immersion is engendered when the creative practitioner sustains focused attention solely on the creative task at hand (Csikszentmihalyi, 1996, pp. 58, 111–112). This is one of the most difficult modes to engender
and sustain — and the most sensitive to environmental conditions (Csikszentmihalyi, 1990, p. 54). Immersion requires certain preconditions, and foremost among these is disengagement — from both explicit social engagement and situations with potentially unpredictable outcomes (Csikszentmihalyi, 1996, pp. 111–123). Even after sustained focus is attained, the improvisatory relationship established between the creative practitioner and the creative product remains fragile. The slightest interruption or unanticipated event may cause a breakdown in immersion (Csikszentmihalyi, 1996, p. 120; Schön, 1983, p. 54). Immersion requires significant mental preparation and effort (Csikszentmihalyi, 1990, p. 54), which the socio-physical environment may either support by protecting creative practitioners from interruptions and distractions or hinder by leaving practitioners vulnerable to outside forces that interfere with their work.

**Immersion Places: Inspirational Settings**

Settings that support intuitive immersion are often inspirational for creative practitioners (Csikszentmihalyi, 1996, pp. 133–139, 354–357). They make it easier for people to immerse themselves in creative investigation with a product or idea (Csikszentmihalyi, 1996, pp. 354–357). During the immersion mode, people generally prefer predictable and comfortable settings (Csikszentmihalyi, 1996, p. 139). Empirical evidence suggests that people not only prefer views of nature and natural lighting during immersion (Ceylan et al., 2008; McCoy & Evans, 2002), but that daylighting (Boubekri et al., 1991; Choi, 2012; Heschong et al., n.d.; Leather et al., 1998; Wang & Boubekri, 2010, 2011) and viewing plants (Bringslimark et al., 2009; Dijkstra et al., 2008; Raanaas et al., 2011) also help them sustain attention. Artifacts in the setting, and often the setting itself, are used as a stimulus to help the creative practitioner find and sustain the focus needed for intuitive immersion (Csikszentmihalyi, 1996, p. 356).

An inspirational setting may be a designated space (such as a studio or office) or a discovered place (such as a favorite café, park, or niche at home,) so long as the affordances of the place fit the person’s need to engage in creative activities without interruption. A café may be very appropriate for a writer who is able to carry along the tools needed, whereas a scientist may
prefer a laboratory setting that contains the specialized equipment necessary for creative productivity. Marcel Proust famously remained house-bound during much of his creative career, working in a cork-lined room — an inner sanctum where he had a high degree of control over social interactions as well as sounds and smells that might interfere with his ability to focus on his writing (Fuss, 2004). Whether café, laboratory, home office, or studio, places that support immersion provide a high degree of user control and contain the tools and materials needed to sustain a creative task.

Places that support intuitive immersion allow the creative practitioner to control or limit intrusions. During immersion creative people must maintain a narrow focus on the task at hand (Csikszentmihalyi, 1990, p. 58). Unanticipated interruptions typically disrupt attention and curtail the immersion mode (Csikszentmihalyi, 1996, p. 120; Schön, 1983, pp. 54, 60). Painter Andrew Wyeth’s studio, located in the pastoral Pennsylvania countryside, has large windows to capture the northern light, palette and brushes ready at hand, notes to himself scrawled on the woodwork — and a sign prominently displayed on the front door stating “I AM WORKING SO PLEASE DO NOT DISTURB. I do not sign autographs”. One example of the need for creative people to prevent unanticipated events during immersion is Coleridge’s (1816, pp. 50–57) famous account of an interruption when he was writing the poem titled Kubla Khan. In his introduction to the poem, Coleridge describes how he composed between 200 and 300 lines of the poem while in a drug-induced sleep. Upon waking he immersed himself in writing the poem, only to be interrupted by “a person on business from Porlock, and detained by him above an hour” (Coleridge, 1816, p. 52). When he returned to his writing, he was only able to remember “some eight or ten scattered lines and images.” For Coleridge, the intuitive flow of creative thought had been irreparably disrupted “like the images on the surface of a stream into which a stone has been cast, but, alas! without the after restoration of the latter” (Coleridge, 1816, p. 53).

Settings that support immersion provide more user control over interruptions than problem-finding spaces, but they are still adaptable to accommodate changes in creative work habits. To sustain immersion, however, the creative practitioner must be the one to orchestrate
all adaptations, because unanticipated events curtail the mode (Csikszentmihalyi, 1990, pp. 59–62). Many creative practitioners develop a routine in their environment to help them engender and sustain creative immersion (e.g. cleaning up work surfaces, or setting out favorite tools or meaningful artifacts) (Csikszentmihalyi, 1996, pp. 351–358; Fig, 2009). When they feel creativity waning they may change routines, alter features of their workspace, or even move to a new setting to help engender and sustain immersion (Fig, 2009). Three key principles therefore, emerge from settings that support immersion. First, they provide opportunities for users to personalize their spaces. Second, they enable users to change (alter) a space or options to change (move) spaces to engender immersion, and 3) they help users to control distractions and, in particular, to moderate social interactions.

**Immersion Events and Processes: Improvisation Spaces**

There are several common events and processes in which people engage during immersion. Because immersion requires sustained attention on the task at hand, people must first disengage from direct social interactions that would prevent them from focusing on the creative task (Csikszentmihalyi, 1990, pp. 58–59). This event may be as simple as closing an office door to prevent unexpected interruptions or putting on headphones to signal to other people that they do not wish to be disturbed. Next, creative practitioners must overcome physical distractions or barriers to sustain attention on the creative task at hand (Csikszentmihalyi, 1996, pp. 120–121). As mentioned in the previous section, some people use rituals to help them mentally prepare for this period of sustained focus, easing their transition into the immersion mode (Csikszentmihalyi, 1996, pp. 351–358). A ritual may be an event (such as turning on the radio) or a process (such as making a cup of tea or coffee.) In his biography, Stephen King is quoted as describing how environmental conditions play a role in his rituals to engender immersion.

*There are certain things I do if I sit down to write,... I have a glass of water or a cup of tea. There’s a certain time I sit down, from 8:00 to 8:30, somewhere within that half hour every morning,... I have my vitamin pill and my music, sit in the same seat, and the papers are all arranged in the same places. The*
cumulative purpose of doing these things the same way every day seems to be a way of saying to the mind, you’re going to be dreaming soon (Rogak, 2010).

Finally, creative practitioners externalize an idea in different ways (e.g. making, composing, writing, diagramming, etc.) in order to obtain immediate feedback in response to their intentions (Csikszentmihalyi, 1990, pp. 54–58). The creative practitioner tightly orchestrates all of the events and processes that occur during creative immersion, because predictability and control help sustain the mode and unanticipated situations curtail it (Csikszentmihalyi, 1990, pp. 59–62; Schön, 1983, p. 56).

**Immersion (Place-scale) Objects: Instrumentation**

Instrumental to supporting immersion are the tools and materials used during externalization of the creative idea or product (Csikszentmihalyi, 1990; Schön, 1983). When they are ready-at-hand, predictable, and customary they help the creative practitioner sustain attention on the task at hand (Sennett, 2008). They are the props that set the stage for the creative performance between practitioner and the creative product. Familiar tools do not demand people’s attention, allowing them instead to focus on the products of their creative effort. They also extend the practitioners’ creative abilities by allowing them to externalize an idea in different ways (Gänshirt, 2007).

Furniture and other artifacts not directly used during the externalization process also support creative immersion when they are part of the inspirational atmosphere of the setting (Csikszentmihalyi, 1990). Their comfort, aesthetic qualities, or personal significance may help the creative practitioner engender immersion. Some creative people like to be surrounded by favorite books, or prefer to have nearby a mug given to them as a gift from their child, or hang on the wall an inspirational image — whether that be a family portrait, favorite saying, or a photograph of a majestic landscape. These artifacts help to set the ambiance of the setting, but do not draw attention from the creative task at hand during immersion. They form the background conditions that help people sustain focus on their creative work.
Immersion Relationships: Transparent Equipment

Relationships significant to the immersion mode primarily occur between the creative practitioner and the objects located in the creative setting. These relationships generally take two forms. In the first type of relationship objects function as transparent equipment to the practitioners, providing the necessary environmental conditions to allow them to focus solely on the creative situation (Sennett, 2008). They include the tools used to externalize a creative idea as well as the furniture, fixtures, and other artifacts that make up the creative settings. These place-scale objects function because they do not draw attention from the task at hand. If the pencil breaks or the light bulb burns out, the equipment is no longer transparent to the practitioner and disrupts creative immersion. All the objects in settings that support immersion — except the externalized product of the creative idea — function as transparent equipment, allowing the practitioner to focus solely on the improvisational relationship with the creative product.

