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Working Paper

2024/07/TOM

(Revised version of 2022/34/TOM)

Spaces for Creativity: Unconventional Workspaces and Divergent Thinking

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In recent years, companies have been experimenting with unconventional workspace designs—often characterized by bright or odd colored walls, unique light fixtures, unusual office furniture, vibrant artwork, display of atypical non-work-related objects, and casual and playful atmospheres—to promote creativity among their employees. However, empirical evidence on the effect of such unconventional workspaces on creativity has been lacking. Using an experimental approach, we examine the causal relationship between unconventional workspaces and individual divergent thinking—the cognitive process of generating many and distinct ideas to solve a creative task. Across four studies involving a total of 1,191 participants, contrary to our initial expectations, we discovered that unconventional workspaces do not always facilitate divergent thinking and can even be detrimental to it compared to conventional workspaces. Specifically, solving a creative task in an unconventional workspace had a negative effect on divergent thinking when features of the workspace were related to the task. Those task-related features would anchor the respondents into limited solution paths, hindering divergent thinking. Hence, the positive effect of unconventional workspaces was significant only when the creative task was unrelated to features of the workspace. We were able to replicate these findings in an online setting by allowing individuals to virtually experience workspaces, implying that it may be possible to facilitate divergent thinking in virtual work environments. This study contributes to the behavioral operations and organization design literatures by empirically establishing the causal effect of unconventional workspaces on divergent thinking and offering important boundary conditions to such an effect.

Keywords: Creativity; Divergent Thinking; Behavioral Operations; Workspace Design; Organization Design

Electronic copy available at: https://ssrn.com/abstract=4172192

Acknowledgements: We thank Linda Argote, Taya Cohen, Andy Hafenbrack, Oliver Hahl, Li Huang, Jinwoo Kim, Yonghoon Lee, Saerom (Ronnie) Lee, Daniel Mack, Sae-Seul Park, Jisoo Park, Phanish Puranam, Ella Miron-Spektor, Roderick Swaab, and the presentation participants at INSEAD, Carnegie Mellon University, Stanford University, the Southern Denmark University, University of Virginia, Yonsei University, the Academy of Management Conference, the INFORMS Conference, the Strategic Management Society Conference, and the Experimental Organization Science Seminar Series for their valuable comments and advice on the paper. We also thank Ishaan Chuhg, Nicole Vershov, and Belle Zhang for their excellent research assistance. This research was supported by the Heinrich and Esther Baumann–Steiner Fund for Creativity and Business at INSEAD and the Center for Organizational Learning, Innovation and Knowledge at the Tepper School of Business, Carnegie Mellon University.

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1. Introduction

Individuals' divergent thinking, or the cognitive process of generating many and distinct ideas to solve a task at hand, has been argued to play a critical role in the production of creative outcomes (e.g., Amabile 1996, Acar and Runco 2011, Girotra, Terwiesch, and Ulrich 2010, Kavadias and Sommer 2009, Sommer, Bendoly, and Kavadias 2020). Accordingly, management scholars have been trying to understand the factors that enable individuals to become more effective in divergent thinking. A growing stream of research examines the behavioral aspects of innovation processes including the generation of creative ideas (Katok, Leider, and Donohue 2018), especially within the field of behavioral operations, which studies the people side of operations and processes.

For example, studies have explored the influence of different team structures—such as nominal versus collaborative—and teams' diversity on their creative performance in idea generation sessions (Girotra et al. 2010, Kavadias and Sommer 2009). Experimental work has also investigated how problem complexity affects individuals' capacity to generate solutions (Sommer et al. 2020) and the process of transitioning from ideation to implementation in innovation endeavors (Kagan, Leider, and Lovejoy 2018). Furthermore, research in this area has examined various forms of collaboration among inventors, exploring aspects such as the impact of collaboration on breakthrough creation (Singh and Fleming, 2010), the role of problem structure (e.g., modular vs. integral) in deciding whether to collaborate for creating breakthroughs (Chan, Mihm, and Sosa, 2021), and effective ways to collaborate with star innovators (Liu, Mihm, and Sosa, 2018). Additionally, studies have examined behavioral aspects in innovation contests (e.g., Boudreau, Lacetera, and Lakhani 2011). Despite these advances on how to better manage innovation processes, the field still lacks understanding on how the *workspace*—in which creative tasks take place—influences the performance of participants in creative endeavors. Our paper aims to fill this important gap.

Historically, the longstanding objective of workspace design has been to enhance worker productivity and efficiency, resulting in established norms that emphasize practicality in office design (Harris 2019). Accordingly, most offices have featured cubicles or partitions between employees' desks, standard ceiling lighting and office furniture, neutral colors, equipment related only to work, and formal

atmospheres to achieve such goals (Harris 2019, Thompson and Jonas 2008, Palvalin, van der Voordt, and Jylhä 2017, Piotrowski 2016). In this paper, we refer to these offices as "conventional workspaces" (see Figure 1a for an example). However, in recent years, with innovation becoming increasingly crucial for firms' competitiveness, there has been a dynamic shift towards radically redesigning office spaces, especially in a stimulating manner (Meinel et al. 2017). Offices designed with this concept include unconventional features such as bright or odd colored walls, unique light fixtures, unusual office furniture, vibrant artwork, the display of atypical non-work-related objects, and casual and playful atmospheres. For instance, as depicted in Figures 1b and 1c, high-tech firms relying heavily on innovation, such as Google and Meta, have led this trend, with the belief that these workspaces will play a positive role in a firm's creativity by facilitating the divergent thinking of employees (Bacevice, Burow, and Tribner 2016, Cohen 2019, Doorley and Witthoft 2012, Waber, Magnolfi, and Lindsay 2014). In this paper, we refer to these offices as "unconventional workspaces."

– Figure 1 about here –

Indeed, there are several theoretical viewpoints which suggest that unconventional workspaces will positively impact individuals' divergent thinking performance. Specifically, these workspaces could potentially trigger a mindset to think and act differently, encouraging individuals to challenge preconceived notions on a given subject (e.g., Baird et al. 2012, Dijksterhuis and Meurs 2006, Lu et al. 2017), recombine ideas (e.g., Savino, Petruzzelli, and Albino 2017, Singh and Fleming 2010), approach their tasks in a creative way (e.g., Amabile 1997), or induce moods conducive to divergent thinking (e.g., De Dreu, Baas, and Nijstad 2008, Hirt, Devers, and McCrea 2008, Murray et al. 1990). However, no academic research to date has rigorously examined whether this causal relationship actually holds.

It is important to note that the creativity literature has examined the role that some individual elements of workspaces such as lights, plants, colors, natural materials, and views of natural environments may have on creativity (e.g., Ceylan, Dul, and Aytac 2008, Kallio, Kallio, and Blomberg 2015, McCoy and Evans 2002; see also Elsbach and Pratt 2007). However, these individual elements, especially if they do not have an unusual or stimulating features, do not necessarily make workspaces "unconventional". For

example, in the study by Ceylan et al. (2008), participants were shown photos of workspaces featuring "plants, bright lighting conditions, windows, cooler colors, and a computer facility" and were asked about the room's *creativity potential* through a survey. Yet, none of those photos showed unconventional workspaces as we conceptualized above. Furthermore, the relationships identified in prior studies have been primarily correlational in nature. For example, recent studies like Lee (2016) and Thoring et al. (2021) investigated the common characteristics of physical work environments that have been associated with creativity in workplaces. However, these studies were primarily based on limited interview data and/or (untested) conjectures, inhibiting causal inference. In sum, despite the growing adoption of unconventional workspaces in practice and plausible theoretical arguments for why such workspaces would have positive effects on the divergent thinking performance of individuals working within them, this causal relationship remains to be investigated.

