Opening the black box of search & recombination: the cognitive styles of individual creativity

Cristina Tu Anh Pham (corresponding author)
School of Management – Politecnico di Milano (cristinatu.pham@polimi.it)

Stefano Magistretti
School of Management – Politecnico di Milano (stefano.magistretti@polimi.it)

Claudio Dell'Era
School of Management – Politecnico di Milano (claudio.dellera@polimi.it)

Abstract

Search and recombination are organizational mechanisms to solve problems in the uncertainty of innovation. So far, studies have analyzed the concept at the macro-level of the organization, thus overlooking the underlying though dynamics that characterize the individuals who undergo the search and the recombination of old and new inputs, as well as stimuli to frame the problem first, and then find the solution. Drawing from literature of individual creativity and the studies on cognition, the study analyzes how individuals employ associative thinking, analogical reasoning and abductive reasoning to search and recombine the knowledge inputs and stimuli. In particular, the study aims at opening the black box of the creative mechanisms of search and recombination, by identifying seven underlying micro-cognitive styles. With an explorative and qualitative study, the authors explore the cognitive styles of individuals undergoing a creative process in workshops organized by three different organizations. The data collection is carried out by ethnographic observations to understand how each individual reasons and acts to search and recombine knowledge inputs and stimuli into novel and useful problems and solutions. With this empirical study, we contribute to innovation literature by investigating the cognitive level of search and recombination mechanisms.

Keywords: Search and Recombination, Cognitive Style, Innovation, Creativity, Design Thinking, Abductive Reasoning, Analogical Reasoning, Associative Thinking

1. INTRODUCTION

At the wake of Men's fashion week of 2015, Gucci, that was known for its clean-cut lines and elegant simplicity, radically changed its direction to something that left the entire fashion industry speechless. This happened as Gucci transitioned from Frida Giannini's decade-long creative direction to Alessandro Michele's. In just five days, he managed to put Giannini's creative legacy aside, and renew a company that had fallen short of allure, unable to deliver innovation or originality to the changing audience (Koblin, 2015). With everyone's surprise, this unknown assistant designer, who had worked in Frida Giannini's shadow, was renewed and reshaped the industry times and times again (CFDA, 2016). Devoted to change, his creative endeavour drove him to search and recombine the new and the old in fashion, together with inspirational stimuli from domains such as gaming, art, and more. This allowed him to shake the industry's pillars and introduce counterintuitive innovations such as gender neutrality, quirkiness, «more is more», the returning collections, the rejection of the seasons-driven pacing of collections, and finally, the blurred lines between audience and creators. Alessandro Michele serves as an example of how the creative search and recombination of knowledge and stimuli of an individual was fundamental to push an organization – or even an industry – towards innovation. More specifically, his example highlighted the importance of understanding the way individuals process and manipulate knowledge and stimuli to spur innovation.

Innovation and creativity are highly intertwined (Amabile, 1988; Amabile & Pratt, 2016), as creativity represents the fundamental phase of innovation in which novel and meaningful solutions are first generated (Anderson et al., 2004). This phase can be characterized by the creative mechanisms of search and recombination (Ehls et al., 2020; Schumpeter, 1934). Indeed, creativity in innovation unravels with either the conscious search of knowledge inputs (Ehls et al., 2020; Katila & Ahuja, 2002) or the unconscious retention of stimuli (Campbell, 1960; Simonton, 1999) that are processed to search for alternative solutions (Cyert & March, 1963). Moreover, creativity unfolds, as different knowledge inputs and stimuli are recombined in novel and meaningful ways, thus creating new knowledge (Acar & van den Ende, 2016; Kaplan & Vakili, 2015). The novel and meaningful solutions, that result from these creative mechanisms, are then implemented in the innovation phases (Anderson et al., 2004; Gilson & Shalley, 2004).

When studying the two creative mechanisms of search and recombination, innovation scholars mainly focused on the organization and the impact that the nature of the knowledge input has on the outcome of creativity. Specifically, they addressed search and recombination by analyzing how the depth or the breadth of an organization's knowledge affects the creative performance of the final solutions, in terms of novelty and value (e.g. Kaplan & Vakili, 2015; Katila & Ahuja, 2002; Teodoridis et al., 2019). However, the example from Alessandro Michele reinforced the standpoint of scholars of creativity that argue that creativity and its mechanisms depend on individuals (Amabile & Pratt, 2016) and their cognitive styles – i.e., the way they think to process, manipulate and interpret these knowledge inputs (Aggarwal & Woolley, 2019; Woodman & Schoenfeldt, 1990). Despite bodies of research have addressed three cognitive styles related to creativity, namely associative thinking (Mednick, 1962), analogical reasoning (Goucher-Lambert et al., 2019) and abductive thinking (Dong et al., 2016), the examination of the cognitive styles involved in the creative mechanisms of search and recombination still remains untapped. In fact, few empirical studies have attempted to open the black box of the creative mechanisms of

search and recombination at the level of individual cognition, as there is little understanding on how individuals search or recombine the knowledge inputs or stimuli.

Therefore, through this qualitative and exploratory study, we aim at responding to the research question How do individuals rely on cognitive styles to search and recombine knowledge in the creative phases of innovation? To do so, we collected our primary source of data through the ethnographic observation of three different innovation workshops, during a design thinking event. The observation of the natural conversations among individual participants, together with the written material produced during the workshop, allowed us to collect the verbalization of the thoughts and reasonings of the individuals participating to the workshop (Goldsmith, 2014), thus resembling the think aloud method (Ericsson and Simon, 1980). The data from the 42 participants along 6 observations was analysed drawing on ground theory techniques (Gioia et al., 2013) to understand what cognitive styles individuals employ to search and recombine knowledge inputs and stimuli in the generation of novel and meaningful solutions. This resulted in the identification of seven micro-cognitive styles that are related to associative thinking, analogical thinking and abductive reasoning. Furthermore, the triangulation of micro-cognitive styles in relation to the outcome of their use was paramount to understand how the micro-cognitive styles are related to either search or recombination.

The contribution of this study is twofold. First, the findings expand the three bodies of literature on associative thinking, analogical reasoning and abductive reasoning by unpacking the three cognitive styles. In particular, the study analyses the thoughts and reasonings of individuals in a during the creative phase of innovation, thus concretizing the three cognitive styles in seven micro-cognitive styles that individuals use to generate novel and meaningful solutions. Second, the findings across the individuals participating the three workshops reveal that some micro-cognitive styles are mainly conducive to search, while others that are more conducive to recombination. Finally, these findings are discussed in relation to the extant literature.

2. THEORETICAL BACKGROUND

When organizations recognize that their performance is below the level that they deem acceptable, they undertake a process of innovation that aims at discovering solutions that eliminate the misalignment between the aspired and the actual level of performance (Posen et al., 2018). Normally, the problems underlying innovation are ill-defined and highly uncertain (Unsworth, 2001). Therefore, the framing of the problem, generation and selection of novel and useful ideas (Hennessey & Amabile, 2010), requires the search and recombination of new or old knowledge inputs and stimuli – e.g. visual stimuli, memories (Lanzolla et al., 2020). The processing and manipulation of the different knowledge inputs and the stimuli to solve an uncertain and ill-defined problem make individual creativity paramount (Gilson & Shalley, 2004; Zhou & Hoever, 2014), with creative acts of individuals being the “raw materials” that can determine the success of an innovation (Bleda et al., 2020; Ford, 1996; Geum & Park, 2016). With this research we focus on the investigation of the underlying cognitive styles of creativity that help individuals in the search and recombination of different knowledge inputs or stimuli into novel and meaningful ideas (Sommer et al., 2020). As search and recombination are investigated in innovation literature, and cognitive styles are investigated in design and creativity literature, the review of the literature will be divided into two sections. The first section will describe search and recombination,

while the second will deepen the understanding on the cognitive styles of associative thinking, analogical reasoning and abductive reasoning, often related to creativity.