The second type of relationship is between the creative practitioner and the externalized creative idea (product) such as a diagram, drawing, model, text, recording, etc. Unlike other objects in an immersion setting, which function as transparent equipment, the creative product helps to sustain the creative practitioner’s attention to it (Csikszentmihalyi, 1990). It supports idea generation by providing immediate feedback in response to the creative practitioner’s actions (Csikszentmihalyi, 1990). The creative product is something that people use to think intuitively about their ideas (Schön, 1983). Objects in the setting that are not transparent to the creative practitioner attract attention. If these are not the objects of the creative situation (e.g. a squeaky chair or drafty room) then the creative practitioner cannot maintain undivided attention to the task at hand, and immersion breaks down.

66 See Chapter III for a more detailed explanation of embodied and embedded cognition and Chapter V further discussion of the role of tools and externalized creative ideas (products) in creative cognition.
Immersion Attributes: Buffers

The attributes of places and place-scale objects that support immersion share many common features. They are available (ready-at-hand,) predictable, customary, comfortable, pleasant, and, to some extent, inspirational to the creative practitioner (Csikszentmihalyi, 1990, 1996; Schön, 1983; Sennett, 2008). The immersion state can be challenging to both achieve and maintain, and these attributes help the creative person to engage with the task at hand and maintain a sustained focus (Csikszentmihalyi, 1990, 1996). Settings and objects that support immersion serve to protect or buffer the creative practitioner from interruptions or intrusions. Virginia Woolf famously wrote “a woman must have money and a room of her own if she is to write fiction” (Woolf, 2001, p. 6) Although we now understand the creative process to be more complex than visions of a creative genius locked alone in a room, Woolf captures this important aspect of creative immersion, perhaps too often overlooked in workplace and educational settings where the focus is often on favoring social interactions over solitary processes.67

Design Principles for Explicit Reflection

Reflection is the process of critiquing the creative product or idea and involves both solitary and social processes (Rittel & Webber, 1984; Schön, 1983).68 As previously discussed in Chapter V, reflection is a form of deliberation used during the creative process to both improve creative ideas and generate new ones (Schön, 1983). The mode is characterized by the externalization of the creative idea in order to investigate its merit and garner a new perspective on the creative situation (Schön, 1983). Its purpose is to make explicit the intuitive assumptions that informed the work of the creative practitioner during immersion and critique the externalized creative idea or product in light of these assumptions (Schön, 1983). Settings, tools, and

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67 See Chapter II for additional discussion regarding the tendency of environmental designers to emphasize strategies fostering social interactions in settings intended to support creativity.
68 Refer to Chapter V for additional discussion about how reflection is a valuative process that involves surfacing assumptions, raising and deliberating questions, and uncovering hidden affordances.
materials are all used by the creative practitioner to help perceive new affordances in the creative situation (Csikszentmihalyi, 1996; Gänshirt, 2007; Kipling, 1937; Schön, 1983; Suchman, 2007).

**Reflection Places: Deliberation Settings**

The externalization of the creative idea is fundamental to the reflective process — and settings that support reflection provide resources to help the creative practitioner externalize and appraise an idea in a variety of ways (Schön, 1983). They may scaffold opportunities for unanticipated situations and social interactions that might provide new and different insights about the creative idea or product. The externalization of a creative idea stimulates exploration of it through forms of solitary and social valuation (Schön, 1983). Settings that support both intrapersonal and interpersonal reflection provide a variety of ways for a creative idea to be externalized and invite social interactions around the appraisal of creative products. They are places that are readily accessible, adapt to user’s changing needs, and provide a variety of resources to facilitate the presentation and critique of creative ideas.

“Flexible” settings, such as the innovation labs described in Chapter II, typically claim to support the types of evaluative and collaborative processes that occur during reflection (Lewis & Moultrie, 2005; Magadley & Birdi, 2009).\(^\text{69}\) However these spaces rarely provide the appropriate level of structure, flexibility, and resources necessary to optimally support the creative practitioner (Lewis & Moultrie, 2005; Magadley & Birdi, 2009). Flexible spaces, in reality, are often either “in–flexible” or “un–programmed” and thus rely on users to make them functional.\(^\text{70}\) This may put undo burden on creative practitioners, and require them to divert attention away from the creative situation in order to make a setting functional. In response to the shortcoming of these types of spaces, I propose the concept of *provocation settings.*

\(^{69}\) The term “flexible” is often used in conjunction with the creativity literature, but it is rarely defined. Sometimes it refers to the ability to reconfigure a space, such as through moveable furniture systems. It is often used as a “catch all” phrase to support under–designed designed spaces where the resources provided are insufficient to support the “possible” activities that might occur within. See Chapter II for further description of these types of settings.

\(^{70}\) Un–programmed spaces are not designed for any particular intended purpose, and thus are frequently underutilized because either people do not know how to use them, or it takes too much effort on the user’s part to make them functional. See Chapter II for further explanation.
Provocation settings are places that provoke exploration, are programmed to support anticipated user needs (planned to support user’s needs for presentation and critique), and adaptable (reconfigurable by users to support infrequent or unanticipated events and processes). Provocation settings that support critical reflection are more structured than problem–finding settings but less structured than settings designed to support immersion. They are places that help a person to focus on the task at hand and also provide resources to assist the creative practitioner in perceiving the creative situation from different perspectives, helping them uncover hidden and potential affordances through their own valuative explorations and social critique. Settings that support reflection are available, reconfigurable, and provide a variety of resources to help change the relationship between creative practitioner and the creative idea or product.

The architectural design studio is one setting that embodies some of these principles — and it was this very setting that proved instrumental in informing Schön’s (1983, 1985) theory of reflective practice. In the design studio practitioners use a variety of tools, materials, and strategies to gain different perspectives on their design (Cross, 2006; Gänshirt, 2007; Sennett, 2008). Architects use a suite of different drawing types and methods to help them perceive different affordances, including rough sketches and hard line drawings that present different views of a design (such as plans, sections, elevations, obliques, exploded axonometrics, perspectives, etc.) (S. Allen, 2009; Robin Evans, 2000). They may use different media to render these drawings such as fat markers, mechanical pencils, and digital software (Cross, 2006; Gänshirt, 2007; Sennett, 2008). They also use different drawing (rendering) techniques to explore things like volume, light and shadow, and spatial relationships (S. Allen, 2009). Even models provide different information according to their form and construction, including conceptual, sectional, digital, building information modeling (BIM), and energy analyses (Elser, Cachola Schmal, & Deutsches Architekturmuseum, 2012; Sennett, 2008). The many ways of externalizing the creative idea allow not only the practitioner to perceive different affordances,  

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71 See Chapter V for a more detailed explanation of how different ways of externalizing ideas changes a person’s abilities to perceive affordances in the creative situation.
but also invite critiques from other people, and even from computational methods. Studio
settings support reflection by providing spaces for individual work as well as one-on-one and
group critique. They also provide manual and computational tools, materials, equipment, and
furniture to support multiple modes of inquiry through externalization of a creative idea.

Because the modes of immersion and reflection are so intertwined, it is inevitable that
they will often occur in the same space (Schön, 1983). Such is the case in the design studio,
where practitioners often need physical proximity to other designers in order to foster
collaboration, while still maintaining personalized workspaces and practices to also allow them to
focus on solitary processes (and indicate to coworkers that they do not wish to be disturbed.)
Thus features of a single setting may allow adaptations to support both immersion and reflection.
Even the simplest design interventions that enable a person to open/close doors and windows to
allow/prevent unanticipated interactions can support both of these modes of creativity.