Uncovering such a causal relationship poses significant challenges, however, especially in real-life organization settings. For instance, the relationship cannot be explored by merely comparing the divergent thinking performance of individuals who work in conventional versus unconventional workspaces across organizations. Other unobserved factors may be associated with both an organization's decision to adopt unconventional workspaces and an individuals' divergent thinking performance; organizational culture is one such factor (Stallworth and Kleiner 1996, Turner and Myerson 1998). Another alternative explanation is that the existence of unconventional workspaces may attract certain types of employees (Maier et al. 2022), especially those who are inherently more creative than others (Stegmeier 2008). Such a scenario would demonstrate the selection effect of the workspace, instead of the treatment effect of it. Finally, even if both types of workspaces coexisted in an organization, as is often the case, it would be infeasible to randomly assign some individuals into conventional workspaces and others into unconventional workspaces, due to fairness and operational issues.

For these reasons, in this study, we investigate the causal relationship between unconventional workspaces and divergent thinking performance, along with its boundary conditions, using four controlled experiments. Study 1 took advantage of a unique opportunity in which we had access to two physical spaces

that had identical floor plans but contrasting interior designs; one space had an unconventional design and the other one had a conventional one. Participants were randomly assigned into these spaces to solve a divergent thinking task. Contrary to our expectations, we found that individuals assigned to the unconventional workspace in this study had lower divergent thinking performance than those assigned to the conventional workspace. Additional analyses suggested that the *relatedness* between possible solutions for the divergent task and salient features of the unconventional space may have driven this negative relationship, by cognitively anchoring the participants. Based on this finding and further scrutiny of related literature, we developed a revised hypothesis. This hypothesis predicted that unconventional workspaces would have a positive impact on divergent thinking only when potential solutions for a divergent thinking task could *not* be readily inspired by features of the workspace. To test this hypothesis, we ran two online studies (Studies 2 and 3) and an additional in-person study in a behavioral lab (Study 4). The results in these studies showed consistent support for our revised hypothesis.

Overall, our paper makes the first attempt to uncover an often assumed but never tested, nuanced causal relationship between unconventional workspaces and divergent thinking performance. Most importantly, we find that unconventional workspaces do not always improve the divergent thinking performance of individuals: features of the unconventional workspace need to be *unrelated* to potential solutions of the divergent thinking task for the effect to be positive. This implies that firms should not blindly adopt unconventional office designs to promote creativity—they must first consider the potential interplay between their intended workspaces and the tasks that will be carried out within them. Moreover, the findings from our online studies show the potential of designing and utilizing virtual workspaces to enhance the divergent thinking performance of individuals working remotely. Taken together, this work contributes to the literature on individual creativity from a behavioral operations perspective (e.g., Girotra et al. 2010, Kagan et al. 2018, Kavadias and Sommer 2009, Sommer et al. 2020). It also contributes to the organization design literature on workspaces, by providing insights into how physical spaces of organizations can be configured to promote individual-level creativity (e.g., Lee 2019). Finally, it opens up novel research opportunities for understanding the micro-processes of innovation in organizations.

2. Development of Baseline Hypothesis

Conventional and Unconventional Workspaces

A workspace is a physical space in which an individual or a group of individuals carries out tasks. In the context of firms, a workspace can be simply assumed to be an office space where employees perform work-related tasks (Myerson and Ross 2006). Office spaces come in many different shapes and sizes (Piotrowski 2016). In particular, the field of interior design, along with some management scholars, have long studied the impact of office designs, including the organizational effects of features such as layout, aesthetics, and ambience (Dul and Ceylan 2014, Elsbach and Pratt 2007, Harris 2019, Khazanchi et al. 2018, Lee 2019, Meinel et al. 2017, Myerson and Ross 2006, Piotrowski 2016, Thoring et al. 2021).

While workspaces have taken various forms, a longstanding objective of workspace design has been to enhance worker productivity and efficiency, leading to established norms emphasizing practicality in office design (Harris 2019). Consequently, traditional offices have primarily featured cubicles or partitions between employees' desks, standard ceiling lighting and office furniture, neutral colors, equipment related only to work (e.g., computers, printers, whiteboards, etc.), and formal atmospheres (Harris 2019, Thompson and Jonas 2008, Palvalin, et al. 2017, Piotrowski 2016). Even today, these workspace designs remain being utilized and are still widely adopted, suggesting that their intended advantages continue to be valid (Haapakangas et al. 2018, Harris 2019, Thompson and Jonas 2008).

However, with innovation becoming increasingly crucial for firms' competitiveness, there has been a dynamic shift towards significantly redesigning office spaces, especially to foster the creativity of individuals and teams. For instance, one popular endeavor has involved the reconfiguration of the layout of workspaces. Specifically, firms have been transforming closed spaces to open spaces where employees can easily interact and have serendipitous encounters with each other, with the expectation that these will promote novel collaborations and innovation (Boudreau et al. 2017, Catalini 2018, Lee 2019).

A more recent development in these attempts to redesigning office spaces for creativity, which has been primarily led by high-tech firms whose survival depend on innovation, have involved the radical redesign of the office's interior, particularly in a stimulating manner (Bacevice et al. 2016, Cohen 2019,

Doorley and Witthoft 2012, Waber et al. 2014). Offices designed with this concept have included features such as bright or odd colored walls, unique light fixtures, unusual office furniture like beanbags or high-top tables and stools, vibrant artwork, the display of non-work-related items such as game consoles, toys, slides, and hammocks, and casual and playful atmospheres, akin to the offices in Figures 1b and 1c.

Considering this evolutionary perspective of workspaces based on how their interior designs have evolved to adapt to their purposes, we refer to these newer designs of work environments as "unconventional workspaces" and compare their effects on divergent thinking with the effects of "conventional workspaces"—the more traditional workspaces, characterized by more standard, neutral, and formal features, which were typically designed with the intent of enhancing efficiency and productivity rather than fostering creativity and innovation.

Unconventional Workspaces and Divergent Thinking

For individuals to generate creative ideas, divergent thinking is essential. Divergent thinking is the cognitive process of generating many possible solutions to a task at hand in diverse directions; therefore, it becomes the basis for producing creative outcomes (Acar and Runco 2011, Runco 2011). However, any kind of idea generation task ultimately occurs within a space, and it is possible that certain workspaces are more conducive to individuals' divergent thinking performance compared to others.

Indeed, several plausible theoretical arguments explain why unconventional workspaces would enhance individuals' divergent thinking performance. Most importantly, we expect that, compared to conventional workspaces, unconventional workspaces welcome or trigger a mindset that encourages atypical thinking and actions, because such workspaces are stimulating and unusual—in a positive and surprising way—compared to those which individuals normally associate formal work environments with (Kobe and Lehman 2021, Meinel et al. 2017, Thoring et al. 2021). This would activate several sub-mechanisms that can positively influence individuals' divergent thinking ability.

