DOI:10.6129/CJP.202106_63(2).0002
中華心理學刊 民 110，63 卷，2 期，121-142
Chinese Journal of Psychology 2021, Vol.63, No.2, 121-142

# Creativity in Design Thinking: Inspiring Sense-making and Thing-making

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Design thinking is a creative method to wicked problem solution. However, the existing operational models lack of identifying mechanisms for creativity. An inspiration model was proposed in the study to illustrate the complexity integration of the divergence and convergence in problem exploration and solution development. The inspiration of problem exploration is sense making; the inspiration of solution development is thing-making. The "evoke-transcendence-action" mechanism of the inspiration model was adopted to describe the creative operation of sense-making and thing-making in design thinking. In the sense making of problem exploration, a design researcher comprehensively empathizes with the experience of a user. Through the systematic analysis of the content, history and context of the experience, the designer and the user may understand each other (evoke), and the story is presented through the narrative analysis. An understanding of the user's experience then leads to the insight of needs (transcendence), forming a specific definition of the problem (action). In the thing-making of solution development, through the interdisciplinary brainstorming (evoke), the promotion of growth mindset and polycultural attitudes in integrated research would liberate intellectual centrism and form a prototype of the aggregate multiple perspectives (transcendence), and further test (action) should be conducted for obtaining feedback and correction. In the study, mutual inspiration of knowledge co-creation was further proposed, stating how design research create progress with knowledge and forming the collective creativity of co-design. Finally, how psychology contributes to the development of design thinking was discussed.

***Keywords:*** *design thinking, inspiration theory, complexity integration, sense-making and thing-making, cocreation*

## Extended Abstract

Design thinking is a creative method to problem solving. However, existing operational models do not identify specific mechanisms for creativity. Here, we propose an inspiration model to illustrate the complex integration of divergence and convergence in problem exploration and solution development. Inspiration-based problem exploration involves sense-making, while inspiration-based solution development involves thing-making. An "evocation-transcendence-action" mechanism was adopted to describe the creative operation of sense-making and thing-making in design thinking. In the sense-making problem exploration, a designer empathizes with the experience of a user. Through the systematic analysis of the content, history, and context of the experience, the designer and the user may understand each other (evocation), and the story is presented through narrative analysis. An understanding of the user's experience provides insight into their needs (transcendence), allowing a specific problem to be identified (action). In the thing-making stage of solution development, through interdisciplinary brainstorming (evocation), the promotion of growth mindset and polycultural attitudes in integrated research liberates the designer from intellectual centrism and allows them to form a prototype encompassing multiple perspectives (transcendence). Further testing (action) should then be carried out to obtain feedback and allow for corrections. In this study, mutual inspiration of knowledge co-creation is further proposed, whereby

design research fosters collective creativity in co-design. Lastly, how psychology contributes to the development of design thinking is discussed.

## Creativity Mechanism in Design Thinking

In this study, it was found that creativity in design thinking is manifested in the effective divergence and convergence of "differentiation-integration" (Tetlock et al., 1993). The cognitive process of differentiation and reintegration involves the deconstruction and reorganization of existing concepts, resulting in the formation of new ideas. This process is termed "complexity integration thinking," and entails the complex differentiation and integration of contradictory structures (Suedfeld et al., 1992; Tadmor et al., 2009; Langer & Moldoveanu, 2002; Smith & Tushman, 2005; Tadmor et al., 2012). This allows the integration of incompatible or contradictory experiences and concepts, which is a key trigger for creativity (Cheng & Leung, 2013; Huang et al., 2015; Suedfeld et al., 1992; Tadmor et al., 2009). Recent studies have verified that this mechanism can promote creative expression in the face of paradoxical framing (Miron-Spektor et al., 2011; Leung et al., 2018) or multicultural experiences (Leung et al., 2008). In this paper, an "evocation-transcendence-motivation" mechanism is used to illustrate the creative mechanisms of divergence (differentiation) and convergence (integration) in design thinking.