**Reflection Events and Processes: Evocation Spaces**

Reflection is often engendered by an unanticipated event (Schön, 1983). The event may
be the creative practitioner’s perception of a surprising new affordance or constraint in the
creative situation or it may occur through social interactions with other people (Schön, 1983).
Other people can help the practitioner perceive new affordances or constraints by critiquing the
creative idea or product and by using the product in a way that the practitioner had not expected
(McCall, 2013). Reflection is sustained so long as the creative practitioner is able to perceive new
affordances or constraints in the situation (Schön, 1983). Practitioners may change their
perceptions of the creative situation, such as by using different tools, materials, vantage points,
or moving to a new context, in order to sustain reflection (Gänshirt, 2007; Schön, 1983). They
may also change the way the situation is experienced by seeking out other people to provide
critique or feedback from use (Fischer, 2005b; McCall, 2013).

The creative practitioner may modulate the environmental conditions of the reflective
space to sustain reflection. This is done through adjustments and adaptations in the socio–
physical environment as well as through changes in the practitioner’s own conceptions of reflective space by narrowing and widening the attentional net. In the design studio, students wear headphones (even when not listening to music) as a sign to others that they prefer not to be bothered during solitary reflection. Other times, they may set models or drawings out on their desk where others can see them, as either part of an implicit or explicit invitation for peer critique. They may pin a drawing up on a wall, standing away from it to try and perceive new affordances. This also invites others to attend to the artifact, potentially eliciting feedback such as “I like that technique you used” or “maybe you could try pushing this element over.” For a more formal appraisal, the student will ask the instructor to participate in a desk critique. This is typically an interpersonal valuative process where the student and instructor work together exploring the design and trying different strategies to improve it. A more formal appraisal comes in the form of a pin-up or formal critique, where students rehearse an argument for their designs and advocate their ideas to a jury of instructors and professionals. This form of social deliberation can be both valuative (focusing on the merits of the design) and evaluative (where jurors look for weaknesses in the designs and students defend their decisions). The goal of a modulative setting is to sustain reflection by helping the creative practitioner perceive affordances (or potential affordances) in a creative product or idea. It supports reflection by empowering the creative practitioner to modulate the events and processes that occur in the space.

Reflection (Place-scale) Objects: Things to Think With

Place-scale objects support reflection by extending people’s creative abilities through use of familiar tools, helping them increase flexible thinking through unfamiliar tools and materials, and facilitating useful analogies as things to help them think about the creative idea (Gänshirt, 2007; Pallasmaa, 2010; Turkle, 2007). People use “things to think with” during both intrapersonal and interpersonal reflection. I will use the metaphor of the “cabinet” and the “stage” to briefly describe this concept. The “cabinet” provides the personally useful things like tools, materials, and interesting objects (both physical and digital) to help the creative practitioner think in new
ways about the creative idea. The “stage” provides the means to communicate these ideas to other people, to provoke interpersonal reflection.

Creative practitioners use a variety of tools and mediums of communication to uncover hidden affordances, perceive potential affordances, and identify false affordances and constraints. Practitioners sometimes have preferred tools and materials that they feel help them in this process, such as Rudyard Kipling’s preference for a camel hair brush and obsidian ink (Kipling, 1937). But they also use unfamiliar tools and new mediums of externalization to help them perceive the creative situation differently by becoming a “novice” in the creative situation — such as when musicians use an unfamiliar instrument or artists experiment with a new medium to spur their creativity (Sawyer, 2012, p. 9). As discussed in Chapter V, although expertise is a precondition for creativity, it comes at a cost, sometimes resulting in rigid thinking that can hinder creativity (R. Epstein, 1990; Frensch & Sternberg, 1989; Martinsen, 1995; R. J. Sternberg, 1997; W. M. Williams & Lang, 1999). Place–scale objects help creative practitioners communicate the creative idea in different ways, allowing them to perceive different affordances in the situation.

Creative practitioners also exploit other, sometimes seemingly unrelated, objects in the environment to use as things to help them think about the creative idea. As described in Chapter V, architect John Utzon used an orange to think about the sectional organization of the Sydney Opera house and the rib like structures he observed in the shipyard outside his office helped him design the building’s form (Peltason & Ong-Yan, 2010). The focus of attention is a bit broader during reflection than immersion, and may vary from narrower to wider as creative practitioners seek resources to aid reflection. Settings to support reflection benefit from having a variety of versatile, complex, and unfamiliar “evocative” objects that can be usurped by the creative practitioner to extend and improve reflective processes. These include different tools and materials for externalizing and communicating creative ideas, as well as other types of personally

72 See Chapter IV for the cost of expertise and Chapter V for additional detail in how the musician Pansch and artist Arp used this strategy.
interesting or inspirational objects that might help the creative practitioner think about the creative idea in new ways.

Reflection Relationships: Cognitive Artifacts

Reflection is maintained by the changing relationship between the creative practitioner and the product of the externalized creative idea, such as drawings, diagrams, models, etc. How this relationship is changed will vary by creative domain and by personal preference, but there are some common strategies. Physically changing the vantage point between creative practitioner and creative product sometimes reveals new affordances. Some examples of this include stepping back from a painting to view it from across the room, moving an architectural model to eye level to alter the perception of scale, or changing the color of graphics in a diagram to better understand the relationship between elements. In this relationship, the creative product is an artifact of the practitioner’s thoughts, ideas, and processes. Changing the relationship between creator and creation helps the creator to reflect on the thinking that went into it.

Whereas many of the objects involved during the immersion mode function as “invisible” equipment (except the creative product), during reflection place-scale objects are most commonly leveraged as things to think with (cognitive artifacts.) Even tools and materials may become “visible” to practitioners as they consider the roles that they play in supporting reflection. Tools may be altered, used in unintended ways, or replaced in an effort to perceive new affordances in the creative situation. Other objects in the environment may be usurped to aid reflection, whether they are used as things to think with respective of the creative situation, or cannibalized in service to externalization of the creative idea.

Reflection Attributes: Variables

Reflection is supported by places (and objects within them) that are available, adaptable, re-configurable, modulative (allow variable levels of control,) and resource-rich. These are all attributes that facilitate responsivity. Responsivity is the ability of a system to adapt to changes
from external forces. Resource rich environments — those with many loose parts that can be appropriated by the creative practitioner — can improve responsivity in a reflective environment. The more variables there are in a setting, the more it can adapt and change to meet the needs of the creative practitioner. The creative practitioner may modulate features of a responsive setting to support social collaborations through critique and feedback from use, provide opportunities for unpredictable situations and social interactions, or externalize and communicate creative ideas in different ways to help perceive new affordances in the situation.

**Design Principles for Semi–explicit Rumination**

Adaptive rumination is characterized by suspension of work on a creative problem, typically during a period of indecision, where the creative practitioner may mull ideas over in the back of the mind either subconsciously or semi–explicitly (Cohen & Ferrari, 2010). Places that support rumination are often (although not always) distinctly different from the places where creative practitioners work. They are environments that engage the practitioner in an activity or task unrelated to the creative problem (or at least seemingly so) (Dijksterhuis & Meurs, 2006; Sio & Ormerod, 2009). These settings may help to improve creative productivity by supporting tacit or subconscious work on a creative problem (Dodds et al., 2012).

**Rumination Places: Restorative Settings**

Rumination is supported by settings that repair fixation on a creative problem by helping the creative practitioner defocus attention on it (Altamirano et al., 2010; Ciarocco et al., 2010; Cohen & Ferrari, 2010). Places that provide opportunities for enjoyable, low cognitive-load, sensorimotor experiences may help distract the creative practitioner from an unproductive line of creative reasoning (Dijksterhuis & Meurs, 2006; Sio & Ormerod, 2009). Empirical evidence suggests physical activity (Ben-Soussan et al., 2013; Blanchette et al., 2005; Cavallera et al., 2011) and access to natural settings (Berman et al., 2008; Herzog et al., 2003; Kaplan, 1995; Van Den Berg et al., 2007) improves productive rumination. Settings with moderate ambient
noise also help repair creative fixation (Mehta et al., 2012). Rumination is supported by settings that are cognitively restorative for people by facilitating diffuse attention (Hernandez & Preston, 2013; Mehta et al., 2012).\textsuperscript{73} Places that support rumination may empower people to work subconsciously or tacitly on the creative problem. Environmental cues may also facilitate novel combinations and mental connections that may lead to breakthroughs (Sio & Ormerod, 2009).