First, unconventional workspaces could create mental stimulation and distractions that are useful for improving cognitive flexibility (Nijstad et al. 2010, Thoring et al. 2021). In particular, a roadblock to creativity has been argued to be *cognitive fixation*—a situation where individuals become fixated on ideas

or problem-solving strategies that are effective in other settings but ineffective in addressing the focal task at hand, thereby hindering the ability to think in diverse directions. Distractions and random stimulation have been found to help individuals break free from such fixations and explore multiple paths of ideation (de Bono 2010). For example, Lu et al. (2017) found that switching between different tasks improved individual creativity because it helped individuals break free from cognitive fixation. Similarly, Baird et al. (2012) found that individuals' creative performance increased when they temporarily set aside a creative task to work on a simple unrelated task. Moreover, in a laboratory study, Dijksterhuis and Meurs (2006) found that individuals tasked with generating new names for products produced more unique names when briefly distracted, compared to participants who were not. This is consistent with the notion of exposing individuals to random stimulation to trigger lateral thinking during an idea generation task (de Bono 2010). As such, unconventional workspace designs could create distractions or random stimulation that allow the minds of individuals to wander and, consequently, fostering divergent thinking.

Second, prior research has suggested that creativity and innovation involve the mix and match of existing (familiar) and new (unfamiliar) ideas and concepts (Sutton and Hargadon 1997, Savino et al. 2017, Singh and Fleming 2010). Individuals bring in existing ideas from their past experiences and knowledge to workspaces. However, as depicted in Figures 1b and 1c, unconventional workspaces tend to be comprised of features that individuals do not expect to see in traditional work environments. We expect those unusual features to inspire new combinations of ideas, leading individuals to produce more creative solutions in those workspaces.

Finally, unconventional workspaces could motivate individuals to think more divergently by putting them in mental states conducive to creativity. For example, Amabile (1997) argued that intrinsic motivation is important for creativity, such that motivation driven by interest and involvement in the work, curiosity, or enjoyment can enhance creativity. The novelty and uniqueness associated with unconventional workspaces are likely to signal a welcoming environment for atypical and even paradoxical approaches, as well as behaviors driven by curiosity. Such mindsets have been demonstrated to result in individuals producing more creative outcomes (Miron-Spektor et al. 2011, Hagtvedt et al. 2019). In addition, it has

been found that positive mood is related to cognitive flexibility and creativity (Amabile et al. 2005, De Dreu et al. 2008, Hirt et al. 2008, Murray et al. 1990). Unconventional workspaces could induce positive moods by providing a task environment that is casual and playful.

Taken together, we posit the following **baseline hypothesis**:

Individuals will have higher divergent thinking performance in an unconventional workspace than in a conventional workspace.

3. Study 1: Test of the Baseline Hypothesis

We test our baseline hypothesis using a quasi-field experiment that involved participants being randomly assigned to two different physical spaces and completing a divergent thinking task. Participants in the treatment condition were assigned to an 'unconventional workspace', and those in the control condition were assigned to a 'conventional workspace.' After experiencing their workspaces, participants engaged in a divergent thinking task, on which their creative performance was scored.

3.1. Methods

Unconventional vs. Conventional Workspaces

For our experiment, we leveraged a unique yet temporary opportunity, utilizing two large flatrooms in a global business school. The two flatrooms were on the same floor, were located side-by-side, and had the same floor plan in terms of size and structure. One of the rooms was designed as a creative unconventional workspace (referred to as "Unconventional Space" hereafter), whereas the other room was kept as a conventional workspace (referred to as "Conventional Space" hereafter). Specifically, the former room included several unconventional workspace features, such as unfinished ceilings, colorful beanbags, high-top tables and stools, and various unique drawings and posters on the walls, aligning with our conceptualization of unconventional workspaces (see Figure 2a). On the contrary, the latter room maintained a conventional design, resembling a classic business workspace with standard ceiling lighting and office furniture, clean mono-colored walls, and equipment related only to work (e.g., computer, projector, whiteboard), once again in line with our conceptualization of conventional workspaces (see Figure 2b).

– Figure 2 about here –

Participants

A total of 55 individuals participated in the study. These participants were either MBA students or executive education program participants at the business school where we conducted our study. Only new, incoming students were recruited for the study to ensure that the participants had never been exposed to the physical spaces we designed nor knew about the existence of these spaces on campus. The participants were volunteers who were interested in understanding how individuals engage in problem solving tasks and did not receive any monetary or non-monetary incentives for participating in the study. Five participants did not follow instructions and thus were removed from the analysis. The remaining 50 participants (11 females, M_{age} = 39.74, SD = 8.56) were included in the analysis.

Design and Procedure

Participants gathered in front of the entrances of the two spaces prior to the experiment. The doors of the spaces were closed, and the windows of the doors were covered from the inside, preventing the participants from noticing that the two rooms looked different inside (see Figure A1 in online appendix). The participants were then randomly assigned to one of the spaces by drawing lots.

Once the participants entered the rooms, they were asked to wander around the room and get accustomed to the workspace for two minutes. Subsequently, they were randomly assigned to a table, where they sat in a designated stool that faced the front of the room. There was a maximum of nine tables in each room for each batch of participants. There were dividers between the tables so that participants could not observe each other during the completion of their task. The *t*-test results of observable characteristics of participants assigned to the Unconventional versus Conventional Space showed that the means of the observable characteristics of the participants (i.e., gender, age, education, and science or engineering training) did not significantly differ between the two workspaces, indicating that the random assignment of participants to the two conditions was effective (see Table A1 in online appendix for details).

Once seated in their assigned rooms, the participants received a booklet that included general instructions on the experiment and on the divergent thinking task. Participants were given five minutes to

complete the task. Participants remained seated and did not interact with each other during the task.

Divergent Thinking Task

The divergent thinking task we used was similar to Guilford's Alternative Uses Task (AUT: Guildford, 1967). Guilford's AUT requires participants to list as many creative uses for everyday objects, such as a brick or a toothpick, as possible (e.g., Lu et al. 2017). In our divergent thinking task, 40 blank circles were printed out across two sheets of paper and participants were asked to draw as many real-world objects as possible, using those circles as an integral part of the objects. They were asked to label their circular objects. Figure 3 shows two examples of the task completed by two of the participants.

– Figure 3 about here –

Performance Measures

To measure divergent thinking performance, we examined two outcome variables. First, we counted the total number of objects that a participant drew (referred to as "*ideational fluency*" hereafter). Second, we counted the *unique* number of objects that a participant drew (referred to as "*originality*" hereafter) (see also Torrance 1981). To create the second measure, we compiled all the objects that the entire pool of participants drew. Then we counted the number of objects that *only* the focal participant drew.

Econometric Model

Since our dependent variables were count variables that took only discrete, nonnegative integer values (i.e., number of drawings), we employed Poisson regression models.[1] The independent variable was *Unconventional Space*, which was coded as 1 if the participant completed their divergent thinking task in the Unconventional Space and coded as 0 if they completed the task in the Conventional Space.

We ran two models for each outcome variable. One model included only the independent variable, and the other model included controls for individual characteristics and the table dummy which indicated where the participant sat in the room.

[1] Results were similar when using negative binomial regression models. However, negative binomial regression models have been advised against for smaller sample sizes because overdispersion cannot be reliably measured. The results were also consistent when testing mean differences using *t*-tests or the Wilcoxon rank-sum test.

3.2. Results

Manipulation Check

We checked whether our manipulation was effective by asking open-ended questions to the participants about the features of the rooms that felt different to them. In their answers, participants of the Unconventional Space mentioned that their room had unusual features such as bean bags, unfinished ceilings, high-top tables and stools, and images drawn on the wall, whereas the participants in the Conventional Space did not note conspicuous differences in the room compared to their typical work environments. Consistent with these answers, participants assigned to the Unconventional Space reported the physical environment of the room to be significantly more different from their usual work environments (M = 5.46, SD = 1.77) than the participants assigned to the Conventional Space did in a follow-up manipulation question (M = 4.27, SD = 1.66), $t(48) = -2.45$, $p = 0.02$).[2] Overall, the participants' responses indicated that our manipulation was effective.