Search and Recombination Mechanisms

The creativity phase of innovation is characterized by the important mechanisms of search and recombination (Kaplan & Vakili, 2015), that help organizations in creating products that will solve problems in uncertain contexts (Katila & Ahuja, 2002). The two mechanisms hold great importance, as they are peculiar to the early stages of ideation and identification of new opportunities (Lanzolla et al., 2020). They represent two parallel, and strictly correlated, ways to process knowledge inputs so to bring about new knowledge in the form of new solutions (Savino et al., 2017).

The creative mechanism of search describes the activities of problem solving that aim at searching and trying a plethora of alternative solutions, until the most satisficing is found (Cyert & March, 1963). This entails the search for knowledge inputs to increase the knowledge base that can be leveraged to generate novel and useful solutions (Ehls et al., 2020). As the knowledge base is consolidated, search consists in the retrieval of the underlying insights behind the structural relations between knowledge inputs (Chan & Schunn, 2015; Ward & Kolomyts, 2010), and the manipulation of to stir a clear articulation of variations of solutions.

The extant literature on search mechanisms have mainly focused on the knowledge inputs and their impact on this creative mechanism of complex problem solving. According to Katila & Ahuja (2002), knowledge inputs can vary according to the dimensions of depth and scope (Katila & Ahuja, 2002). The former describes the exploitative (March, 1991) nature of the search mechanism, whereas the former describes its explorative (March, 1991) nature. More specifically, the two authors described the impact of the recurrence of the use of old knowledge (Katila & Ahuja, 2002). Once a solution to a problem (Posen et al., 2018) is found, the existing knowledge that derives from it can be reused and exploited to deepen the understanding of the core knowledge elements within it (Katila & Ahuja, 2002), as a result of repletion-based improvements (Levinthal & March, 1993). Alternatively, the existing knowledge can be used only once, as the solution is found.

Other scholars, have focused on the search scope, that connects the finding of solutions to the exploration of new knowledge. The domain in which new knowledge is searched and retreived, however, can differentiate in terms of distance from the problem domain – hence, scope. Local search describes the quest for originality within the range of knowledge that is close to the consolidated knowledge bases (Jung & Jeongsik, 2016). Conversely, distant search uses knowledge that is far from the consolidated knowledge base, as it seeks for emerging new ideas in different and distant fields. Several authors have investigated the impact of distant or local knowledge in relation to the preferred objective of creativity – novelty or value (e.g. Kaplan & Vakili, 2015) or the pace of innovation and change (e.g. Teodoridis et al., 2019).

The mechanism of recombination for the creation of innovative solutions was first introduced by Schumpeter (1939) and further developed by numerous scholars in the field of innovation (Savino et al., 2017). It refers to the combinatory acts that connect existing building blocks of knowledge to create new solutions (Kaplan & Vakili, 2015). Moreover, it is correlated to knowledge integration, as the acts of connecting and combining inputs of knowledge entail the transaction and absorption of the knowledge (Zahra et al., 2020). This, in turn, implies a combinative capacity to interpret the

combination of different existing knowledge inputs so to unfold new knowledge in the form of emergent ideas that are both novel and useful (Sommer et al., 2019). Ultimately, recombination describes the ability to notice the connections between existing knowledge inputs (Acar & van den Ende, 2016). It indicates the processing and interpretation of the different combinations, to generate explanations that reconcile the discrepancies of the different knowledge elements to postulate novel and useful properties and introduce novel knowledge (Ward & Kolomyts, 2010).

Parallel to search, the recombination mechanism is defined by the dimension of distance, both in terms of psychological distance from the present self (Trobe & Liberman, 2010), or the relative distance between different inputs (Acar & van den Ende, 2016). This dimension distinguishes itself in distant and local recombination (Kaplan & Vakili, 2015), with the former related to a more generalist knowledge base and the latter, to a more specialist knowledge base (Teodoridis et al., 2019). More specifically, distant recombination is linked with the tension view (Kaplan & Vakili, 2015), which advocates for the combination of knowledge elements from apparently incompatible domains as more conducive to innovation (Abecassis-Moedas & Benghozi, 2012; Brun et al., 2019). Conversely, local recombination is linked with the foundational view (Kaplan & Vakili, 2015), which supports that domain-relevant knowledge (Amabile, 1988) and the combination of knowledge elements from the same – or similar – domain(s) can be more conducive to innovation.

Cognitive Styles of Individual Creativity

To move our understanding on how individuals search and recombine knowledge inputs and stimuli from memory, or sensoria stimulation, a body of research has focused on the study of cognition (Gavetti, 2005; Gavetti & Levinthal, 2000). Indeed, cognition explains how individuals think, know and process different forms of inputs (Armstrong et al., 2012). Cognitive styles define relatively consistent ways in which individuals acquire, organize and process information (Ausburn and Ausburn 1978). They determine how individuals use and manipulate new and old knowledge inputs, how they scan their mental and physical environment for stimuli, and how they perceive the innovation problem (Aggarwal & Woolley, 2019; Förster et al., 2004; Wiesenfeld et al., 2017). They are applied by individuals in different and spontaneous ways, according to the different setting and situations (Messick, 1984). In fact, they can change from one individual to the other, and outline the way they process and reason with conscious or unconscious knowledge inputs and stimuli (Aggarwal & Woolley, 2019). In terms of creativity, cognitive styles constitute individual characteristics that can help advance the understanding of the creative behavior (Woodman & Schoenfeldt, 1990).

Individuals who undergo the creative process are normally exposed to units of inputs that can either be complete, stand-alone knowledge inputs (e.g. Savino et al., 2017) – e.g., a working technology – or mere stimuli (e.g. Gaucher-Lambert & Cagan, 2019) – e.g., a simple image, a memory, an emotion. In the literature of creativity, three bodies of literature explain how knowledge inputs and stimuli are scanned, integrated, manipulated and processed in creative ways. These bodies of literature are respectively related to (i) Associative Thinking (Mednick, 1962), (ii) Analogical Reasoning (Goucher-Lambert et al., 2019) and (iii) Abductive Reasoning (Dong et al., 2016).

<u>Associative Thinking</u>

According to Mednick (1962), the generation of novel and useful ideas depend on one's ability to "bring otherwise mutually remote ideas into contiguity" (p. 222), thus, it implies the conscious or unconscious exposition to knowledge inputs and stimuli are

processed according to their possible associations. Associative thinking allows individuals to retrieve distant inputs (Ward & Kolomyts, 2010) as they engage in associations of elements through serendipity, similarity and mediation (Mednick, 1960). To this end, serendipity allows individuals to generate novel and meaningful variants of solutions, by accidentally putting in contiguity distant elements (Mednick, 1962). In this logic, individuals search for inputs as they unconsciously incubate and randomly converge memories, everyday observations, emotions, past experiences and existing knowledge (Campbell, 1960). Then, through a Darwinian process, just few inputs emerge (Simonton, 1999). Similarity, instead, describes the retrieval of inputs that appear remote, but share similarities (Mednick, 1960) – e.g. two products share the same underlying function as they cover the same need. Finally, mediation describes the search of inputs, through the use of a mediatory concept that links to two very remote elements (Mednick, 1960).