The plaza at the Salk Institute\textsuperscript{74} is one designed setting that is associated with rumination and illustrates some features of a place that may support this process. First, it is a transitional space. The plaza connects two laboratory buildings, and so people must walk through it to move between the different work settings on the Salk campus. Second, the setting provides a rich multisensory experience through its materials, textures, and views and sounds of nature—which may help people defocus attention and begin to ruminate. Third, the setting invites movement. The expansive plaza provides only a few opportunities to sit. Finally, the space provides a way for people to capture creative ideas. Many creative practitioners relate the fragility of ideas that emerge during rumination (Ghiselin, 1954). As discussed in Chapter II, the architect Louis Kahn intended the plaza space to be contemplative and anticipated that the scientists who used it might need somewhere to jot down a thought or idea that occurred during rumination. He provided chalkboard covers to the equipment chases at the perimeter of the plaza where people could use them to capture a creative insight that might pop into their heads during rumination.

\textbf{Rumination Events and Processes: Interstitial Spaces}

Rumination is supported by events and processes that help the creative practitioner disengage from work on the creative product or idea as well as from direct social interactions

\textsuperscript{73}Physical activity, access to nature, and ambient noise have all been found beneficial for rumination; but productive rumination may occur in other types of settings as well. In Chapter VI I described how Feynman was able to repair creative fixation during his “serious” research by distracting himself with an opportunity to “play” with physics.

\textsuperscript{74}See Chapter II for a more detailed discussion about how the design of the Salk Institute was intended to foster contemplative thought and creativity. It was inspired by Jonas Salk’s belief that the time he spent among the cloistered courtyards of a monastery in Assisi, Italy led to his discovery of the polio vaccine.
(e.g. holding a conversation with someone). Processes that entail working on enjoyable mundane
tasks or engaging in semi-automatic processes that involve both sensory and motor activity may
help to sustain rumination (Dijksterhuis & Meurs, 2006; Sio & Ormerod, 2009). A common theme
among stories about rumination is that creative practitioners sometimes develop habits of
walking in natural settings to help to engender and sustain the process, as described in this
quote by Housman.

... I would go out for a walk of two or three hours. As I went along, thinking of
nothing in particular, only looking at things around me, with sudden and
unaccountable emotion, sometimes a line or two of a verse, sometimes a whole
stanza at once, accompanied, not preceded, by a vague notion of the poem
which they were destined to form part of. Then there would usually be a full of
an hour or so, then perhaps the spring would bubble up again...When I got
home I wrote them down, leaving gaps, and hoping that further inspiration
might be forthcoming another day. Sometimes it was, if I took my walks in a
receptive and expectant frame of mind... – A. E. Housman (Ghiselin, 1954, pp.
90–91).

Unlike the other modes of creativity, which can be triggered by an event, rumination
appears to be more often engendered by a process. Research suggests that physical activity may
increase ruminative productivity, so processes like walking, jogging, biking, swimming,
gardening, etc. may be more useful to practitioners than passive activities, such as sitting and
thinking (Dijksterhuis & Meurs, 2006; Sio & Ormerod, 2009). Contact with nature also appears to
positively affect the cognitive processes associated with rumination (Atchley, Strayer, & Atchley,
2012; Van Den Berg et al., 2007) — although most studies of the phenomenon take place in
laboratory settings, instead of the types of places commonly described by creative people. Some
people find riding in a car, bus, or train beneficial, as well (Buttimer, 1983; Ghiselin, 1954;
Törnqvist, 2004). Researchers have speculated that the sensory stimulation from sights, sounds,
smells, and motion of a vehicle may aid the process (Ghiselin, 1954; Törnqvist, 2004). It appears
that rumination may be supported in the interstitial spaces between places — where the mind is
not completely focused on any one thing and may hold multiple, sometimes competing, and
often incomplete, thoughts. These may be majestic and contemplative places, like cloisters of the
monasteries in Assisi, Italy said to have inspired Jonas Salk, or the plaza of the Salk Institute

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where Salk directed Louis Kahn to capture some of those same qualities (S. W. Leslie, 2008, 2010). Just as effective, however, may be the more modest settings of the interstitial spaces between places, such as the tree lined walks between university campus buildings or the bicycle path that leads from home to work.

Rumination (Place-scale) Objects: Diversions

Place-scale objects appear to be less important to rumination than events and processes, however they can play a role in low cognitive load activities. Johannes Brahms is quoted as saying "the best songs came into my head while brushing my shoes before dawn” (Erb, 1913, p. 9). For some people repetitive motion through interactions with place-scale objects may help to engender or sustain rumination. The regular and predictable rhythm of riding a bike or shining shoes may help the creative practitioner sustain rumination (Törnqvist, 2004), perhaps by supporting the defocused attention believed instrumental for the process (Ansburg & Hill, 2003; Martindale, 1999; Rawlings, 1985; Vartanian et al., 2007).

Rumination Relationships: Intersections

The primary relationship during rumination is between the creative practitioner and the processes that interfere with non-productive fixation on a creative problem. The intersection of the non-related activity with ruminative thought can sometimes lead to breakthrough by allowing the creative practitioner to perceive affordances in the creative situation through abstraction of the problem (D. Ward et al., 2011). Philo Farnsworth was plowing a field when he came up with the idea to project moving images line-by-line — which led to the invention of the television (Thomas, 2004). J.K. Rowling was riding on a train when she conceived the Harry Potter character (Compson, 2003, p. 28). George de Mestral came up with the inspiration for Velcro as he picked burrs off of his dog after a walk in the woods (Hargroves & Smith, 2006). Sometimes the ideas that occur during rumination bear no obvious relationship to features of environment in
which they occurred, but there are many anecdotes where the ruminative setting itself sparked inspiration or analogy that led to breakthrough on a creative problem.

**Rumination Attributes: Sensorimotor Experiences**

The attributes of places, processes, and objects that support rumination might best be described as sensorimotor. The places people go, the things that they do, and the items with which they interact during creative rumination appear to both stimulate the senses and engage the body in repetitive and mundane tasks. Such semi-automatic activities place low cognitive demands on the creative practitioner, but they also are enjoyable for the creative practitioner. Brahms may have liked to shine shoes (Erb, 1913, p. 9), but Samuel Johnson preferred to pet his cat, Hodge (Boswell, 1907, p. 1004), and E.A. Housman found long walks both enjoyable and productive for creative rumination (Ghiselin, 1954).

**Design Principles for Evaluation**

Evaluation is largely a socio-cultural process and the settings that support evaluation range from physical places to technological sites (R. J. Sternberg, 2006b). In some cases the creative practitioner may never occupy the evaluative setting directly. Creative performances may take place around the globe. Scientific discoveries are typically replicated in private laboratory spaces. Socio-technical environments have no physical location and creators may not even be members of the virtual communities who use, filter, rate, and curate their ideas and products.

**Evaluation Places: Curatorial Settings**

Evaluation is supported by the places of implementation for which a creative idea or product was intended. Such places are often socio-cultural settings that include critics, users, and curators of the creative product or idea. The physical settings for evaluation traditionally include places like the jazz club, concert hall, theater, opera house, cinema, art gallery, or conference hall. Evaluation is supported by settings that provide broad exposure for a creative product or idea and invite critique from experts and users (Csikszentmihalyi, 1996; R. J. Sternberg, 2006b).
The division between physical space and technological space may be blurred in some settings.

Creative ideas and products may be widely and rapidly disseminated through radio, video, television, e-journals, e-books, web conferencing, etc. — and evaluation can happen anytime, anywhere. Even when the physical products of creativity cannot be distributed or tested electronically (e.g. a new automobile design,) professional and user critiques may still be compiled in socio-technical environments (e.g. Caranddriver.com, Motortrend.com, Edmunds.com, etc). Evaluation is generally supported by social density and connectivity, whether through physical spaces or technological sites (or both) (Fischer, 2005b; R. J. Sternberg, 2006b; Stolarick & Florida, 2006).