Effect of the unconventional space on divergent thinking performance

The results of the Poisson regression analysis that tested the effect of the unconventional space on *ideational fluency* (M = 12.38, SD = 4.53) and on idea *originality* (M = 2.70, SD = 2.53) are presented in Table 1. Unexpectedly, and in contrast to our baseline hypothesis, the results showed that *ideational fluency* was *lower* for participants who completed the task in the Unconventional Space compared to those who completed it in the Conventional Space ($p < 0.05$). Specifically, based on Model 1, participants in the Conventional Space produced 1.21 times more solutions compared to those in the Unconventional Space within the given timeframe. Model 2 included the control variables. The results were consistent.

Table 1 additionally shows that idea *originality* was also significantly lower for participants in the Unconventional Space compared to those in the Conventional Space ($p < 0.05$). Specifically, based on

[2] During the debrief session that followed the experiment, most participants, including those from the tech industry, characterized their normal (usual) work environments as closely resembling our paper's conceptualization of a "conventional workspace," featuring standard ceiling lighting, conventional office furniture, neutral colors, and formal atmospheres. However, to improve this manipulation check, in Studies 2-4, we specifically asked the participants the extent to which they found the experimentally assigned workspace to have unconventional features.

Model 3, participants in the Conventional Space generated 1.52 times more unique solutions compared to those in the Unconventional Space within the given timeframe. Model 4 included the control variables and showed consistent results.

In sum, the results of Study 1 did *not* support the baseline hypothesis. Instead, the analyses showed statistically significant results in the opposite direction: individuals had higher divergent thinking performance in the Conventional Space than in the Unconventional Space.

– Table 1 about here –

3.3. Post-hoc Analysis: Did the Salient Circular Features of the Unconventional Space Produce Cognitive Anchoring?

To reconcile the unexpected result of our initial analyses, we re-examined each solution that our participants provided and the design of our unconventional workspace. During this review, we observed an interesting pattern among some participants of the Unconventional Space: there seemed to be individuals who derived their initial solutions based on the circular objects they saw on the main wall of the workspace. Especially, we noticed those whose earlier solutions were inspired by the Disney and Pixar cartoon characters with circular components (e.g., Mickey Mouse, Woody, and Lightning McQueen) drawn on the wall, which were presumably the most salient features of the wall (see Figures 3 and 4).

– Figure 4 about here –

A possible explanation for why participants in the Unconventional Space had lower divergent thinking performance than those in the Conventional Space could be that the Unconventional Space also created countervailing forces that went against the sub-mechanisms we originally proposed to be conducive to creativity (i.e., distraction, stimulation, recombination of ideas, increased intrinsic motivation, and positive mood). One of those forces could be, in fact, *cognitive anchoring*, which leads individuals to narrowly focus on cues that are in their immediate environment (Acar 2021, Crilly and Cardoso 2017). Also known as design fixation in the engineering design literature (Cardoso and Badke-Schaub, 2011), cognitive anchoring has similarities but conceptually differs from cognitive fixation. The former refers to the tendency to be strongly influenced by initial valid ideas encountered by a problem solver during an idea

generation task, whereas the latter is the general tendency to think about an object or a situation only from a single main point of view (Duncker, 1945).

On the one hand, a workspace containing more circular objects could potentially improve an individual's divergent thinking performance by providing more clues to complete the task. However, on the other hand, the literature on individual creativity and brainstorming suggests that cues that give out potential solutions to idea generation tasks could *hinder* divergent thinking performance because those cues could cognitively anchor individuals' minds on a narrow set of initial ideas that are closely related to the cues and thus limit their ability to come up with subsequent solutions.

Previous work in the creativity literature has found some evidence of cognitive anchoring. For example, in Smith and colleagues' (1993) study where participants were tasked with drawing as many diverse toys or imaginary creatures as possible as part of an idea generation task, individuals produced fewer and less novel ideas when the task instructions included a pictorial example. This was because participants tended to become anchored on that example, leading them to generate ideas that closely resembled variations of it (see also Chrysikou and Weisberg 2005 and Jansson and Smith 1991). Similarly, in the brainstorming literature, Kohn and Smith (2011) found that individuals generated fewer unique ideas when they brainstormed in a group compared to when they brainstormed individually, because group brainstorming led individuals to become anchored on the initial ideas generated by others (Diehl and Stroebe 1987,1991, Girotra et al. 2010).

Based on these insights, we conducted a post-hoc analysis that investigated whether the aforementioned salient drawings on the wall (i.e., Disney and Pixar cartoon characters with circular components) triggered an anchoring effect that hindered divergent thinking performance. Specifically, if cognitive anchoring was the countervailing mechanism contributing to the low performance in the divergent thinking task for participants in the Unconventional Space, we expect to find that drawing Disney or Pixar characters early in the task (as illustrated by the participants who drew Mickey Mouse as their first solution in Figure 3) would be associated with lower divergent thinking performance within the Unconventional Space. To examine this, we ran a Poisson regression with divergent thinking performance as the dependent

variable and *Early Disney or Pixar character* drawing as the independent variable, a dummy variable which took the value of 1 if a participant drew a Disney or Pixar character as one of their first five drawings (and 0 otherwise). The results of this analysis are presented in Table 2.

– Table 2 about here –

Consistent with our prediction, the results showed that drawing Disney or Pixar characters early in the task was correlated with a decrease in divergent thinking performance within the Unconventional Space, without (Model 1) or with controls (Model 2), providing suggestive evidence in line with the cognitive anchoring mechanism.[3] Motivated by these results, in the next section, we develop a revised hypothesis.

4. Revised Hypothesis

While the results from Study 1 contradicted our original theory, it may not be that our original theory is invalid. Rather, there may be boundary conditions to the theory, such that potential interaction effects exist between the design of an unconventional workspace and the type of creative task carried out within it, which will determine whether the effect of an unconventional workspace on divergent thinking performance is net positive or negative. Specifically, based on the results of the post-hoc analysis of Study 1, we suspect that when potential solutions for a creative task can be readily inspired by design features of an unconventional workspace, the net effect of such unconventional workspace on divergent thinking performance will be negative due to the stronger force of cognitive anchoring, as opposed to our proposed mechanisms that promote divergent thinking (Chrysikou and Weisberg 2005, Jansson and Smith 1991, Kohn and Smith 2011, Smith et al. 1993).

Put differently, we posit that the degree of *relatedness* between the design features of an unconventional workspace (comprising various figures and objects) and the potential set of solutions for a creative idea generation task will determine the effect of an unconventional workspace on divergent thinking performance: high relatedness will lead to worse divergent thinking performance. Importantly, even with the same level of space-task relatedness, we expect the risk of cognitive anchoring to be

[3] For the *originality* variable, there was too little variation in the outcome variable to run this analysis.

significantly higher in unconventional workspaces compared to a conventional ones, as the former spaces are designed precisely to catch the attention of occupants and make the features within them salient.

The reason why high space-task relatedness in a workspace may lead to cognitive anchoring rather than cognitive stimulation can also be linked to the search literature, particularly if divergent thinking is viewed as a search process (e.g., Levinthal 1997, Fleming 2001). For instance, Billinger et al. (2014) demonstrate through an experimental approach that individuals adapt their search behavior based on the feedback received on their task performance. Positive feedback prompts individuals to stay within the local vicinity of their initial solutions and to avoid exploration of alternative distant solutions. Conversely, a lack of reinforcing feedback triggers more exploratory and distant search behaviors.