Analogical Reasoning

Another fundamental cognitive style typical that supports the processing of knowledge inputs and stimuli is analogical reasoning analogical reasoning (Moreno et al., 2014). This cognitive style is coherent with the figure of speech of the analogy that describes the comparison and correlation between two dissimilar things that share a connection at a deeper or more abstract level. Hence, analogical reasoning can be defined as a way of thinking in which the individual finds correlations among different knowledge inputs or stimuli. In particular, analogical reasoning unfolds as the knowledge from one input – the source – is applied to another one – the target (Cornelissen, 2006; Goucher-Lambert et al., 2019). This is allowed by mental leaps that create a connection of relationship between the source and the target (Chan et al., 2015; Holyoak & Thagard, 1995; Tseng et al., 2008). The processing of knowledge inputs and stimuli through analogical reasoning entails mapping and seeding the analogical relations between stimuli and inputs, and the retrieval the useful concepts (Goucher-Lambert & Cagan, 2019).

Abductive Reasoning

The creative generation and selection of novel and useful solutions, as well as the re-formulation of wicked and ill-define problems, typical of innovation (Buchanan, 1992) require abductive reasoning (Dong et al., 2016). Officially introduced by Pierce (1934), it describes a cognitive style that aims at creating new knowledge, through the formation of explanatory hypotheses, that propose speculative – but plausible – explanations with the aim of reconciling the differences between different knowledge inputs or stimuli (Folger & Stein, 2017). Indeed, abductive reasoning is a cognitive style of creativity in which individuals find hypothetical leaps, most of the time unconsciously (Dew, 2007). As stated by Thagard & Shelley in 1997, individuals generate and evaluate hypotheses in order to make sense of puzzling facts (Dunne & Dougherty, 2016) through the use of the "logic of what might be" (Kolko, 2015). In this sense, abductive reasoning describes the motivated continuous effort to understand connections between different inputs, in order to anticipate their trajectories and act effectively. Hence, it is the appropriate cognitive style for making sense of new – or unknown– combinations and cope with uncertainty (Richardson and Kramer, 2006; Roozenburg, 1993).

The analysis of the extant literature shows that despite the commonalities between search and recombination and individual cognitive styles of creativity, the nexus between these bodies of literature is still untapped. Hence, there is still a lack in understing on how individuals process and manipulate information (knowledge and stimuli) in search and recombination at a cognitive level. With this study, we aim at opening the black box of these two creative mechanisms by understanding the individual cognitive styles underlying the search and recombination of inputs from old to new knowledge and stimuli.

3. METHODOLOGY

The objective of this research is to conceptualize, articulate and empirically explore the underlying cognitive styles of individuals in the creative mechanisms of search and recombination. Differently from extant empirical studies, that had focused on quantitative data in highly controlled environments, we conducted a qualitative and exploratory study that leverages on the contextualised ethnographic observation of individuals, behaving naturally across three innovation workshops of design thinking.

Research Setting

To engage in this investigation and better observe how individuals creatively search and recombine different knowledge inputs and stimuli, we deem design thinking innovation as the perfect setting for the research. Indeed, this practice of innovation (Dell'Era et al., 2020) has not only been appointed with greater levels of creativity (Christiaans, 2002; Micheli et al., 2019) but it has also been characterized by high levels of uncertainty (Stigliani & Ravasi, 2012), as this type of innovation is often characterized by problems that are wicked in nature (Buchanan, 1992). Indeed, problems of design thinking innovation – thus the creative challenges – have no definitive formulation, nor a right solution to them (Dorst, 2011). Coherently, this form of innovation is especially focused on "making sense of things" that are complex and uncertain. Scholars have pointed towards how design thinking innovation encompasses a set of mental structures and strategies of designers to complex creative problem solving (Bleda et al., 2020). The creative and hypothetical drive of design thinking innovation is also apparent as it has been described for the interpretation of several inputs, and the elaboration of insights that come from the detection of the subtle and unspoken socio-cultural drivers (Norman & Verganti, 2013) to the empathic observation of what people say and do, to ultimately understand not only the right solution, but also the right problem (Dorst, 2011; Drews, 2009).

Research site

The observations were conducted during three innovation workshops that adopted design thinking as the approach to innovation. Each workshop presented a specific innovation challenge and context of use, however, the expected output was of similar nature, with participants having to ideate a concept of a new service or product for a near-medium horizon. The individuals participating to the laboratories were extremely heterogeneous, both in terms of expertise and experience. Their expertise spanned from design, to development, to business, whereas their experience varied from junior positions to the c-line. This allowed diversity of expertise and experience in each workshop.

Data Collection

Data was collected from three innovation workshops. In particular, the researchers observed a total of 42 individuals, across 6 teams from a workshop facilitated by a consulting firm and two others facilitated by expert educators of the methodology. The researchers gathered for each experience workshop both primary and secondary sources of information. This latter source of information consists in archival documentation from the facilitating companies – i.e., the workshop brief, the context of the workshop challenge and the process followed during the workshop. Moreover, they collected, as secondary sources of data, the information available on the internet on the workshops' participants. Both types of secondary sources of data aimed at contextualizing the individuals, and understand their role, expertise and experiences.

Primary sources of information were gathered through ethnographic observations during the workshops (LeCompte & Schensul, 2010; Locke, 2011). This allowed to observe in a systematic way the creative logics, without discerning them from the situational conditions (LeCompte & Schensul, 2010; Woodman & Schoenfeldt, 1990).

The data from primary sources were collected over the duration of the workshop by the authors and four supporting ethnographers who attended the workshops as silent observers. The whole workshop sessions were recorded. Meanwhile, the researchers took quick notes on each individual's creative logics employed during the workshop. This was done with the help of two types of templates (Fig. 1): (1) gathering contextual information and (2) gather the creative operations of the individuals and the kinds of input, hence observing their creative logics throughout the creative tasks of the workshop (Tab. 1)

Table 1. Details about data collection

Type of evidence	**Number of pieces of evidence**	**Purpose of collected evidence**
Primary source of data	- Collection of 6 ethnography, 2 for each workhop. Each ethnography is composed by a word file for a total of 11 pages for the first workshop, 11 pages for the second workshop and 25 pages for the third workshop. For a final total of 47-word pages. - Video recordings around 3,5 h for the first workshop, 2,29 h for the second workshop and 2,45 h for the third workshop. For a total of more than 8 h of registration.	-The aim of having the word files is to not lose any sentence said during the process, to facilitate the further analysis. - The objective of recoding is capturing all the information in order to have all the necessary information to perform the research.
Secondary source of data	- Collected information about the experience and expertise of 42 participants, though online research - 2 Design Thinking event presentation of 50 minutes each. - 3 Plenary sessions one for each workshop around 20 minutes each	- Identify the antecedents to the creative phases of the innovation process. - Presentation of macro current topics, to stimulate the innovation thinking. - Plenaries aim is an internal alignment in order to understand exactly the topic to work on during the laboratories.

	- The data structure is composed by an excel file with 15 columns and 464 lines.	- Used to analyze all the information and to easily find relevant pattern and data.
Archival data	- 6 Miro boards, with the output performed by each team analyzed. A Miro board consists in: Workshop one and two 18 pdf pages, Workshop 3 are 6 pdf pages. For a total of 42 pdf Miro pages.	- Software used to map the creative process of innovation, the pdf is useful to follow the overall process and integrate the registration with concrete outputs.