**Evaluation Events and Processes: Implementation Spaces**

For the creative practitioner, evaluation is engendered and sustained through feedback from implementation and use (McCall, 2013). The definition of use, however, varies between domains. For the performing arts, use is the audience or critics’ experience of the performance. In the scientific domains, use may include replication of an experimental protocol or application of a new theory. Evaluation in industrial design occurs through production and in architectural design evaluation typically consists of scholarly critique, historical analysis, and the occupants’ experiences. Evaluation happens over time and space and feedback may be incremental (Csikszentmihalyi, 1996; R. J. Sternberg, 2006b). Although evaluation appears to be the end of the creative process, this feedback may engender new work on the creative idea in order to improve it, or even lead to the discovery of a new creative problem to pursue (McCall, 2013). Evaluative settings, therefore, may play an overlooked role in the generation of creativity.

**Evaluation (Place-scale) Objects: Ventures**

In most cases the place–scale object that supports evaluation is the creative product itself. In some cases, however, this is not possible and instead a model is used during the evaluation process (Watson, 1968). Models are frequently used in many disciplines including
mathematics, the sciences, and environmental design (Elser et al., 2012; Watson, 1968). As mentioned previously, a famous example of model use in science is the work on the structure of DNA by Crick and Watson (Watson, 1968). In the field of architecture, models often serve for evaluation of a building design by clients, users, and the design team due to the expense and permanence of constructing a building. Some architectural projects are unbuilt works and the model becomes the object of final critiques by experts in the field — and in some cases it is treated as a complete work of art in and of itself (Elser et al., 2012, pp. 11–21). In any case, when the externalized creative idea is disseminated for critique it becomes a venture — something at risk of rejection or failure. The process of putting a creative idea out into the world for appraisal is a risky undertaking and the outcome of the evaluation process is uncertain (R. J. Sternberg, 2006b).

**Evaluation Relationships: Feedback**

The primary relationships during evaluation occur around feedback from critique or use (Csikszentmihalyi, 1996; McCall, 2013; Schön, 1983). Feedback may come in two forms: primary, when the creative practitioner observes the feedback firsthand, and secondary, when feedback comes to him in terms of verbal or written critiques from users and experts (professional critics) (McCall, 2013). In the case of primary feedback, the creative practitioner directly perceives feedback from implementation (McCall, 2013). Evaluation may be engendered by an event (such as when a someone uses a product in a way other than how the practitioner intended it) and may be sustained by a process (such as observing a live performance and the audience’s reactions to it) (McCall, 2013; Schön, 1983). Secondary feedback is generally obtained through a social relationship between practitioners and critics, who may be novices (e.g. users) or experts (e.g. professional critics or other experts in the field in which the practitioner practices) (Csikszentmihalyi, 1996; Fischer, 2005b; McCall, 2013; R. J. Sternberg, 2006b).
Evaluation Attributes: Networks and Filters

Evaluation is supported by social connectivity (Florida, 2012; R. J. Sternberg, 2006b; Stolarick & Florida, 2006). Creative products and ideas are disseminated across networks (both physical and technological); and dissemination processes are affected by social density, diversity, and connectivity of these networks (Csikszentmihalyi, 1996; Feldman et al., 1994a; Florida, 2012; R. J. Sternberg, 2006b; Stolarick & Florida, 2006). As discussed earlier in this chapter (and in Chapter II), the links/nodes design pattern is intended to support social connectivity. Something not typically addressed in environmental design literature, however, is how attributes of these physical configurations serve as filters by controlling who can access creative products and ideas, and when, where, and how they can access them. Technological environments have their own filters, but by and large, socio-technical spaces have weaker filters — and thus promote more egalitarian access — than physical space. The role of technology and its interrelationship with the built environment has been largely overlooked in the environmental design literature. Some emerging work at the intersection of technology and architectural design, sometimes referred to as interactive design or 4d space, is being conducted at the smaller scales of product, interior, and architectural design (Bullivant, 2007; Fox & Kemp, 2009). This research, however, does not specifically examine how interactive spaces might support creative processes.
<table>
<thead>
<tr>
<th>Creative Mode</th>
<th>Problem-finding</th>
<th>Immersion</th>
<th>Reflection</th>
<th>Rumination</th>
<th>Evaluation</th>
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<td><strong>Places</strong></td>
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<td>Curatorial Settings</td>
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<td><strong>Events + Processes</strong></td>
<td>Attractor/Reactor Space</td>
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<td><strong>Relationships</strong></td>
<td>Participant/Obseserver</td>
<td>Transparent Equipment</td>
<td>Cognitive Artifact</td>
<td>Intersections</td>
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<td><strong>Attributes</strong></td>
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<td>Networks + Filters</td>
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<td><strong>Physical</strong></td>
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<td><strong>Social</strong></td>
<td>(Opportunities for social interactions)</td>
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Rich Environments Empower Creative People in Five Ways

The design principles described here illustrate how rich environments empower creative practitioners. There are five general ways of empowering them that are worth highlighting. Some help to explain why the environmental design strategies reviewed in Chapter II have produced unanticipated results. Others reveal issues that are rarely considered in the design of settings to support creativity. These concepts summarized here distinguish “optimal” rich environments from “everyday” workplace settings.

1. Rich Environments Help Creative People Move Between Creative Modes

Environmental conditions that support one mode of creativity will inhibit another. The review of environmental design strategies in Chapter II revealed that many settings intended to support creativity focus on promoting social interactions. The few empirical studies that examined the effect of such design strategies found that social interactions did increase, but creative productivity was negatively impacted. Oftentimes these settings promote one creative mode (such as problem–finding) to the detriment of others (like intuitive immersion). Not only is each creative mode an instrumental part of the creative process, but movement between modes helps creative practitioners work through the complexity of creative problems. Breakdowns are important to creativity. Creativity is supported when features of the designed environment empower the creative practitioner to curtail an unproductive mode of creativity in order to engender another. Conversely, when people do not have the ability to sustain different modes of creativity, creative productivity may be negatively impacted. If a setting is designed to sustain only some modes of creativity — or stimulate only certain kinds of breakdowns (such as unanticipated social interactions) — then creative practitioners may not be able to sustain other modes (like immersion and rumination) long enough to be very productive.
2. Rich Environments Amplify Creative People’s Creative Abilities

Creative practitioners rely on features of their environments to help them uncover hidden and potential affordances in a creative situation. Although the white, empty art studio may be a figural representation of a creative space as a “blank slate” where anything might happen, in reality the places where artists work are often sensory-rich and full of tools, materials, and other inspirational objects (Fig, 2009). Creative people need things to think with (A. Clark, 2008a). Settings inhibit creativity when they do not provide sufficient resources to help people externalize their ideas (Amabile, 1998). Those that focus only on digital resources (like the teleconferencing and video projection technologies in the innovation labs described in Chapter II) also miss opportunities to more effectively support creativity by providing a variety of sensory rich tools, materials, and objects to engender problem–finding, sustain immersion, trigger reflection, and promote evaluation.

3. Rich Environments Help Creative People Orchestrate Creative Experiences

Creativity happens in both structured and unstructured spaces and activities. The process is supported by varied degrees of user control — with intuitive immersion typically sustained by the most highly structured and controlled environments and problem–finding often engendered by the least restrained settings. Even the most structured creative environments, however, still empower creative practitioners to customize or adapt them to their changing needs. Unstructured spaces and activities are more often overlooked than structured, although this appears to be changing (at least within certain industries.) Some organizations in the technology sector support unstructured activities through workplace practices where they require employees to find and pursue their own creative problems for a percentage of their work week (Johnson, 2010, pp. 91–95). This strategy to support creativity, however, is typically conducted within the regular structure of the workplace setting. A few companies do include workplace spaces for unstructured social and physical activities (such as the building atrium and campus grounds at Pixar described in Chapter II) (Isaacson, 2011, pp. 430–431). There is a lack of literature,
However, concerning the effects of providing creative practitioners freedom to work wherever or whenever they like. I suggest that some creative modes (such as problem-finding) may benefit from greater access to unstructured spaces and activities than can be provided in work settings. This is an area of empirical investigation that warrants further attention, particularly with the advent of new technologies that support any–time, any–where work, learning, and collaboration.