Ultimately, we argue that when individuals are in a stimulating unconventional workspace, they will engage with the workspace's environment—more so than when they are in a conventional workspace—while searching for inspirations to solve their creative task at hand. If they find successful cues early on in such an environment, they are at the risk of remaining in the vicinity of those initial ideas, leading to cognitive anchoring that hinders divergent thinking. On the other hand, when solutions to a divergent thinking task cannot be readily inspired by features of an unconventional workspace, cognitive anchoring is less likely to dominate. In such cases, the unusual and stimulating features of the unconventional workspace are more likely to encourage individuals to proactively engage in exploratory search behavior, allowing them to benefit from the sub-mechanisms that unconventional spaces are supposed to strongly activate and maintain (i.e., distraction, stimulation, recombination of ideas, increased intrinsic motivation, and positive mood). Accordingly, we develop a revised hypothesis that considers circumstances when solutions for a given divergent thinking task cannot be readily inspired by features of a workspace:

> ***Revised Hypothesis****: Individuals will have higher divergent thinking performance in an unconventional workspace than in a conventional workspace only when solutions for a given divergent thinking task <u>cannot</u> be readily inspired by features of the workspace.*

5. Study 2: Online Replication of Study 1

In this study, we first attempted to replicate the results of Study 1 online, using Amazon's Mechanical Turk

(mTurk) online platform.[4] We turned to an online setting to continue our research for two important reasons. First, we lost access to the Conventional Space used in Study 1, because the room was renovated into a set of small offices soon after we completed Study 1. Second, the COVID-19 pandemic hit in early 2020 when we were planning to conduct additional studies, making it impractical to conduct in-person experimental studies for two years. Interestingly, we found this last constraint to be a valuable opportunity, because during the pandemic, employees started to work from home, and understanding how to facilitate employee creativity in virtual settings became an important challenge for companies relying on innovation for survival (e.g., Brucks and Levav 2022, Horvat and Uzzi 2022).

Studying the impact of unconventional workspaces in a virtual setting indeed presented challenges compared to a physical setting. Specifically, two primary concerns were that the treatment effect of the workspace could be weaker, and that participants might have lower attention levels than in physical spaces. However, we believed that these limitations would render any results found in a virtual setting conservative, if our manipulations were successful. In the following section, we explain how we manipulated our workspace conditions virtually, through a video recording of two actual workspaces.

5.1. Methods

(Virtual) Unconventional vs. Conventional Workspaces

We created two virtual workspaces for online participants by videotaping the original Unconventional Space we used for Study 1 (albeit featuring new drawings on the wall) and a conventional flatroom in the same building that had the same table and seating configuration as the Unconventional Space (see Figure A2 in the online appendix for screenshots and links to the videos used in the experiment). Each video was two minutes and thirty seconds long. For each workspace, we first filmed the entrance to the room and then the entire room—showing the tables, chairs, walls, and the ceiling in detail. Each video ended at a table in the back of the room with the camera facing the front of the room. This last scene remained in the background of the task screen while participants engaged in their tasks.

[4] The data collection and analysis plan for this study was pre-registered: https://aspredicted.org/mp7wi.pdf.

Participants

We recruited 400 participants from Amazon Mechanical Turk (mTurk) to complete the study. Participants qualified for the experiment only if they were at least 18 years old, fluent in English, and were not using a mobile device for the task (e.g., phones, tablets). The last condition was intended to ensure that participants viewed the videos on a larger screen (e.g., monitor, laptop screen), maximizing the effectiveness of our virtual manipulations. Participants were promised a fixed monetary incentive, pre-approved by an Institutional Review Board (IRB), contingent upon completing both the task and survey questions. The reason for not offering incentives based on performance was based on concerns about the potential adverse effects of extrinsic incentives on creative performance, as highlighted by the prior literature on creativity and innovation (e.g., Amabile 1988, Ederer and Manso 2013, Lee and Meyer-Doyle 2017). We maintained fixed monetary incentives for all of our remaining studies (Studies 2-4).

We excluded five participants who failed to complete both the task and the survey questions, three participants who did not follow the task instructions, and 17 participants who reported at the end of the experiment that they received help on the task (from the internet or other people), leaving 375 participants (233 females, M_{age} = 43.91, SD = 14.02) for the final analysis.

Design and Procedure

Participants were randomly assigned to the Unconventional and Conventional Space conditions in the order they joined the online study. Participants were informed that they would be engaging in a simple problem-solving task in a 'virtual workspace' due to the COVID-19 pandemic. Subsequently, they were instructed to watch a video of their assigned workspace to familiarize themselves with it before solving the task. The participants viewed the aforementioned two-minute-thirty-second-long video of their assigned space and were explicitly instructed to watch the entire video without skipping or fast-forwarding any parts of it.

The *t*-test results of observable characteristics of participants assigned to the Unconventional versus Conventional Space showed that the means of the observable characteristics of the participants did not significantly differ between the two spaces except for age, which was marginally different (p = 0.09) (see Table A2 in online appendix for details). To account for this modest difference, we controlled for age (along

with the other observable characteristics of the participants) in our analyses that checked for robustness.

After watching the video, the participants were shown the following message on their screen: "*Loading question and sending you to your virtual workspace*." Shortly after, the divergent thinking task appeared on the screen, with the last scene of the video serving as the background image. The participants were given three minutes to complete the task.

Task and Measures

The divergent thinking task we used in this online study was identical to the "circle task" used in Study 1. Participants were asked to brainstorm real-life objects that include a circle as their main component. Since we could not physically distribute paper with pre-printed circles in this virtual study, as we did in Study 1, participants were instructed to enter names of objects included a circle as their main component into blank answer boxes on their computer screens.

We examined the same two divergent thinking performance outcomes of Study 1, *ideational fluency* and *originality*, and estimated Poisson regression models for each outcome variable without and with controls, respectively. To check whether our manipulation was effective, we asked participants to report the extent to which they found their virtual workspace to have unconventional features (1 = strongly disagree; 7 = strongly agree) at the end of the study.

5.2. Results

Manipulation check

Participants assigned to the Unconventional Space reported that the virtual workspace had significantly more unconventional features (M = 5.67, SD = 1.48) than the those assigned to the Conventional Space reported (M = 2.31, SD = 1.35), $t(373) = -23.01$, $p = 0.00$, indicating that the manipulation was effective.

Effect of the unconventional space on divergent thinking performance

The results of the Poisson regression analysis that tested the effect of the Unconventional Space on both *ideational fluency* (M = 13.29, SD = 6.29) on idea *originality* (M = 1.35, SD = 1.90) are presented in Table 3. Model 1 included only the independent variable, *Unconventional Space*. Consistent with the results of Study 1, the result showed that *ideational fluency* was *lower* for participants who were assigned to the

Unconventional Space compared to those who were assigned to the Conventional Space ($p < 0.01$). Specifically, participants in the Conventional Space produced 1.08 times more solutions compared to those in the Unconventional Space within the given timeframe. Model 2 included the control variables. The results were consistent.

Next, corroborating the results of Study 1, the results in Model 3 of Table 3 showed that idea *originality* was also significantly lower for participants in the Unconventional Space compared to those in the Conventional Space ($p < 0.01$). Specifically, participants assigned to the Conventional Space generated 1.38 times more unique solutions compared to those in the Unconventional Space within the given timeframe. Model 2, which included the control variables, showed similar results.