**Discovery Phase.** The main purpose of the discovery phase is to promote a joint understanding between the user and the designer of the problems faced by the user, making it a joint sense-making process. Users not only provide important lived experiences but are also empowered through increased awareness and understanding of their own experience, as they are not necessarily aware of their own experiences (Kolko, 2018). Users' understanding of their own experiences can contribute to novel insights into their needs, ensuring that designers appreciate the users' experiences as a collective, and do not "over-empathize" with them (Blaszczak-Boxe, 2017) and lose objectivity. Design researchers must develop a knowledge of, and sensitivity to, the issues raised. In addition to the structured recording of the users' experiences (e.g., empathy maps) and the development of the experience (e.g., journey maps) (Stickdorn & Schneider, 2010), contextualizing the experience is important for understanding the meaning of the experiences and requires systematic thinking that encompasses the whole context (Seng, 1990). Design researchers must therefore use narrative analysis methods that integrate disparate experiences to inspire insights into users' beliefs and values (Lin & Liou, 2016).

**Definition Phase.** To define a problem is to reframe it to specify actionable design challenges and problem-solving goals. At this stage, the designer is akin to a pathologist, using knowledge of relevant "symptoms" to make a "diagnosis." At the same time, the user must also be involved in reaching a consensus on the specific problem definitions. As advocated by community action research (Seng & Schamer, 2006), designers offer theories and tools that empower users to reflect on the underlying causes of their issues and reach a consensus. The motivational theory of management by objectives (Drucker, 1995; Rodgers & Hunter, 1991) posits that when employees understand the objectives of a task and are involved in setting them, there will be greater buy-in, thus promoting greater engagement and motivation. At the definition stage, the designer and the user co-create by reaching a consensus on the specific design goals based on empirical insights into user's needs.

**Creative Inspiration for Sense-making.** In a diamond model of problem exploring with design thinking, the complex operation of divergence and convergence from discovery to definition is a process of sense-making. It was found in our study that the creative inspiration for sense-making lies in the researchers fully empathizing with user experiences. Through the systematic analysis of experience (content, process, and context), designers and users can evoke mutual understanding. Storytelling through narrative analysis facilitates understanding of the user's experience and provides insight into their needs (transcendence), leading to a concrete definition of the problem (action).

**Development Phase.** This phase is concerned with the consideration of a wide range of potential solutions. The creativity at this stage lies in the capability to think

fluently and to arrive at novel and flexible solutions.

Solution development often involves issue-driven interdisciplinary collaboration, and difficult problems often require creativity to reconcile conflicting demands. Liou and colleagues (Liou, 2011; Li et al., 2013; Chiu et al., 2016; Liou & Lan, 2018) worked with foresighted technology development teams at research and development institutions and interdisciplinary innovation design teams and reported that such groups encountered difficulties in carrying out their tasks and pressure to complete them, and when they became aware of disciplinary differences, they often ignored and excluded thoughts from other fields, insisting that their own ideas and practices were best, resulting in "intellectual centrism." In contrast, interdisciplinary team members who were aware of polyculturalism (Morris et al., 2015) tended to have more positive attitudes towards interdisciplinary learning, and had a "growth belief," in which they believed that collaboration with different disciplines helped them to solve problems. Such individuals usually had better team interactions and improved innovation performance as a result (Li et al., 2013; Liou et al., 2016; Leung et al., 2020; Keller et al., 2019).

**Delivery Phase.** It is prototypical of design thinking and the physical development of innovative designs to facilitate communication between users and interdisciplinary experts. Traditional design thinking is an iterative experiment in hypothesis development and validation. In contrast to problem discovery, which is about the user experience in the old context, the prototype testing phase is about reexploring the user experience in the context of the new design. Previous studies on organizational innovation (Lee et al., 2004) reported that an organizational culture of innovation is an experimental spirit of error tolerance that leads to increased innovation. Prototype testing encourages faster identification of errors and provides useful feedback for improved learning; this positive attitude towards mistakes is a growth mindset (Dweck & Leggett, 1988), whereby a person believes they can, and will, do better—an easily inspired attitude (Liou, 2017, 2018). On a larger scale, living laboratories and community action research are constantly identifying problems and refining experiences, promoting dynamic and continuously open innovation in the field.

**Creative Inspiration for Thing-making.** In the diamond model for problem exploring with design thinking, the integration of divergence and convergence from development to delivery is a process of thing-making. It was found in this study that the creativity of thing-making is inspired by interdisciplinary brainstorming (evocation). Moreover, in a pluralistic approach, through the integrated study of growth mindsets and the convergence of cultural attitudes, intellectual centrism can being removed and convergent thinking can be reached (transcendence) and further tested (action) and refined.