Data Analysis

The analysis of the data followed an iterative process that connected the empirical observations with the theoretical ideas (Fig.2). For simplicity, the process will be reported into three steps (Fig. 1):

Step 1. Tracing the Cognitive Operations and Inputs of the Individuals

During the workshops, individuals of the teams alternated individual work with group work. In between each creative task, they conversed to share their own reasonings. First, the researchers transcribed the all the recorded conversations of the individuals participating to the workshops. Then, they combined them with the field notes that were collected during the workshop, and with the material used and produced by workshop participants during the workshop. The intensive reading and the triangulation of these data (Strauss & Corbin, 1998) allowed the generation of constructed codes. The coding was performed through 6 iterations performed by two researchers and cross-checked by two external researchers that did not handle the data set. This iterative process finally culminated in the elimination of redundancies and the convergence of the codes into first order categories (Gioia et al., 2013) reflecting the individual cognitive operations and inputs for search and recombination.

Step2. Tracing the Creative Logics of the Individual

The second step of the analysis saw the progressive clustering of the first-order categories into second order-themes. This analysis was partially informed by theory that helped identifying the creative logics that individual undergo when having to perform creative tasks. These second-order themes were then aggregated into high level dimensions (Gioia et al., 2013) of search and recombination (Savino et al., 2017).

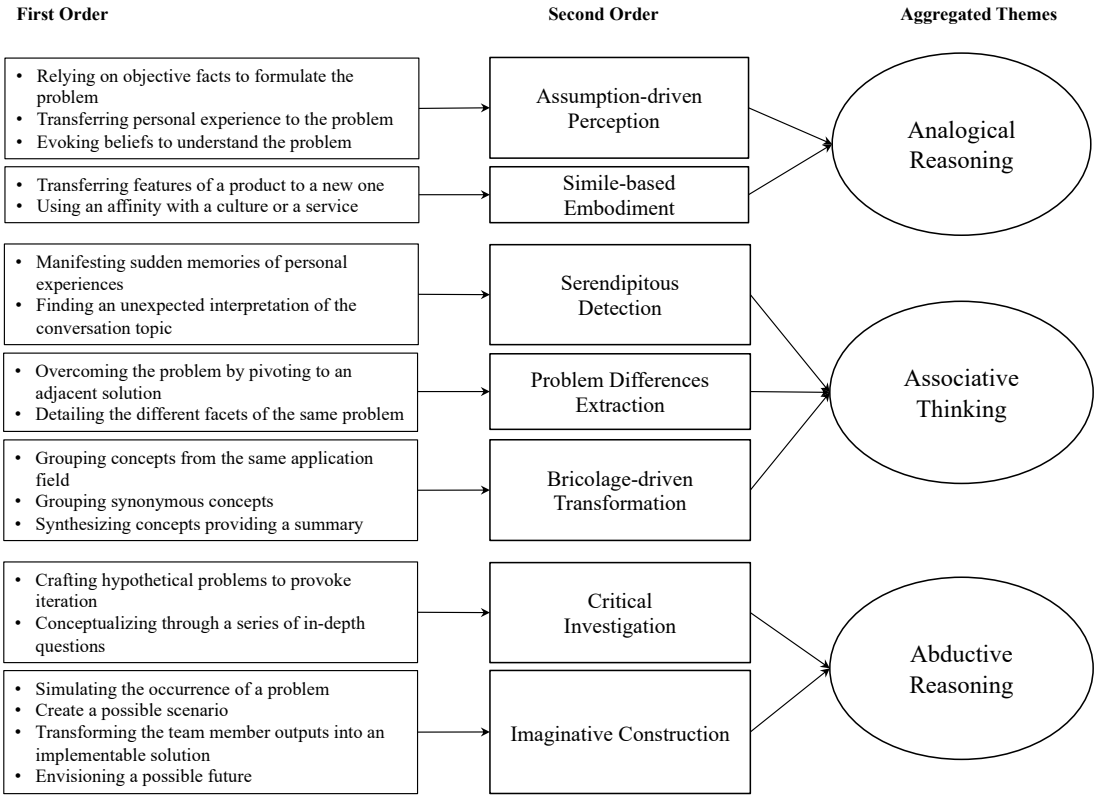
Step 3. Finding Patterns

The identification of the creative logics in search and recombination was followed by a final step of the analysis. In this step, the researchers tried to discover and map the patterns. First, the researchers mapped the creative logics along the creative process. Then, the researchers tried to discover whether there were recurrent patterns related to the type of input.

Figure 1. Data analysis process and steps

Research process	Analytical steps	Methodological grounding for analytical steps
Obtaining data on how people performed creative tasks in an innovation process.	Protocol Analysis: thought the thinking aloud method	Tracing creative processes as they happen (Goldschmidt, Linkography, unfolding the design process, 2014)
Unpack the Cognitive Styles of individuals employed to process and manipulate the knowledge inputs and stimuli	Codes 1st order coding 2nd order coding Aggregated Themes	Code the data collected (Gioia et al., 2013; Giudici et al., 2018)
Identify patterns in the use of the Cognitive Styles in terms of their use for Search or Recombination	Patterns among tasks Cross-workshop patterns Cross-individual patterns	Explaining process that underline a posteriori pattern (Dennis A. Gioia, Kevin G. Corley, and Aimee L. Hamilton, 2013)

Figure 2. Coding Tree of Cognitive Styles



4. FINDINGS

The observation of the ways of thinking of individuals across the three innovation workshops of design thinking allowed the recognition of the three cognitive styles of associative thinking, analogical reasoning and abductive reasoning. More specifically, the observation of the activities of thinking of individuals led to the identification of seven underlying micro-cognitive styles (Fig. 2). Along the three workshops, the individual participants employed personal combinations of the micro-cognitive styles, as they approached new knowledge, from the innovation challenge, old knowledge, from their own experience, and both mnemonic and sensorial stimuli, as a result of the stimulation from the external facilitators, other participants or even personal sensibility.

Analogical Reasoning: Assumption Driven-Perception

Related to analogical reasoning, the first micro-cognitive style refers to *Assumption-driven Perception*. Along the workshops, participants who adopted this micro-cognitive style reasoned through assumptions to find analogies between new knowledge, former experiences or personal beliefs and the innovation challenge. Indeed, individuals generated assumptions that leveraged on the individual's reference system, consisting of their new and old knowledge, personal perceptions and experiences or beliefs to trigger the retrieval of variations of opportunities. They did that, by *relying on objective facts to formulate the problem*, thus creating assuming an analogical connection between the contextual new knowledge inputs or stimuli provided during the workshop and the opportunity. An example could be found in GabrieleD, who participated to a workshop aimed at developing a new retail model for a Packaging-Free shop – Negozio alla Spina:

> *"for sure, people that are already client of the Negozio alla spina, I assume, they are people careful to the theme of sustainability "* – GabrieleD

In his case, the individual, GabrieleD, started from the source information provided by the facilitator, to make assumptions on the costumers' habits.
Similarly, the assumptions could also draw from personal experience, as individuals applied their own knowledge of a personal situation to the general experience of the other users, thus *transferring personal experience to the problem*:

> "*Well, especially in Milan, I do not know the other cities, people use the sharing service accordingly to where they live. Since this is big pain point, the range of the map and the availability, I think that need it more. I'm reasoning with assumption; we should also see what the data says*"- LucianoC

Hence, LucianoC relied on his personal experience as a citizen of Milano, to identify an opportunity for the innovation challenge of shaping the future of car sharing mobility.

Alternatively, assumptions were also generated from personal beliefs, as some individuals *evoked beliefs to understand the problem*.