– Table 3 about here –

Finally, we conducted a post-hoc analysis mirroring the one performed for Study 1. Specifically, we tested whether using salient drawings on the newly designed wall of the virtual Unconventional Space (i.e., planet/globe/Earth, steering wheel, Ferris wheel, stop sign, pumpkin/tomato) as solutions early in the task (i.e., within the first five answers) was associated with lower divergent thinking performance within the virtual Unconventional Space. The results of this analysis are presented in Table 4. Both models (with and without controls) yielded results consistent with those presented in Table 2 (i.e., the post-hoc analysis for Study 1), indicating that cognitive anchoring similarly occurred in the virtual Unconventional Space.

– Table 4 about here –

Overall, Study 2 offered important evidence that virtual workspaces can serve as effective alternatives to physical workspaces when manipulating unconventional versus conventional workspace in a manner similar to Study 1. Based on the findings of Study 2, we proceeded to utilize the virtual workplace setting to examine the revised hypothesis in Study 3.

6. Study 3: Online Study for Testing of the *Revised Hypothesis*

In this study, we tested the revised hypothesis using the same virtual setting as Study 2.[5] As in Studies 1

[5] We followed the same pre-registered data-collection and analysis plan used for Study 2.

and 2, participants were randomly assigned to the virtual Unconventional and Conventional Space conditions. However, unlike those studies, this new set of participants in Study 3 solved a different divergent thinking task, which involved brainstorming solutions for a problematic situation, whereby the features of the workspace were unlikely to provide direct clues to potential solutions.

6.1. Methods

To maintain consistency between Studies 2 and 3, we used the same two-minute-and-thirty-second-long videos used in Study 2 to manipulate the Unconventional and Conventional Spaces. We recruited 400 participants from Amazon mTurk to conduct the study. We applied the same participation qualification rules from Study 2, leaving 375 participants (189 females, M_{age} = 42.83, SD = 13.00) for the final analysis. Identical to Study 2, participants were randomly assigned to the virtual Unconventional and Conventional Space conditions in the order they joined the online study. The fixed monetary incentive for completing this study remained consistent with that of Study 2.

The *t*-test results of observable characteristics of participants assigned to the Unconventional versus Conventional Space in Study 3 showed that the means of those characteristics did not significantly differ between the two spaces, indicating that random assignment of participants to the rooms was once again effective (see Table A3 in online appendix for details).

Task and Measures

For this study, participants were given an open-ended divergent thinking task which required them to provide solutions to a problematic situation (Acar and Runco 2011, Runco 2011):

> *Imagine that you have arrived at a store that requires you to wear a mask due to the pandemic situation. However, you forgot to bring one. How will you deal with this situation? The store does not sell masks and returning home without the item you needed is not an option. Your goal is to type in as many answers as possible.*

We chose this task because deriving solutions for this task would require divergent thinking, but the features of the virtual workspaces, as depicted in Figure A2 of the online appendix, were unlikely to inspire those solutions. Participants were given 20 answer boxes that they could fill for three minutes.

Consistent with the approach taken in Studies 1 and 2, we examined the same two performance

outcomes of divergent thinking; *ideational fluency* and *originality*. We employed Poisson regression models for each outcome variable, without and with controls. To check if our manipulation was effective, we asked participants to report the extent to which they found the virtual workspace to have unconventional features (1 = strongly disagree; 7 = strongly agree) at the end of the study.

6.2. Results

Manipulation Check

Participants assigned to the Unconventional Space reported that the virtual workspace had significantly more unconventional features (M = 5.71, SD = 1.44) than the participants assigned to the Conventional Space did (M = 2.42, SD = 1.54), $t(373)$ = -21.36, p = 0.00, indicating that the manipulation was effective.

The results of the Poisson regression analysis that tested the effect of the Unconventional Space on *ideational fluency* (M = 4.85, SD = 2.25) and on *originality* (M = 0.03, SD = 0.17) are presented in Table 5. Model 1 included only *Unconventional Space*. Supporting our revised hypothesis, the results showed that *ideational fluency* was higher for participants who were assigned to the Unconventional Space compared to those assigned to the Conventional Space ($p < 0.01$). Specifically, participants in the Unconventional Space produced 1.14 times more solutions compared to those in the Conventional Space within the given timeframe. Model 2 included the control variables. The results were consistent.

Next, consistent with the results above for ideational fluency and with the revised hypothesis, the results in Model 3 of Table 5 showed that idea *originality* was also higher for participants in the Unconventional Space compared to those in the Conventional Space ($p < 0.15$). Specifically, participants assigned to the Unconventional Space generated 2.77 times more original solutions compared to those in the Conventional Space within the given timeframe. Model 4 included the control variables, and the results were consistent. Notably, the results of this analysis were statistically significant only at the 15% level. This was probably because the task was familiar to all the participants (as the study was conducted during the pandemic) and was completed by a significantly larger number of participants than in Study 1 (i.e., 375), increasing the number of redundant ideas across participants (and therefore reducing the number of unique ideas across them; see Kornish and Ulrich 2011 and Silvia et al. 2008 for explanations on this). To adjust

for this, we ran another analysis that coded unique answers as the solutions that were provided by less than 10% of the participants (i.e., fewer than 37 participants out of 375).[6] Thus, the alternative dependent variable for this analysis, *top 10% originality*, was the count of these top 10% unique solutions for each participant. The results of this analysis are presented in Models 5 and 6 of Table 5.

Model 5 included only *Unconventional Space*. As expected, the results of this model showed stronger statistical support for the revised hypothesis: divergent thinking performance in terms of *top 10% originality* was higher for participants who were assigned to the Unconventional Space compared to those who were assigned to the Conventional Space ($p < 0.01$). Specifically, the results showed that participants in the Unconventional Space produced 1.68 times more top 10% unique solutions compared to those in the Conventional Space within the given timeframe. Model 6 included the control variables. The results were consistent. In sum, the results of Study 3 were consistent with the revised hypothesis.

– Table 5 about here –

6.3. Alternative Testing of the Revised Hypothesis Using Pooled Data from Studies 2 and 3

Studies 2 and 3, respectively, tested the effect of unconventional workspaces on two different tasks (related (circle) and unrelated (mask) task). In this section, we pooled the data from Studies 2 and 3 to examine whether the interaction term, *Unconventional Space* x *Unrelated Task*, was positive and significant, as an alternative approach for testing the revised hypothesis.[7]

To run this analysis, we first calculated *z*-scores of the performance outcomes (*ideational fluency* and *originality*) since the circle and mask task had different means and standard deviations. By converting the performance outcomes into *z*-scores, the means and standard variations of the outcome variables were

[6] Some solutions were expressed differently but were qualitatively the same (e.g., "let your hair swing over your face and keep your head down" vs. "wrap my hair around my mouth and nose"). In our coding scheme, these solutions were *not* coded as two different solutions but as a duplicate solution (i.e., uniqueness was coded in a conservative way). Following this coding scheme, three coders independently evaluated the uniqueness of the solutions and created clusters of solutions. When there was disagreement between the coders, they reassessed the uniqueness of the solution until they came to an agreement on which cluster the solution should be included in. A total of 41 clusters were identified, and among these, 28 were ones that less than 10% of the whole sample of participants (375) provided as a solution to the divergent thinking task. Among the 28 clusters, 11 clusters were singletons, which comprised a truly unique solution that was provided by only one participant.