## Mutually Inspiring Knowledge Co-creation

**Clinical Research under Epistemic Asymmetry.** Understanding design thinking in terms of design research reveals that the aforementioned "problem-solving" exploratory process is essentially a form of clinical research under epistemic asymmetry (Jeffrey, 2016). Clinical research involves the development of knowledge about diagnoses and treatments. It has both a descriptive approach, which describes the behavioral facts, and a prescriptive approach, which develops strategies to improve behavior (Kahneman et al., 1982). Simon (1969) defined "design" in The Sciences of the Artificial as making the present environment better, and design thinking as an approach to knowledge development that improves future creative processes by combining description and prescription.

Design thinking therefore deals with real world issues. Edmondson and McManu (2007) proposed several criteria for the "methodological fit" of field research, whereby the research topic, past theoretical foundations, research methods, findings, and presentation of results must be internally aligned with the research protocol. This theoretical top-down confirmatory research should be paired with real upstream exploratory research to result in a hybrid method of verification and exploration. Increasing our knowledge of users' experiences is equivalent to the clinical understanding

of a symptom, which can then lead to a diagnosis. In the same way, design thinking progresses from exploratory to confirmatory research, i.e., from hypothesis generation to hypothesis testing. Creative design thinking thus involves divergence (discovery and development) , the hypothesis generation, and convergence (definition and delivery), the hypothesis testing. Therefore, design thinking research aligns with scientific research frameworks, whereby understanding of systematic knowledge (theory) and the development of phenomena (experience) is required.

**Mutually inspiring Knowledge Co-creation.** Herein, we propose an inspiration model of creativity. This model advocates for complex system problem solving and design thinking that promotes mutually inspiring knowledge co-creation rather than the polarized division of work with asymmetric information discussed above. To better understand the dynamics at play in design research, Sanders and Stappers (2008) separated the functional roles of the user, researcher, and designer to highlight their respective contributions to knowledge co-creation. With the accumulation of knowledge, users and designers can work together to co-develop a collective design.

**Knowledge Creation in Community-based Action Research.** Mutually inspiring knowledge co-creation is the counterpart to the innovative community design paradigm that has been applied to local initiatives in recent years. For example, Seng and Scharmer (2006) advocated for community-based action research as a knowledge creation process, arguing that community growth comes from the establishment of shared purposes, the principles of sharing, and a common understanding of the knowledge creation process. The common purpose is to develop knowledge of institutional and social change to define the raison d'être of the community, and the principle of sharing is established as a deep-seated belief for the members of the community. A common understanding of the knowledge generation process will enable community members to clearly identify how individual efforts and contributions fit within the overall community awareness system (Liou, 2009).

## Apply Psychology to Promote the Development of Design Thinking

Design intends to create better experiences, so psychology, as a behavioral science, can contribute a wide range of theories and research methods to the field of design thinking. Psychological education cultivates individuals' feelings and guides the code of conduct for human behavior, while design creates a supportive environment for this appropriate behavior. Thus, the question of how the environment and its design shapes behavior can be addressed using psychological principles. The following paragraphs discuss the possible ways in which psychology can contribute to experiential understanding of design and creative inspiration.

**Understanding of Experience.** In terms of how environmental stimuli correspond to psychological experiences, Simon (1969) stated that design involves improving the existing environment to foster better experiences. Thus, the fundamental question is: How does the operation of the environment correspond to the psychological experience? Traditional "psychophysics" aims to establish a transition between physical stimuli in the environment and subjective psychological experiences. Similar to this mind-object relationship, behavioral decision theory in experimental economics seeks to explain how the probability and utility of an event corresponds to subjective human perceptions and attitudes surrounding risk and value (Kahneman et al., 1982). This theory can thus contribute to service design in psychological analyses of consumer behavior. Design thinking centers around empathizing with the user's experience to gain insights into their needs. Additionally, understanding user experiences involves both insight into the content and development of their experience in addition to contextualized sense-making. Early social psychologists (Schank & Abelson, 1977; Schank, 1986) proposed script-based models for gathering knowledge relating to episodic life events, with units of activity-focused research describing life experiences (Kumar & Whitney, 2007) and life narratives (Lin & Liou, 2016; McAdams et al., 2001).