> "*Maybe with the pandemic people want to change the way they live, people maybe do not want to live in the center, it is interesting to change the range of action"* - MariaM

Analogical Reasoning: Simile-based Embodiment

Across the three workshops, individuals employed similes – i.e., rhetorical figure that explicitly shows the correlation between two elements – to connect existing solutions or inspirations and draw from them features to apply to the innovative solution. By adopting the micro-cognitive style of *Simile-based Embodiment*, individuals aim to clarify a concept by presenting it in parallel with another. This comparison is done by similes of two types. The former describes *making a comparison with a product or an object with a specific feature*. Hence, the individual explains a concept making comparison with another that has a specific feature, which can be directly used as a solution since it already works and it can be directly implemented in the problem or solution that the individual is facing.

> "*For example, some dark stores with a dedicated locker of mine, where only I can go and leave my containers as an **Amazon locker**. This is interesting compared to the theme of the conversion of empty spaces.*" - ChiaraT

Another way to reason through simile-based embodiment is by *using an affinity with a culture or a service:* the individual presents an affinity with something that has an abstract meaning as a service, a culture, or an idea and then it is used as an inspiration to further develop some new concepts.

> "*For example, looking to a **culture** that I know such as the **Asian** one, Japanese put hygiene above the problem of sustainability. In this moment, the pyramid of needs is changed a little, the hygiene problem seems above the sustainability one.*" - MicheleD

Associative Thinking: Serendipitous Detection

Through serendipity individuals participating the workshops found unforeseen inspiration. Indeed, *Serendipitous Detection* describes the way an individual makes unexpected associations to change the team's conversation and present an opportunity through different lights. It can activate from unconscious variations in the mind, and manifest as realizations that bring a new perspective can be done starting from the personal experience or from the team discussions. The serendipitous detection can appear as *manifesting sudden memories of personal experiences*. The individual associates the topic of discussion with one of his/her experiences. This allows him/her to introduce a new opportunity. By doing so, the individual suggests something that is not related to what has been said before, but gives a different and new prospective. An example is showed by MarziaC, who pivoted the conversation from the guarantee of hygienic and health safety to personal security:

> "*Security also personal, I am a girl and I live in Bologna. A sharing system gives you security, not having to take the public transport with people not too recommendable, would make me feel more serene, so is not used just for work."* – MarziaC

Moreover, serendipitous detection can also manifest as the individual *finds an unexpected interpretation of the conversation topic.* Coherently, the individual links the the group conversation to something that is not related to topic of discussion. Also in this case, this opens to the detection of alternative opportunities, through the introduction of a different lens.

Associative Thinking: Differences Extraction

Differences Extraction is a way individuals generate opportunities of solutions, through the identification of the different facets of a problem or a solution. Individuals who adopt this micro-cognitive style, create associations through distinction, thus seeking dissimilarities among variations of the same problem or solution. The identification of differences, instead of similarities, can be achieve by *overcoming the problem by pivoting to an adjacent solution*. This entails a process of deep understanding of the core characteristics of a problem to find variants of the same problem, thus overcoming the obstacle of the initial, irresolvable problem:

> *"I build on this, I agree, but I invite you (AlessandroC) and the group to see the positive part, that is: instead of prohibiting something that already exists today and that does not go in the right direction, let's starts from artificial intelligence even if is seen as something negative at the moment and let's evolve it into a positive logic. Forbidden it would mean, in my opinion, stop a process of change that is happening today, but I put it in a positive way, instead of prohibiting, we can correct it."* – DenisD

Another way individuals can reason through differences, consists in *detailing the different facets of the same problem.* Also in this case, the person shows and finds all the different facets of the same problem, discussing about it and presenting all its perspectives:

> *"When it comes to work with 'geographical boundaries', it's something that's very much linked to 'trust', because no matter where you are, the quality of your work doesn't change. The fact of having digital services in the workplace available everywhere, allow the reduction of geographical boundaries and allow instead to work independently and therefore to create more and more trust with the leader"* – RossanaV

Associative Thinking: Bricolage-driven Transformation

Bricolage-driven Transformation is a micro-cognitive style that leverages on similarities between new knowledge inputs, old ones and experiences, and inspirational stimuli to explain how they mix together and find interesting links. The bricolage can occur with a direct or conceptual link or synthetizing more concepts.

By *grouping concepts from the same application field*, the individual adopts a concrete mental model and finds a descriptive element that is common to more knowledge inputs and stimuli. Thus, linking them together.

> *"the -increase of online requests has created the necessity to identify new packaging styles to deliver the product- hence we could say that this refers to the packaging and logistic world"* – FedericaF

Conversely to the previous, reasoning through transformative bricolage can also be achieved by *grouping synonymous concept*. In this case, the individual puts together a set of outputs that share similar properties. The inputs are more conceptual, and the association requires higher mental effort.

"If we look at them (brainstorming post-its) from the high level, an aspect that all of us have mapped is the fact that people use less the public transport, so in my opinion this is the starting point" – MariaM

Finally, this micro-cognitive style also manifests as individuals *synthesize concepts providing a summary*. These individuals are characterized by the ability to provide a clear summary of all the inputs, outputs or stimuli. This stems from a deep understaning of all the concepts and the personal reinterpretation and map of the concepts constituting the overall picture:

"On the one hand we have the theme of driving and on the other hand the theme of inspiration" – ChiaraM

Abductive Reasoning: Critical Investigation

Critical Investigation is a micro-cognitive style of individuals who have an inquisitory nature. Through constant questions or provocations, they trigger iteration and deeper reflection. In turn, these support the conceptual leap of abductive reasoning. This micro-cognitive style emerged as a result of *crafting hypothetical problems to provoke iteration.* Indeed, individuals formulated and advanced provoking questions to trigger the search of variations of alternatives, thus rethinking the knowledge inputs and stimuli to find stronger and more valuable opportunities. Hence, these provoking questions aim at express thoughts and iterate concepts and ideas, stimulating a creative discussion.

"Have you reflected on how many stores in Milan, that have started to make deliveries at home, could have new costs associated to the delivery? They are seven store per city" – FedericaF

Critical investigation can also be achieved as individuals break down thoughts into smaller ones. To do so, they *conceptualize through a series of in-depth questions.* Indeed, they reason by asking specific questions, that are increasingly detailed in nature. This allows to proceed in building the solution and detailing it thanks to a creative discussion:

"To fight Covid consequences, I would take up the problem of widening the range of users to areas not covered. What do you think?" – Luca A.

Abductive Reasoning: Imaginative Construction

Imaginative Construction describes the way of thinking of individuals who create hypotheses using their imagination and envisioning the possible or eventual occurrence of a problem, a contextual scenario, a solution or a future change. Indeed, individuals across the workshops often made sense of the new knowledge inputs and the stimuli, by *simulating the occurrence of a problem*. The individual who adopts Imaginative Construction, frames his hypothesis of solutions in response to a crafted problem or requirement, that he/she guesses to be true:

"My idea was related to the topic of 'strengthen the e-commerce'. Thinking about our clients (faminily and young people), I guess that they have limited time to go to the shops. We could provide a weekly subscription, the physical store can be considered as a showroom." - FrancescoA

Parallel to that, individuals also *create possible scenarios* to build connection among the different building blocks of knowledge and stimuli. Indeed, some individual participants adopted a mental model based on abduction and imagination that helped them concretize the connections among the ensemble of the knowledge inputs from the team, from personal experience and the collection of stimuli from the facilitators. They did so, by collecting all the relevant information in a plausible scenario.