4. Rich Environments Inspire and Restore Creative Productivity

The environmental features that people do not specifically attend to during creativity may play a significant role in creative productivity. This is true, for example, with tools used during immersion. They shape the creative practitioner's creative experiences, but only function if they do not draw attention (Sennett, 2008). However, there are other features of the designed environment that also appear to exert what Murray (1938) describes as objective pressure, environmental influences that directly are perceived through direct sensory stimulation although not directly attended to. During creativity people claim they draw creative inspirations from majestic landscapes (Csikszentmihalyi, 1996) and prefer to work in rooms with natural materials and daylighting (Ceylan et al., 2008; McCoy & Evans, 2002). Research suggests that it may not be simply the aesthetics of these features that explain their wide appeal. Time spent in natural settings (Berman et al., 2008; Hartig et al., 2003), views of plants (Bringslimark et al., 2009; Dijkstra et al., 2008; Raanaas et al., 2011), natural lighting (Boubekri et al., 1991; Leather et al., 1998; Wang & Boubekri, 2010, 2011), and ambient noise (Mehta et al., 2012) have all been found to improve cognitive processes associated with creativity. These features appear to be particularly beneficial during the intuitive processes of immersion and rumination. There is some debate in the literature about what effect these environmental features have on creative processes (such as arousal, attention restoration, or processing disfluency). What they have in common is that they help the creative practitioner focus on a productive line of creative thinking.
5. Rich Environments Promote Creativity—in—Action

Creativity is neither sedentary activity nor a purely mental process (as it is often described in the creativity literature.) It involves interactions with objects, people, and places in—the—world (Csikszentmihalyi, 1990, 1996). People engage with the tools and materials of the creative situation during immersion. They use things to think with during intrapersonal and interpersonal reflection. They may walk, bike, jog, or swim to sustain rumination. Rich Environments can help “nudge” people into action by providing a wide variety of affordances. The types of affordances, and how they are actualized, may cause beneficial “breakdowns” in some modes of creativity while triggering others. Thinking and acting are intertwined; therefore the types of activities afforded by a particular environment will influence the modes of creative thinking that may occur within it.

Design Methods for Rich Environments

User—Centered Design: Performance and Phenomenology

The discussion in this chapter illustrates how features of the designed environment support different modes of creativity both by what people perceive and attend to and by what they only directly perceive. This suggests that environmental design approaches should focus on how a setting supports both human performance (i.e. functional concerns) and phenomenological experiences (i.e. aesthetic concerns). In a performance—driven approach, the environmental designer focuses first on identifying the activities that will occur in a setting, and then develops a design to support those activities. This differs from morphological or prescriptive approaches premised on the replication of forms or design patterns to elicit particular creative behaviors. Performance—driven approaches largely consider what Murray (1938) referred to as perceived environmental pressures (beta press.) The phenomenological approach, in contrast, focuses on objective environmental pressures (alpha press) — those directly perceived and not attended to. Introduced in Chapter III, this design approach, as advocated by Pallasmaa (2005), emphasizes
multi-sensory environmental design (which has historically strongly privileged sight over the other senses). It also considers the role of movement and activity in perception. As Pallasmaa (2000) explains, “A building is encountered; it is approached, confronted, related to one’s body, moved through, utilized as a condition for other things. Architecture directs, scales, and frames actions, perceptions, and thoughts” (p. 8).

The design principles presented here are intended as an empirically-based system to guide design decisions. They are intentionally general, because settings must ultimately support the specific individualized practices of creative individuals. Environmental designers should understand differences between groups of people working in various creative domains, as well as differences among individuals working within the same creative domain. Generally, relationships between creative practitioners and features of their environments (e.g. events, processes, and objects) serve to engender, sustain, or inhibit creative modes by providing action opportunities for the creative person. Specifically, however, creative activities are not the same for all people across domains. Although the type of feature (such as object) may engender a particular mode (immersion), the attributes of the object will often differ. Simply put, attributes that engender immersion for an artist (e.g. “paint-ability”) will differ from those that engender immersion for a musician (e.g. “strum-ability.”) Although this difference seems obvious at the scale of the object, it may become less so at the scale of the city. Environmental designers must consider how to support the unique, domain-specific activities and processes that are particular to each individual project. The Rich Environments Design Principles provide the skeletal structure for informing the design of settings to support creativity. To identify the programmatic requirements particular to each project, the environmental designer must develop understanding about the particular performance requirements unique to each case.

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75 There are variations in the phenomenological design literature. For the purposes of this dissertation I will refer exclusively to Pallasmaa’s approach, since it aligns with the enactive cognition perspective.
**Multiscalar Design Strategies**

Each mode of the creative process is supported by different features of the designed environment — and these features occur at different environmental design scales, ranging from product design to city planning. As a rule of thumb, the optimum environmental scale of a design intervention often corresponds to the size of the creative practitioner’s field of attention during the mode. Thus immersion, with the narrowest field of attention may be best served by design interventions at the smaller environmental scales, such as product, interior, and architectural design. During reflection, the attentional net widens a bit to perhaps include the urban design scale to foster wider social interaction and more opportunities for feedback from use. Rumination, which often occurs in interstitial spaces, may be best enabled by interventions at the architectural, landscape, and urban design scale. Problem-finding and evaluation both require the widest field of attention, and thus interventions at the urban design and city planning scales may be more impactful than those at smaller environmental scales. This rule of thumb, however, operates best at the level of general design principles. Each environmental design project will have its own set of domain and individually specific creative practices to support.

As illustrated in the preceding section all categories of environmental features play a role in each mode; thus all environmental scales have something to contribute to each mode. For example, because the immersion mode requires a narrow attentional net in order to maintain focused attention to the task at hand, the primary environmental scale is focused around the tools and material (products) and the attributes of personal workspaces (interiors.) The immersion state, therefore, may be of primary concern to product designers, interior designers, architects, and, in some circumstances, landscape architects (e.g. to design natural settings that can be viewed from workspaces). Conversely, the problem-finding mode often requires the widest field of attention, thus interventions to support this mode may focus more on urban design and city planning policies. This does not mean, however, that design interventions to

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76 Refer to Chapter II for a review of the creative city literature and debates around the impact of city planning policies on creative productivity.
promote problem finding at the smaller product, interior, or architectural scales are insignificant. These design interventions tend to become more domain-specific at the smaller scales, so general design principles are less applicable. For example, new scientific problems are frequently discovered in the laboratory — such as when an experiment produces unexpected results or a theory fails to predict an observed outcome. In these domain-specific cases, the laboratory becomes a problem-finding setting and the particular tools, materials, and attributes of the setting particular to that domain may enable or sustain the mode for the scientist.

**Participatory Practices**

The general design principles presented in this chapter are intended to guide the design of settings to support creativity, but they are not sufficient for informing the design of particular settings. There are numerous domain and user specific activities and needs that must be addressed through environmental design interventions. Participatory design practices are a means of identifying creative processes and practices that should be supported by an environmental design, such as a new building design or interior renovation. Participatory design is a method of gaining user and stakeholder input on a project during the pre-design or pre-planning stages (Zeisel, 2006). Typical methods include surveys, focus groups, and individual interviews (Zeisel, 2006). Creative practitioners may be unable to make explicit the more intuitive or subconscious aspects of their creative processes — the types of processes that are generally most sensitive to environmental conditions. With this in mind, the environmental designer can look to participatory methods that may help surface intuitive behaviors. Multiple methods of data collection may include direct observations, trace observations (when the researcher examines an empty setting for evidence of use), image elicitation (when researchers elicit user responses to photos or drawings), and cognitive mapping exercises (when participants draw detailed maps of their spaces from memory) (Zeisel, 2006).

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77 Experience sampling method, developed by

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This list is intended to serve as a starting point for a suite of useful research methods, by beginning with those that are currently more commonly used in practice. There are many new digital technologies that show promise for future research and practice.
Csikszentmihalyi (1987) to study intuitive processes, is a method where participants wear beepers and are periodically “beeped” to answer questions about what they are doing in that moment. It is useful for environmental design professionals who are involved in the pre-design and pre-planning phases to become educated in qualitative and quantitative research methods in order to better anticipate a range of events and processes that will occur in the spaces they design. Participatory processes are limited, however, by time, expense, and the power people have to imagine settings beyond their range of experiences. The Rich Environments Design Principles may then be used to help creative practitioners reflect upon their own creative processes and identify strategies to use their environments more effectively.