Design also needs to understand the continuum of how individuals interact with their environment. For example, Social Cognitive Theory emphasizes eco-environmental affordances (Gibson, 1979; Norman, 2010) through goal-seeking action strategies informed by individual motivation and judgement of environmental opportunities. Recently, cultural psychology research has also provided insights into how culture influences behavior and into specific cultural differences in terms of values, beliefs, and normative systems. Such findings inform the wider cultural context that must be considered when creating an appropriate experience (Leung et al., 2018). Today's Internet of Things is shaping new forms of consumer behavior, place-making in architecture, and community planning, as well as service processes in healthcare and tourism. Recently, however, cyber-psychologist Zuboff (2019) warned of runaway "surveillance capitalism," advocating a rethinking of the danger of emerging intelligent technologies over-predicting and controlling human behavior and infringing on users' experiential autonomy.

Physiological-psychological aggregation and affective interactions provide multiple dynamic measurements and manipulations of users' experiences. By using virtual reality and augmented reality devices, ubiquitous monitoring of the environment, brain neural activity (e.g., EEG), physiological excitement (e.g., heart rate variability recordings), and eye movement tracking, along with real-time attention and information processing, objective records of mind and body and subjective experiences can be integrated to explore people's interactions with their environment. Moreover, the integration of cognitive and emotional processes with the exploration of processing fluency will shed light on the psychological explanation for the emergence of aesthetic experiences (Reber et al., 2004; Wang & Kao, 2013).

**Creative Inspiration.** The features of the inspiration model discussed above go beyond traditional creative theory. First, unlike traditional creativity, which pursues a novelty that is different from the past, inspiration emphasizes that the creator is enlightened by reorganizing past experiences to produce new ideas. The process of inspiration is therefore an interaction between the condition of the inspiration source and the condition of the inspired. Liou's (2018) series of studies confirmed that the following three interactive mechanisms, "story involvement and cognitive motivation," "paradoxical framing and middle ground cognitive styles," and "evoked emotions and neurotic personality traits" have significant creative inspirational effects. Furthermore, creativity is about mutation rather than imitation; inspiration triggers creative action rather than the passive consumption of creative works (the source of inspiration), leading to the diffusion of inspiration to others, spreading through creativity in society (Liou, 2017, 2018). The qualities and applications of awareness, interaction, mutation, and diffusion in the aforementioned inspiration models can be further developed in the future.

This study suggests that creativity in design thinking is expressed through divergent and convergent differentiation and integration. The "evocation-transcendence-motivation" mechanism of the inspiration model describes the conversion of this differentiated/integrated mental model to the corresponding solutions. Additionally, psychological studies of individual or group creative processes have increasingly focused on the dynamic analysis of the creative process (idea formation and selection) and the meaning of creativity (novelty and usefulness) (Liou & Lan, 2018).

The mechanisms that inspire sense-making and thing-making in design thinking (divergent and convergent thinking) need to be examined in a psychological context to better understand inter- or transdisciplinary co-creative group motivations. For example, during group problem solving, the development of task difficulty (cognition) and social conflict (emotion) in the "cognition-emotion" dual approach can be applied (Leung et al., 2020), while the role of cultural metacognition and trust (Chua et al., 2012) can be applied to creative cooperation. Additionally, Liou (2020) highlighted two approaches to group creativity in the context of paradoxical objectives: the complexity integration processes will promote group creativity, while the intellectual centralism process will inhibit it. Future psychological studies may clarify the mechanism by which promotion and suppression mechanisms play a role in the creative process of mutual inspiration in diverse groups.

## Conclusions

Design thinking is an approach dedicated to finding creative solutions to complex problems. Thus, the effective use of creative mechanisms is the driving force behind problem solving. This study addressed the shortcomings of existing design thinking models by (1) highlighting divergent and convergent methods of knowledge transfer and (2) extending the theory of creative inspiration and discussing how the adoption of design thinking strategies in the face of high levels of uncertainty can drive social innovation due to mutual inspiration between designers and users. Lastly, it is proposed that psychology can provide theoretical and methodological foundations for the application of creative inspiration to design thinking, especially when interpreting and creauser experiences.