> *"(I imagine that…) From his agenda he puts directly into the ATM app the address of where he has to go, the trigger is the place to reach. it has already left in the morning; he has to decide now what transport to take. He has not yet got off the car, because the answer of the app could also be: continue by car. This are the triggers: address and time he wants to arrive."* – ClaudioD

Similarly, individuals also concretized the collection of knowledge inputs from all the participants into a single solution. Indeed, they did so through the adoption of a micro-cognitive style that *transformed the team member outputs into an implementable solution*. The individual systematizes the output from other team members, by transforming them into features of a new solution.

> *"This are the triggers: address and time he wants to arrive. Taking weather info and real time info, the app proposes alternative routes, faster and safer, as possible variable (short, fast, safe)."* – LauraM

Finally, Imaginative Construction can manifest as individuals *envisioning a possible future*. They mentally travel in time, space and hypotheticality to picture themselves and the solution in distant futures.

> "*I wrote the opposite, because in my opinion artificial intelligence replaces some things, but human sensitivity not. So, figuring out if a person has certain needs is something that I think will remain human. I imagine that in the future 2030 the AI will do those boring jobs because they have little to do with the word human resources, but much to do with the word company machine and therefore maybe once HR gets rid of this boring activates has more time to personally follow the employee then support him in growth, to give advice, to create an ad hoc training course. "* - EleonoraP

5. DISCUSSION & CONCLUSION

The analysis of the cognitive styles of the individuals across the three innovation workshops highlights the occurrence of the adoption of seven micro-cognitive styles underlying their analogical reasoning, associative thinking and abductive reasoning. Despite being very different, in terms of knowledge base, sensibility to stimuli, experience or expertise, the individuals adopted the seven micro-cognitive styles in a way, that underlined the recurrent adoption of four micro-cognitive styles in support of the creative mechanism of search, and the adoption of three micro-cognitive styles in support of the recombination mechanism (Fig.3).

The Micro-Cognitive Styles underlying the Search Mechanism

The mechanism of search defines the creative endeavor in which individuals draw from old and new knowledge, as well as inspirational stimuli to generate variations of alternatives (Campbell, 1960; Chan & Schunn, 2015; Simonton, 2011), until they find

the best solution that satisfies the objective (Cyert & March, 1963). Across the three workshops, individuals recurrently adopted the micro-cognitive styles of (i) *Assumption-Driven Perception*, (ii) *Differences Extraction*, (iii) *Serendipitous Detection* and (iv) *Critical Investigation* to retrieve and interpret the inputs and stimuli (Ward & Kolomyts, 2010) and find variants of opportunities that can guide the generation of novel and meaningful solutions.

Indeed, the observations highlighted how individuals who adopted assumption-driven perception were able to connect the workshop challenge with knowledge inputs (e.g., new information introduced by the facilitators and the other participants, or from past personal experience) or stimuli (e.g., subtle changes in society), in order to identify novel and potentially meaningful needs to address.

Similarly, the indivduals who adopted the micro-cognitive style of *differences extraction* unfolded new opportunities in the form of new, and different, facets of the same problem or solution. Thus, individuals unbundled the problem – and the solutions – into different variations.

Through *serendipitous detection*, individuals blindly search for alternative opportunities, as they create associations – in their mind – with the stimuli from the discussion of other participants or the facilitators.

Finally, individuals who adopt *critical investigation*, search for the most valuable variations of opportunities, as they reflect deeply on the problem or the hypothesized solution. Thus, searching for the most satisficing (Cyert & Marc, 1963) solution, through constant questionings and iterative provocations.

The Micro-Cognitive Styles underlying the Recombination Mechanism

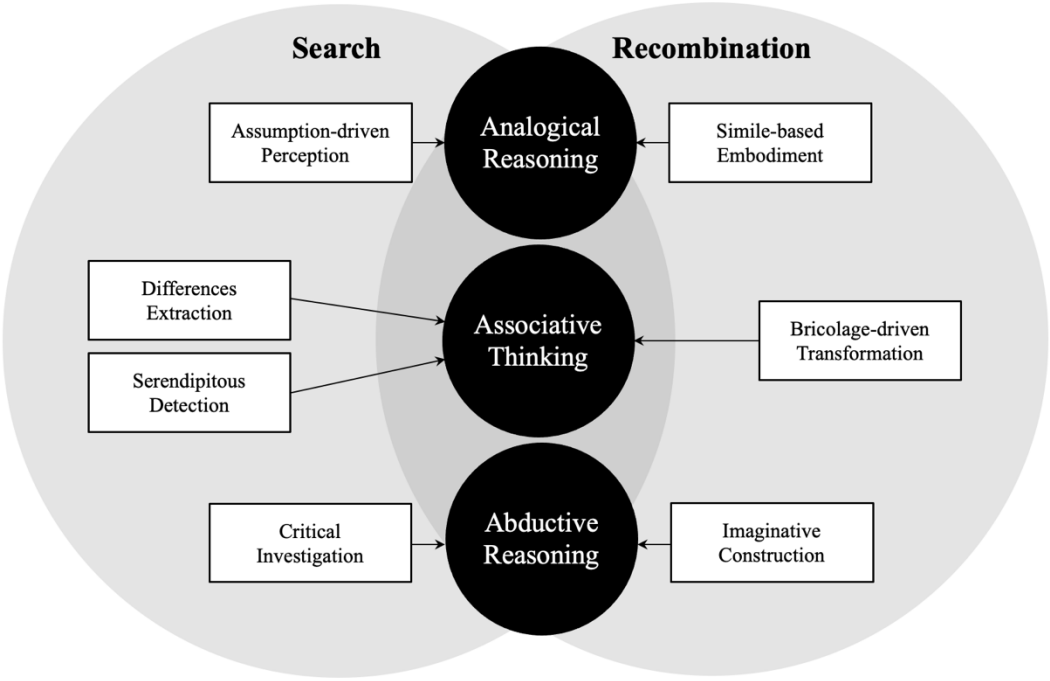
Innovation requires the creative recombination of existing elements of knowledge (Schumpeter,1939). By undertaking this creative mechanism, individuals combine different building blocks, in the form of knowledge inputs and inspirational stimuli, to create completely new knowledge (Savino et al., 2017). This, implies the ability to deeply understand, absorb, integrate and connect the different knowledge inputs and inspirational insights (Zahra et al., 2020). Recombination implies the ability not only to connect, but, ultimately, create reconciling explanations to the discrepancies in the complex system of inputs and stimuli, thus creating new knowledge (Acar & van den Ende, 2016; Ward & Kolomyts, 2010).

Across the individuals of the three workshops, the micro-cognitive styles that were conducive to the mechanism of recombination are (i) *Simile-based Embodiment*, (ii) *Bricolage-driven Transformation*, (iii) *Imaginative Construction*.

When individuals adopted simile-based embodiment as a micro-cognitive style, they outlined the analogies between the information from the workshop challenge, together with their experience and knowledge of existing solutions or cultures. Drawing on a parallel comparison, this micro-cognitive style allowed individuals to understand the high-level features of the different elements and fuse them into one unique solution.

As in the case of bricolage-driven transformation, individuals drew on similarities to create linkages that would lead to grouping and synthetizing a mix of knowledge inputs and inspirational stimuli. In this case, associative similarities were used to evolve and transform single elements into new concepts.

Finally, through imaginative construction, individuals were able to frame the information from different knowledge inputs and inspirational stimuli, by concretizing them into an imaginative problem, scenario or solution.



Our study of individuals helped us produce a detailed account of the cognitive styles involved in search and recombination at the level of the individual. It shed light over the creative microfoundations of these innovation mechanisms. The study contributes to the the debate on search and recombination by openining the black box of the anatomy of the two creative mechanisms by investigating the specific cognitive styles that support search, and the specific creative logics that support the recombination. Indeed, it details the four micro-cognitive styles involved in searching and three micro-cognitive styles involved in recombining different knowledge inputs and stimuli.