**User–Responsive Design**

Even the most carefully planned environmental design interventions cannot predict all the events and processes that may occur once they are in use. The expertise of the environmental designer to anticipate variation and change in creative activities over time can be improved with the design of adaptable settings that allow for customization of, and alteration to, original design intentions as users’ needs change. This form of user-responsive design can improve the probability of success for settings intended to promote creativity by allowing creative practitioners to modify designs in the face of particulars. User-responsive environments find the balance between customized and customizable design. These settings neither dictate how users must perform within them nor demand user participation in order to make them functional. They provide structure, but also allow for improvisation between creative practitioners and their environments. Ultimately the balance between fixed and adaptable features may be informed by examining creative people in their setting in order to identify what types of flexibility really matter to them.

Environmental designs may empower users by enabling them to customize, manipulate, and reconfigure places and objects to suit their needs. Unanticipated events and process can occur due to the inability for creative practitioners to surface all of the information necessary to
support their creative processes. Other unplanned events will likely be the result of changes in individual and group processes. As discussed throughout this dissertation, creative practitioners use strategies to alter their processes and their environmental conditions when productivity wanes. Unanticipated situations may also arise in response to the changing nature of creative products, which may require new tools, materials, and processes.

Adaptations allow opportunities for environmental designers to learn more about how best to design for creative practitioners. Post occupancy evaluations may help environmental designers understand how best to design for responsivity and adaptations — so users are not burdened with under designed or constrained environments. It may be even more beneficial for environmental designers to learn from design interventions that do not function well than those that support creativity well. The things that inhibit creativity demand particular attention, because creative practitioners are quite proficient at making features of the designed environment work for them — as long as they are able to perceive and actualize the affordances provided.

**Empowering the Creative Practitioner Through Rich Environments**

The concept of Rich Environments is a response to the existing strategies used to design environments intended to support creativity, as illustrated in the Chapter II literature review. Informed by both the Multi-Modal Process Model of Creative Practice as well as the Creativity in Context Framework, it situates existing and new design principles and methods to support creativity within the context of the modes of creative practice. It takes as its central tenet the goal of designing environments to enable creative practitioners. It acknowledges that cognitive, social, and physical processes are intertwined in the person–environment relationship. They cannot be untangled, nor should they be. The physical environment is an instrumental component of the creative process. Only through understanding the person–environment relationship with respect to each of the cognitive modes of creativity can design professionals develop the environmental strategies necessary to support them.
CHAPTER VIII
SUMMATION, FUTURE RESEARCH, AND CONCLUSION

Summation

I set out in this dissertation to investigate the role of the designed environment in creativity. Responding to the growing interest in designing settings to support creativity, I hoped to develop a theoretical framework, grounded in creativity theory, to guide the design and evaluation of these settings. As I embarked on this process I soon discovered that there was no existing creativity theory suitable for such a framework. Creativity researchers either ignore the physical context of creativity or suggest it is not a productive line of inquiry. Teresa Amabile (1998), whose work has focused on the social context of creativity, asserts that the physical features of a workplace are of little importance to creativity. Mihaly Csikszentmihalyi (1996, p. 135), suggests that physical context is important for creativity, but asserts that it is probably impossible to examine empirically. With little foundation upon which to base my research, I began to investigate what role (if any) the designed environment played in creativity.

This investigative process was driven by a thorough review and evaluation of the creativity, cognitive science, and environmental psychology literatures — along with an analysis of environmental design strategies, first person accounts by creative practitioners, and my own creative experiences as an architect and environmental design educator. Subsequently, I constructed my own theory of the creative process. My Creative Practice model describes creativity as a combination of five physically-situated and interrelated modes of creative cognition. This model rebuts Amabile’s assertion that physical context is not important to creativity. Next, I developed a theoretical framework to connect creative processes to the designed environment. The Creativity-in-Context framework provides a structure to organize empirical examination of the relationship between the designed environment and creativity —
which rebuts Csikszentmihalyi’s suggestion that this relationship is impossible to examine empirically. With the Creative Practice model and Creativity–in–Context framework as a new foundation, I was then able to develop the Rich Environments Design Principles and Methods. These provide a preliminary structure to assist environmental design practitioners as they plan and evaluate settings intended to support creativity. The following sections provide a more detailed summary of this process and highlight the significance of my contributions to the fields of creativity and environmental design.

**Why the Gap Between Theory and Practice?**

In the early chapters of this dissertation I demonstrated that a gap exists between the creativity and environmental design literatures. Despite the numerous examples of buildings designed to foster creativity among users, there is little evidence that such strategies are based on more than folk knowledge or substantiated by post occupancy analysis. Additionally, the creativity literature focuses almost exclusively on purely mental processes or the socio–cultural environment, largely ignoring the physical context of creativity. I suggest that this gap between research and practice is fundamental to understanding why 1) environmental design strategies have failed to effectively predict how settings support creativity, and 2) creativity research has largely ignored the role of the physical environment in creative process. In other words, it is a “chicken–and–egg” problem. Creativity researchers suggest that the physical environment is not a productive line of inquiry because environmental design strategies have failed to consistently demonstrate its effect on creative productivity (Amabile, 1998; Csikszentmihalyi, 1996, p. 135). Yet without an empirically grounded theory upon which to base design decisions, environmental designers are left to devise their own normative theories based on anecdotes and folk knowledge — which yield inconsistent results.
Embodied and Embedded Cognition Form a Bridge

Next I suggested that the cognitive science literature in the area of situated cognition might serve as a first step toward bridging the gap between the environmental design and creativity literatures. A review of the situated cognition literature suggests that the physical environment must be instrumental to creative processes, however it does not determine human behavior. The designed environment mediates cognitive processes as well as social interactions, making it necessary (although not sufficient) for creativity. I propose that Gibson’s (1977) affordance theory provides a common theoretical grounding for both the creativity and environmental design literature. I further extend work on Gibson’s original theory by Chemero (2003) and Heft (2001, 2007) with the concept of potential affordances. Potential affordances are action opportunities in the environment that require additional creative work on the part of the perceiver in order to actualize them.

A New Physically–Situated Creativity Model

I then proposed the Multi-Modal Process Model of Creative Practice as a physically situated model of creativity that is grounded in affordance theory. I used Csikszentmihalyi’s (1990) theory of creative flow and Schön’s (1983) reflective practice theory as the nucleus for this new process model. Building from the two modes described in these theories, my model describes creativity as five interrelated modes: problem–finding, intuitive immersion, explicit reflection, semi-explicit rumination, and evaluation. My Creative Practice model provides several new contributions to the creativity literature. First, it describes the role of the physical environment in creative processes. This is something all but Csikszentmihalyi’s flow theory fail to do. Second, it illustrates how creativity is an iterative and spiraling process of interrelated modes. Existing models describe creativity as a sequential series of stages — with no explanation for the relationship between stages or how the process is iterative. Third, it reveals that breakdowns are a positive and crucial component of the creative process. Breakdowns help the creative practitioner move between different modes of thinking about the creative problem. Finally, the
Creative Practice Model demonstrates how the physical environment is instrumental to the breakdown and repair processes during creativity.

**A New Theoretical Framework to Link Theory and Practice**

With the introduction of the *Creativity–in–Context Theoretical Framework*, I proposed a solution concerning how to consider the person–environment relationship during creativity. This new framework bridges the creativity, cognitive science, and environmental design literatures and provides five unique contributions. First, it incorporates the Creative Practice Model to illustrate how the relationship between people and their environment is mediated by their mode of creative cognition. Second, it employs a Taxonomy of Environmental Design Features that I developed to evaluate all scales of the designed environment — from tools to cities. I propose that this taxonomy is necessary to connect the disparate literatures in the environmental design disciplines and essential for understanding how design strategies can effectively support creativity across the many scales of the designed environment. Third, the framework illustrates how the perception of affordances (and potential affordances, in particular) is instrumental to creativity. Fourth, the Creativity–in–Context Framework shows how the creative practitioner *exploits* features of the designed environment to move more efficiently between modes, thereby increasing creative productivity. Finally, the framework rebuts Csikszentmihalyi’s (1996, p. 135) claim that it is impossible to empirically examine how the physical environment might increase creativity by providing a structure to organize such future empirical investigations. Ultimately the Creative Practice model and the Creativity–in–Context framework contribute to the creativity literature because they describe testable hypotheses.