[7] This result is re-tested in Study 4, in which the workspaces and tasks are both randomly assigned in a single study.

standardized to 0 and 1, allowing valid comparison of the performance outcomes between the two tasks. Using the *z*-scores as the outcome variables, we estimated coefficients for the variables *Unconventional Space* (=1 if Unconventional Space; =0 if Conventional Space), *Unrelated Task* (=1 if mask task; =0 if circle task), and the interaction of the two variables (*Unconventional Space* x *Unrelated Task*), employing OLS regression models without and with controls. The results of this analysis are presented in Table 6.

– Table 6 about here –

The dependent variable for Models 1-4 was *ideational fluency*. Model 1 only included *Unconventional Space* using the pooled data from Studies 2 and 3. The coefficient for *Unconventional Space* was positive but not statistically significant, suggesting that the average effect of the Unconventional Space on *ideational fluency* did not differ from zero. In Model 2, we added *Unrelated Task* and the interaction term *Unconventional Space* x *Unrelated Task*. The coefficient for *Unrelated Task* was negative and statistically significant ($p < 0.05$). However, the interaction term *Unconventional Space* x *Unrelated Task* was positive and significant ($p < 0.01$), supporting our revised hypothesis. In Models 3 and 4, we added our control variables. The results were consistent.

In Models 5-8, we tested the effects for idea *originality*. Model 5 only included *Unconventional Space*. The coefficient for *Unconventional Space* was positive, but statistically insignificant. In Model 6, we added *Unrelated Task* and the interaction term *Unconventional Space* x *Unrelated Task*. Similar to the results for ideational fluency, the coefficient for *Unrelated Task* was negative ($p < 0.10$), and the interaction term, *Unconventional Space* x *Unrelated Task*, was positive and significant ($p < 0.01$). In Models 7 and 8, we added our control variables, and the results were consistent.

Figure 5 depicts the interaction effects in Models 2 and 6, using the performance percentiles calculated using the *z*-scores. As depicted in Figure 5a (based on Model 2 of Table 6), the Unconventional Space increased *ideational fluency* only when participants solved the unrelated task. In terms of magnitude, the *ideational fluency* of participants in the Unconventional Space was 11.53 percentile points higher than that of participants in the Conventional Space when solving the unrelated task (note that the 50^{th} percentile represents the average score of all participants solving the unrelated task). Similarly, Figure 5b (based on

Model 6 of Table 6) shows that the Unconventional Space boosted idea *originality* only when participants were solving the unrelated task. In terms of magnitude, the idea *originality* of participants in the Unconventional Space was 6.38 percentile points higher than that of participants in the Conventional Space when solving the unrelated task. In summary, the analyses using the pooled data from Studies 2 and 3 showed consistent support for the revised hypothesis.

– Figure 5 about here –

7. Study 4: Additional In-Person Study for Testing of the Revised Hypothesis

In this final study, we conducted an additional exclusively in-person experiment in a physical behavioral lab to retest the revised hypothesis.[8] While Studies 1-3 showed results that were aligned with the revised hypothesis, there were notable limitations. First, despite Study 1 being the sole 'physical' study, the sample size was relatively small, raising concerns around low statistical power and overfitting. Furthermore, only the baseline hypothesis was tested in this setting. Second, although Studies 2 and 3 were conducted with a larger sample and examined both the baseline and revised hypotheses, we could not directly observe the participants' engagement with our manipulations and were not able to control their immediate physical environments, leaving the possibility of interaction effects between those environments and the virtual workspaces we presented as our manipulation. Third, Studies 2 and 3 were conducted separately and sequentially—i.e., they tested the effects of unconventional workspaces on divergent thinking performance when engaging in a related an unrelated task, *respectively*. A more conservative approach would be to examine these effects in a single study where both workspace (conventional and unconventional) and task relatedness (circle and mask task) are randomly assigned and the interaction effect between the workspaces and tasks are tested. Finally, in our existing studies, we failed to control for the amount of relatedness that existed for each task in each workspace (i.e., the number of objects in the workspaces that could have been related to the circle or mask task), nor did we include manipulation checks in the studies for task relatedness. In this additional study, we resolve all these issues.

[8] The data collection and analysis plan for this study was pre-registered: https://aspredicted.org/Z9H_D13.

7.1. Methods

Unconventional vs. Conventional Workspaces

For this experiment, we newly designed three *physical* workspaces in a behavioral laboratory of a university in the U.S. Two of the lab rooms were designed as unconventional workspaces (referred to as "Unconventional Space 1" & "Unconventional Space 2" hereafter), whereas the remaining room was designed as a conventional workspace (referred to as "Conventional Space" hereafter). The two new unconventional workspaces not only differed between themselves, but also differed from the unconventional workspaces we used in Studies 1-3. This aimed to introduce variance in the designs of unconventional workspaces presented to participants as part of our manipulation, thereby improving the general applicability of our results. The conventional workspace also differed from the ones we used in Studies 1-3, although it retained the concept of featuring standard ceiling lighting, standard office furniture, neutral colors, equipment only related to work, and a formal atmosphere. All three of the workspaces were located in the same laboratory and had the same dimensions in terms of space and layout.

To create the unconventional workspaces, we adopted a five-step approach based on design principles used for designing physical environments (Carrick and Sosa 2018, Kobe and Lehman 2021).

First, adhering to the approach, we established a vision for the new unconventional workspaces that were to be built in the laboratory spaces. To do this we conducted a thorough search using Google's images search function, exploring over 50 examples of "unconventional workspaces" by entering keywords such as "unconventional workspace/office," "creative workspace/office," and "unusual workspace/office." A key reason for examining a broad sample of workspaces was to enhance the external validity of our designs, avoiding limiting our designs to rare and unique examples. From this extensive review, we identified shared features shared by these workspaces. These included a holistic mix of unusual and visually stimulating colors, wall art, rugs, furniture, work desk/chairs, lighting, ceiling fixtures, plants, and non-work-related objects, as we have conceptualized in this paper.

Second, we invited design capabilities into our team. To do this, we hired an experienced industrial design student from a top U.S. university to design, under our guidance, two new unconventional

workspaces employing the unconventional workspace features we identified.

Third, we engaged in a concept development phase to design workspace concepts that would capture our vision within the physical constraints imposed by the behavioral lab facilities. Specifically, we explored multiple designs of unconventional workspaces, ultimately leading to the creation of two distinct workspace themes. Despite their differences, both themes heavily incorporated features we identified in Stage 1, giving rise to playful and casual atmospheres resembling those found in creative studios.

Fourth, we iteratively refined our designs. After several rounds of iterations, the tentatively final designs were drafted. At this stage, we invited one professional interior designer with 10 years of work experience, which included designing workspaces for large companies in the U.S, and one doctoral candidate in architecture to review our unconventional workspace designs and provide feedback on the designs' realism and their representation of unconventional workspaces in the real world. Both concurred that the designs were realistic and representative. They offered some suggestions to improve the designs, which we incorporated into the final designs of the two rooms. Additionally, they reviewed our conventional workspace and concurred with its alignment with our study's goal to compare the effects of conventional versus unconventional workspaces on divergent thinking performance.

Finally, the last step was implementation. The final workspaces were built out across eight weeks according to these designs. Figure 6 depicts these new workspaces.