Moreover, our study suggests that the extant descriptions of search and recombination only provide the partial conceptualization of organizational mechanisms aimed at generating and evaluating solutions to a problem. They overlook the underlying individual cognitive styles that support individuals throughout the entire creativity in innovation. With our study, we answer the call from Posen et al. (2018) to further the cognitive understanding of how individuals creatively form problems in innovation and generate solutions. This entails going beyond the understanding of search and recombination as mere reactive mechanisms, that unfold only in response to the loss in performance (Posen et al., 2018; Sommer et al., 2019).

Implications for Future Research and Management

This study contributes to opening the black box of search and recombination, by understanding the cognitive styles of individuals in the creativity of innovation. However, we conducted the study in the semi-real setting of three innovation workshops within a design thinking event. We expect a comparative replication of the study in real-life conditions to extend the understanding of how individuals embedded in an organizational setting search and recombine knowledge inputs and stimuli in a creative way.

Moreover, this study opens to further research to have a more comprehensive understanding on the potential correlations among the cognitive styles in search and recombination and the individual factors, such as antecedent conditions – i.e. experience, education, context – personality traits, and inter-personal attitudes.

From the practitioners' perspective, this study casts a new light on how to nurture individual creativity in search and recombination, by framing its conceptualization in a set of dynamic logics that enable the creative framing of problems and the creative solving of the problems. Thus, it stresses on going beyond the idea that creativity can only be achieved by individuals who present specific characteristics. On the contrary, it sustains that, depending on the creative tasks, individuals can display different creative logics that support search and recombination mechanisms.

References:

Abecassis-Moedas, C., & Benghozi, P. J. (2012). Efficiency and innovativeness as determinants of design architecture choices. *Journal of Product Innovation Management*, *29*(3), 405–418. https://doi.org/10.1111/j.1540-5885.2012.00914.x

Acar, O. A., & van den Ende, J. (2016). Knowledge Distance, Cognitive-Search Processes, and Creativity: The Making of Winning Solutions in Science Contests. *Psychological Science*, *27*(5), 692–699. https://doi.org/10.1177/0956797616634665

Aggarwal, I., & Woolley, A. W. (2019). Team creativity, cognition, and cognitive style diversity. *Management Science*, *65*(4), 1586–1599. https://doi.org/10.1287/mnsc.2017.3001

Amabile, T. M. (1988). A Model of Creativity and Innovation in Organizations. In *Research in Organizational Behavior* (Vol. 10, pp. 123–167).

Amabile, T. M., & Pratt, M. G. (2016). The dynamic componential model of creativity and innovation in organizations: Making progress, making meaning. *Research in Organizational Behavior*, *36*, 157–183. https://doi.org/https://doi.org/10.1016/j.riob.2016.10.001

Anderson, N., De Dreu, C. K. W., & Nijstad, B. A. (2004). The routinization of innovation research: A constructively critical review of the state-of-the-science. *Journal of Organizational Behavior*, *25*(2), 147–173. https://doi.org/10.1002/job.236

Armstrong, S. J., Cools, E., & Sadler-Smith, E. (2012). Role of Cognitive Styles in Business and Management: Reviewing 40 Years of Research. *International Journal of Management Reviews*, *14*(3), 238–262. https://doi.org/10.1111/j.1468-2370.2011.00315.x

Bleda, M., Querbes, A., & Healey, M. (2020). The influence of motivational factors on ongoing product design decisions. *Journal of Business Research*, *March 2019*. https://doi.org/10.1016/j.jbusres.2020.02.018

Brun, J., Le Masson, P., & Weil, B. (2019). Out of the picture? How incompatible knowledge and distant visual stimuli may foster idea generation. *Creativity and Innovation Management*, *28*(3), 368–388. https://doi.org/10.1111/caim.12311

Buchanan, R. (1992). Wicked Problems Thinking in Design. *Design Issues*, *8*(2), 5–21.

Campbell, D. T. (1960). Blind variation and selective retentions in creative thought as in other knowledge processes. *Psychological Review*, *67*(6), 380–400. https://doi.org/10.1037/h0040373

Chan, J., Dow, S. P., & Schunn, C. D. (2015). Do the best design ideas (really) come from conceptually distant sources of inspiration? *Design Studies*, *36*, 31–58. https://doi.org/https://doi.org/10.1016/j.destud.2014.08.001

Chan, J., & Schunn, C. D. (2015). The importance of iteration in creative conceptual combination. *Cognition*, *145*, 104–115. https://doi.org/https://doi.org/10.1016/j.cognition.2015.08.008

Christiaans, H. H. C. M. (2002). Creativity as a design criterion. *Creativity Research Journal*, *14*(1), 41–54. https://doi.org/10.1207/S15326934CRJ1401_4