**New Design Principles and Methods to Assist Environmental Designers**

In conclusion, I introduced the concept of Rich Environments to describe the practical implications for the Creative Practice Model and Creativity–in–Context Framework. I proposed a two–fold strategy to assist environmental designers as they plan creativity settings: the *Rich*
Environments Design Principles based on the Creative Practice Model and the Rich Environments Design Methods based on the Creativity–in–Context Framework. The design methods include 1) strategies that focus on supporting human performance (performative design), 2) participatory practices to empower users with settings that support their full range of intuitive, explicit, solitary, and social creative processes (user–centered design), and 3) recommendations for designs that accommodate change due to unanticipated user needs and the evolution of creative processes over time (responsive design.)

The Rich Environments Design Principles are intended as a preliminary critiquing system both to guide environmental designers as they work with users during the planning stages of a project and as a structure against which to evaluate existing settings. The guidelines are based on four general principles. First, each of the five creative modes is best supported by different environmental preconditions. Second, the environmental conditions that support one mode may inhibit another. Third, the relationships between some modes are closely intertwined (e.g. immersion and reflection) and best supported by environments that enable transition between modes. Finally, people change environments to help them move between modes and increase their creative productivity. These principles reveal how common environmental design strategies intended to support creativity frequently bias one mode of creativity over the others — sometimes creating conditions that are inhibitory to certain modes and thus negatively impacting creative productivity. These principles also help to explain why some design strategies fail — such as Louis Kahn’s strategy for separating the scientists’ offices from their laboratories to foster social interactions at the Salk Institute. The guidelines describe how creativity is supported by places that are serendipitous for problem–finding, inspirational during immersion, evocative to trigger reflection, restorative during rumination, and exhibitionary during implementation and evaluation. Only rarely, however, does the typical workplace setting provide these different environments.

Together the Creative Practice Model, Creativity–in–Context Framework, and Rich Environments Guidelines form a starting point, a preliminary organizational system, for future
research on the role of the physical environment in creative processes. These are not intended to be static or prescriptive design codes. It is through design–based research and experimentation that these guidelines and methods may best be questioned and refined. For example, some of the most renowned buildings were based on design strategies that contradicted what users said they wanted (Hughes, 2008; Kahn, 2003; S. W. Leslie, 2008). In some cases these strategies were enormously successful from both critic and user perspective, but in others architecturally acclaimed structures have alienated their occupants. Without an informed position and theoretical grounding from which to make decisions, designers’ actions are arbitrary and outcomes a result of chance or misunderstood factors.

**Future Research: Radically Rethinking The Places Where We Work, Learn, and Live**

Horst Rittel famously described environmental design problems as “wicked problems” (Rittel & Webber, 1973). He suggested that environmental designers have “no right to be wrong” with the design decisions they make because the economic, social, and environmental impact of their decisions are significant. In this dissertation I have revealed that, in too many cases, environmental designers have been wrong about how to design settings to support creative work. They have employed design strategies intended to coerce social interactions without full understanding of the impact on creative productivity or the nature of the person–environment relationship during creativity. Radically rethinking how to design for creativity means settings must empower creative practitioners, not attempt to control their behaviors.

Environmental design problems are inherently creative problems — meaning there is no single optimal solution (Rittel & Webber, 1973; Simon, 1996, pp. 27–30). The role of environmental design is not to simply problem–solve by applying research from the scientific domains to design solutions. Instead creativity is required to question current design methods and strategies through active experimentation from an empirically informed position. In the following sections I briefly propose how the Creative Practice Model, Creativity–in–Context Framework, and Rich Environments Guidelines might provide this empirical grounding. They...
create the structure from which environmental designers can radically re-envision the ways we empower creative practitioners in the places they work, learn, and live.

**The Future Creative Workplace**

As I mentioned in Chapter VII, workplace design has tended toward strategies that “shove” instead of “nudge” people towards particular behaviors — such as forcing social interactions in hopes of spurring collaboration and creativity. Even flexible workplace policies, like those that promote free time to pursue personally interesting projects, are often contradicted by physical settings that are inherently inflexible. Open office plans may implicitly communicate to creative practitioners that organizations value hours logged at the desk and evidence of social collaborations. This might leave employees with the impression that they need to remain at their desks or converse with colleagues even if it negatively impacts their creative productivity. Future workplace designs may emphasize physical freedom and choice by providing access to the variety of settings that support different modes of creativity. Going a step further, workplaces might also be designed to “nudge” people, reminding them how they can improve productivity through different creative behaviors. Design strategies could be as simple as visual cues that are noticed when attention strays from the task at hand — reminding the creative practitioner that other resources and environments are available to engender different modes of creative thinking. A bit stronger nudge might be provided by technological developments where productivity is augmented electronically. When it wanes, the creative practitioner might be given a gentle reminder, such as... “I see you’ve been working on that same problem for a while now. How about a nice walk in the garden? The weather is warm and sunny outside!” Or... “Perhaps you would enjoy a cup of coffee from the café? I see that your colleagues Joe and Melinda are there right now.” Ultimately, however, the workplace of the future may in fact not be “a” work place at all, but a loose network of places where people within an organization regulate their own work environments based on balancing personal and organizational creative goals and processes.
The Future of Educational Settings to Support Creativity

The future university campus, a place long associated with creativity and innovation, may begin to blur the division between workplace and learning space. Recent economic and technological developments threaten the survival of “bricks-and-mortar” institutions due to rising tuition, dwindling government funding, and competition from open source Massive Open Online Courses (MOOCs). Many have called for the academy to rethink the large lecture course delivery model in light of growing alternatives for free, any–time, any–place learning provided by MOOCs. Yet what does this mean for creativity? This dissertation reveals that place does matter for creativity; thus there is likely a viable future for bricks–and–mortar institutions. (Although it may require radically re–envisioning what the future of learning will look like on university campuses.) The diversity of physical spaces and social opportunities they offer leave universities uniquely positioned to play a role in re–conceptualizing the workplace described in the preceding section. Large lecture halls might become the site for public screenings. A virtual smorgasbord of open online courses, curated by local faculty, can provoke social interaction and discussion for salon–style events following the screening. The blurring of divisions between the academy and industry may not only spur knowledge sharing and collaboration, but might also alleviate some resource pressures. Underutilized campus spaces could be leveraged by organizations as they structure a network of employee workplaces. In turn, resources generated from screenings and rental fees could be used to offset student tuition and fund the re–conceptualization of the university classroom — as it evolves from the lecture format to a more faculty–intensive studio and discussion model that better supports creativity.

The Future (New) Urban Neighborhood

The neighborhood of the future may provide the fabric that links working, learning, and living spaces to support creativity. New Urbanism is a movement that promotes walkable neighborhoods and a variety of housing and workplace options — all with the intention of fostering a sense of community (Ellis, 2002). Interestingly, many of the design principles outlined
in the charter produced by the Congress for the New Urbanism (CNU) (2001) also support creativity. For example, the New Urbanism movement is credited with pioneering the live–work housing that has become popular with the creative class (Ellis, 2002). However, it has also been largely criticized for its trend toward nostalgic architectural styles and traditional town planning, ignoring the social and economic realities of the urban condition, and a reliance on ideology over theory (Ellis, 2002; Fainstein, 2000). I suggest that with a theoretical grounding in creativity, New Urbanism might be re–conceptualized to address some of its shortcomings. It can provide a coherent vision for urban planning strategies that empower creative practitioners by providing them the resources they need to exploit their environments in service to creative productivity.

**Conclusion: Towards an Ecological Psychology of Creativity**

In the 1970’s Teresa Amabile noticed that creativity research focused almost exclusively on the psychometric dimensions of creativity and set out with her dissertation to spearhead a new field of research: the social psychology of creativity (Amabile & Pillemer, 2012). Unbeknownst to her at the time, a few other researchers were coming to a similar realization and together they produced a shift in the field, which now considers creativity a socially situated process. Although the social context of creativity has garnered much attention, the physical context of creativity has been neglected. The small body of emerging research I introduced in Chapter II does suggest, however, that interest in this area may be growing. I argue that the time is right for yet another shift in the field of creativity research: one that understands creativity as a process physically embedded in the world. It is my hope that this dissertation might contribute in some way to this transformation — towards an ecological psychology of creativity.
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