Cornelissen, J. P. (2006). Making sense of theory construction: Metaphor and disciplined imagination. *Organization Studies*, *27*(11), 1579–1597. https://doi.org/10.1177/0170840606068333
Dell'Era, C., Magistretti, S., Cautela, C., Verganti, R., & Zurlo, F. (2020). Four kinds of design thinking: From ideating to making, engaging, and criticizing. *Creativity and Innovation Management*, *29*(2), 324–344. https://doi.org/10.1111/caim.12353
Dew, N. (2007). Abduction: A pre-condition for the intelligent design of strategy. *Journal of Business Strategy*, *28*(4), 38–45. https://doi.org/10.1108/02756660710760935
Dong, A., Garbuio, M., & Lovallo, D. (2016). Generative sensing: Adesign perspective on the microfoundations of sensing capabilities. *California Management Review*, *58*(4), 97–117. https://doi.org/10.1525/cmr.2016.58.4.97
Dorst, K. (2011). The core of "design thinking" and its application. *Design Studies*, *32*(6), 521–532. https://doi.org/10.1016/j.destud.2011.07.006
Drews, C. (2009). Unleashing the Full Potential of Design Thinking as a Business Method. *Design Management Review*, *20*(3), 38–44. https://doi.org/10.1111/j.1948-7169.2009.00020.x
Ehls, D., Polier, S., & Herstatt, C. (2020). Reviewing the Field of External Knowledge Search for Innovation: Theoretical Underpinnings and Future (Re-)search Directions. *Journal of Product Innovation Management*, *37*(5), 405–430. https://doi.org/10.1111/jpim.12549
Ford, C. M. (1996). A Theory of Individual Creative Action in Multiple Social Domains. *The Academy of Management Review*, *21*(4), 1112–1142.
Förster, J., Friedman, R. S., & Liberman, N. (2004). Temporal Construal Effects on Abstract and Concrete Thinking: Consequences for Insight and Creative Cognition. In *Journal of Personality and Social Psychology* (Vol. 87, Issue 2, pp. 177–189). American Psychological Association. https://doi.org/10.1037/0022-3514.87.2.177
Gavetti, G. (2005). Cognition and hierarchy: Rethinking the microfoundations of capabilities' development. *Organization Science*, *16*(6), 599–617. https://doi.org/10.1287/orsc.1050.0140
Gavetti, G., & Levinthal, D. (2000). Looking Forward and Looking Backward : Cognitive and Experiential Search. *Administrative Science Quarterly*, *45*(1), 113–137.
Geum, Y., & Park, Y. (2016). How to generate creative ideas for innovation: a hybrid approach of WordNet and morphological analysis. *Technological Forecasting and Social Change*, *111*, 176–187. https://doi.org/https://doi.org/10.1016/j.techfore.2016.06.026
Gilson, L. L., & Shalley, C. E. (2004). A little creativity goes a long way: An examination of teams' engagement in creative processes. *Journal of Management*, *30*(4), 453–470. https://doi.org/10.1016/j.jm.2003.07.001
Gioia, D. A., Corley, K. G., & Hamilton, A. L. (2013). Seeking Qualitative Rigor in Inductive Research: Notes on the Gioia Methodology. *Organizational Research Methods*, *16*(1), 15–31. https://doi.org/10.1177/1094428112452151
Goucher-Lambert, K., & Cagan, J. (2019). Crowdsourcing inspiration: Using crowd generated inspirational stimuli to support designer ideation. *Design Studies*, *61*, 1–29. https://doi.org/https://doi.org/10.1016/j.destud.2019.01.001
Goucher-Lambert, K., Moss, J., & Cagan, J. (2019). A neuroimaging investigation of design ideation with and without inspirational stimuli—understanding the meaning of near and far stimuli. *Design Studies*, *60*, 1–38. https://doi.org/https://doi.org/10.1016/j.destud.2018.07.001
Hennessey, B. A., & Amabile, T. M. (2010). Creativity (2010 Annual Review of Psychology). *Annual Review of Psychology*, *61*, 569–598. https://doi.org/10.1146/annurev.psych.093008.100416
Holyoak, K. J., & Thagard, P. (1995). Mental Leaps: Analogy in Creative Thought. *MIT Press*. https://doi.org/10.22329/il.v18i2.2388
Jung, H. J., & Jeongsik, J. L. (2016). the Quest for Originality- a New Typology of Knowledge Search and Innovation. *Academy of Management Journal*, *59*(5), 1725–1753.
Kaplan, S., & Vakili, K. (2015). The Double-Edged Sword of Recombination in Breakthrough Innovation. *Strategic Management Journal*, *36*, 1435–1457. https://doi.org/10.1002/smj.2294
Katila, R., & Ahuja, G. (2002). Something Old , Something New : A Longitudinal Study of Search Behavior and New Product Introduction. *Academy of Management Journal*, *45*(6), 1183–1194.
Kolko, J. (2015). Design thinking comes of age. *Harvard Business Review*, *2015*(September).
Lanzolla, G., Pesce, D., & Tucci, C. L. (2020). The Digital Transformation of Search and Recombination in the Innovation Function: Tensions and an Integrative Framework*. *Journal of Product Innovation Management*, *0*(0), 1–24. https://doi.org/10.1111/jpim.12546
LeCompte, M. D., & Schensul, J. J. (2010). *Conducting Ethnographic*. AltaMira Press. http://93.174.95.29/_ads/E2456D0D956E4A866BFC57443F5C2099
Levinthal, D. A., & March, J. G. (1993). The Myopia of Learning. *Strategic Management Journal*, *14*(Special Issue: Organizations, Decision Making), 95–112.

Locke, K. (2011). Field research practice in management and organization studies: Reclaiming its tradition of discovery. *Academy of Management Annals*, *5*(1), 613–652. https://doi.org/10.1080/19416520.2011.593319
March, J. G. (1991). Exploration and Exploitation in Organizational Learning. *Organization Science*, *2*(1), 71–87.
Mednick, S. (1962). The associative basis of the creative process. *Psychological Review*, *69*(3), 220–232. https://doi.org/10.1037/h0048850
Messick, S. (1984). The Nature of Cognitive Styles: Problems and Promise in Educational Practice. *Educational Psychologist*, *19*(2), 59–74. https://doi.org/10.1080/00461528409529283
Micheli, P., Wilner, S. J. S., Bhatti, S. H., Mura, M., & Beverland, M. B. (2019). Doing Design Thinking: Conceptual Review, Synthesis, and Research Agenda. *Journal of Product Innovation Management*, *36*(2), 124–148. https://doi.org/10.1111/jpim.12466
Norman, D. A., & Verganti, R. (2013). Incremental and Radical Innovation: Design Research vs. Technology and Meaning Change. *Design Issues*, *30*(1), 78–96. https://doi.org/10.1162/DESI_a_00250
Posen, H. E., Keil, T., Kim, S., & Meissner, F. D. (2018). Renewing research on problemistic search — A review and research agenda. *Academy of Management Annals*, *12*(1), 208–251. https://doi.org/10.5465/annals.2016.0018
Savino, T., Messeni Petruzzelli, A., & Albino, V. (2017). Search and Recombination Process to Innovate: A Review of the Empirical Evidence and a Research Agenda. *International Journal of Management Reviews*, *19*(1), 54–75. https://doi.org/10.1111/ijmr.12081
Simonton, D. K. (1999). Creativity as blind variation and selective retention: Is the creative process Darwinian? *Psychological Inquiry*, *10*(4), 309–328. https://doi.org/10.1207/S15327965PLI1004_4
Simonton, D. K. (2011). Creativity and Discovery as Blind Variation: Campbell's (1960) BVSR Model After the Half-Century Mark. *Review of General Psychology*, *15*(2), 158–174. https://doi.org/10.1037/a0022912
Sommer, S. C., Bendoly, E., & Kavadias, S. (2019). How Do You Search for the Best Alternative? Experimental Evidence on Search Strategies to Solve Complex Problems. *Management Science*, *66*(3), 1395–1420. https://doi.org/10.1287/mnsc.2018.3247
Sommer, S. C., Bendoly, E., & Kavadias, S. (2020). How do you search for the best alternative? Experimental evidence on search strategies to solve complex problems. *Management Science*, *66*(3), 1395–1420. https://doi.org/10.1287/mnsc.2018.3247
Stigliani, I., & Ravasi, D. (2012). Organizing thoughts and connecting brains: Material practices and the transition from individual to group-level prospective sensemaking. *Academy of Management Journal*, *55*(5), 1232–1259. https://doi.org/10.5465/amj.2010.0890
Teodoridis, F., Bikard, M., & Vakili, K. (2019). Creativity at the Knowledge Frontier: The Impact of Specialization in Fast- and Slow-paced Domains*. *Administrative Science Quarterly*, *64*(4), 894–927. https://doi.org/10.1177/0001839218793384
Tseng, I., Moss, J., Cagan, J., & Kotovsky, K. (2008). The role of timing and analogical similarity in the stimulation of idea generation in design. *Design Studies*, *29*(3), 203–221. https://doi.org/10.1016/j.destud.2008.01.003
Unsworth, K. (2001). Unpacking Creativity. *Academy of Management Review*, *26*(2), 289–297.
Wiesenfeld, B. M., Reyt, J.-N., Brockner, J., & Trope, Y. (2017). Construal Level Theory in Organizational Research. *Annual Review of Organizational Psychology and Organizational Behavior*, *4*(1), 367–400. https://doi.org/10.1146/annurev-orgpsych-032516-113115
Woodman, R. W., & Schoenfeldt, L. F. (1990). An Interactionist Model of Creative Behavior. *The Journal of Creative Behavior*, *24*(1), 10–20. https://doi.org/10.1002/j.2162-6057.1990.tb00525.x
Zahra, S. A., Neubaum, D. O., & Hayton, J. (2020). What do we know about knowledge integration: Fusing micro-and macro-organizational perspectives. *Academy of Management Annals*, *14*(1), 160–194. https://doi.org/10.5465/annals.2017.0093
Zhou, J., & Hoever, I. J. (2014). Research on Workplace Creativity: A Review and Redirection. *Annual Review of Organizational Psychology and Organizational Behavior*, *1*(1), 333–359. https://doi.org/10.1146/annurev-orgpsych-031413-091226