– Figure 6 about here –

Related vs. Unrelated Task

We retained the circle and mask tasks from Studies 1-3 to allow for comparability across the studies. As a reminder, the circle task was the *related task*, wherein solutions could be readily inspired by the features of the workspace, and the mask task was the *unrelated task*, wherein solutions could *not* be readily inspired by the features of the workspace. Importantly, to balance the *level of relatedness* for the tasks across all workspaces, we purposefully included identical number of circular objects in each workspace, including the conventional workspace. We also excluded object or features of the room that could clearly inspire solutions for the mask task. Table A5 in the online appendix lists the circular objects that were included in

each room.[9]

Participants

A total of 336 individuals participated in the study. These participants were undergraduate students, MBA students, or visitors at the university where we conducted our study. They were recruited through various channels, including flyers, emails, class instructors, and the university's online research subject pool portal. Participants were promised a fixed monetary incentive amount or course credit that was approved by the Institutional Review Board (IRB), contingent upon completing both the task and survey question.[10]

We excluded three participants whose responses were not recorded (technical error), leaving 333 participants (152 females, M_{age} = 23.34, SD = 6.52) for the final analysis. Among these participants, 55 were randomly assigned to the [*Unconventional Space 1* & *Related Task*] condition, 57 to the [*Unconventional Space 1* & *Unrelated Task*] condition, 57 to the [*Unconventional Space 2* & *Related Task*] condition, 55 to the [*Unconventional Space 2* & *Unrelated Task*] condition, 56 to the [*Conventional Space* & *Related Task*] condition, and 53 to the [*Conventional Space* & *Unrelated Task*] condition.

Design and Procedure

Participants first checked in at the front desk of the lab where the workspaces could not be seen. Next, in the order that they arrived, they were randomly assigned to one of the six conditions explained above (3 workspaces x 2 tasks). The *t*-test comparing the observable characteristics of participants assigned to the unconventional versus conventional workspace conditions and the related versus unrelated task conditions showed no significant mean differences, indicating that the random assignment of participants was effective (see Table A4 in online appendix for details).

Once the participants entered their assigned workspaces, they were seated in the center of the room, where there was an individual desk and chair. On the desk, there was a laptop, which they used to engage in their tasks. For the participants to sufficiently experience the room, they were instructed to look around

[9] When categorizing circular objects, duplicate objects were considered as one category (e.g., red and yellow yoga balls in the Unconventional Space 2 were categorized as "Yoga balls"). The manipulation checks indicated that task-relatedness was effectively balanced across the workspaces. See Section 7.2 for details.

[10] Whether the students received a monetary incentive or course credit did not change the findings.

and familiarize themselves with the workspace for 45 seconds before they were given the task.[11] Once given the task, participants had three minutes to complete it. Participants remained seated, but were allowed to look around the room at any time during the task.

Divergent Thinking Tasks and Measures

As mentioned earlier, participants were randomly assigned to either the circle task (used in Studies 1 and 2) or the mask task (used in Study 3)**.** Consistent with Studies 1-3, we assessed two performance outcomes for the divergent thinking tasks: 1) the *total number* of solutions (i.e., *ideational fluency*) and 2) the number of solutions that *only* the focal participant answered across the entire participant pool (i.e., *originality*). In this study, we normalized both performance outcomes, dividing them by the actual time (seconds) participants spent on their tasks.[12] Finally, consistent with the pooled analysis in Section 6.3, we calculated *z*-scores for these time-adjusted performance outcomes (*ideational fluency* and *originality*) to enable reliable comparison between the scores for the circle (related) and mask (unrelated) task which had different means and standard deviations.

Using the *z*-scores as the outcome variables, we estimated coefficients for the variables *Unconventional Space* (=1 if Unconventional Space; =0 if Conventional Space), *Unrelated Task* (=1 if mask task; =0 if circle task), and the interaction of these two variables (*Unconventional Space* x *Unrelated Task*) employing OLS regression models, without and with controls. Our main variable of interest was the interaction term, *Unconventional Space* x *Unrelated Task*, which we predicted to be positive and statistically significant, according to the revised hypothesis.

Finally, in order to check if our manipulations (both *unconventionality* and *task relatedness*) were effective, we included two manipulation checks at the end of the study. First, we asked participants to report the extent to which they found the workspace to have unconventional features (1 = strongly disagree; 7 =

[11] The workspaces in Study 4 were notably smaller than that of those of Study 1 (c.f. Figure 2 and 6). Hence, in less than one-minute anyone could sufficiently familiarize themselves with the space.

[12] This adjustment was necessary due to some participants being allowed to work on their tasks up to 30 seconds longer than others as a result of a misconfiguration in the timers. However, the results remained fully consistent using the original non-normalized performance outcomes, suggesting that the participants might have generated most of their ideas in the earlier parts of their experiment sessions.

strongly agree). Second, we asked them to report the extent to which they were able to obtain helpful hints from the workspace when coming up with solutions for their task (1 = strongly disagree; 7 = strongly agree).

7.2. Results

Manipulation Checks

Participants assigned to the Unconventional Spaces reported that their workspaces had more unconventional features (M = 5.72, SD = 1.38) than the participants assigned to the Conventional Space did (M = 2.97, SD = 1.67), $t(331)$ = -15.91, p = 0.00, indicating that the workspace-unconventionality manipulation was effective. Moreover, participants assigned to the related-task condition reported that they were able to obtain more helpful hints from the workspace when coming up with solutions for their task (M = 5.65, SD = 1.39) than the participants assigned to the unrelated task condition did (M = 2.15, SD = 1.40), $t(331) = 22.98$, $p = 0.00$, indicating that the task-relatedness manipulation was also effective. Moreover, the task relatedness did not significantly differ between the Conventional and Unconventional Spaces for the circle task (M = 5.59 vs. M = 5.69, $t(166)$ = -0.43, p = 0.67), nor for the mask task (M = 2.06 vs. M = 2.19, $t(163)$ = -0.56, p = 0.58), suggesting that the balancing of related objects (or the lack thereof) across the workspaces was also effective.

Test of the interaction effect between the unconventional space and the unrelated (mask) task

As predicted in the revised hypothesis, we expect to observe higher divergent thinking performance in the unconventional workspace than in a conventional workspace, only when individuals solved the unrelated task. In other words, we expected a positive and significant interaction term between *Unconventional Space* and *Unrelated Task*. The results of the OLS regression analysis that tested the effect of this interaction term in terms of the dependent variable *ideational fluency* (M = 14.99, SD = 5.32 (related task); M = 6.26, SD = 2.31 (unrelated task)) are presented in Table 7. [13]

– Table 7 about here –

[13] Our results can be also replicated by running separate Poisson regressions for the related (circle) and unrelated (mask) tasks, as indicated in our pre-registration for Study 4. We report the integrated models that includes the interaction effects instead, as these models allow direct comparison of the effects between the workspace types.

Model 1 only included *Unconventional Space* using all the data we collected, which pooled observations from both Unconventional Spaces 1 and 2. The coefficient for *Unconventional Space* was negative but not statistically significant, implying that the average effect of *Unconventional Space* on *ideational fluency* did not differ from zero. In Model 2, we added *Unrelated Task* and the interaction term *Unconventional Space* x *Unrelated Task*. Whereas the coefficient for *Unrelated Task* was negative and statistically significant ($p < 0.01$), the interaction term *Unconventional Space* x *Unrelated Task* was positive and significant ($p < 0.01$), supporting our revised hypothesis. In Models 3 and 4, we added our control variables. The results were consistent.

In Models 5-8, we retested the revised hypothesis by comparing the scores on *ideational fluency* using only the sample of participants who were assigned to the Conventional Space and Unconventional Space 1. The results were consistent with those found in Models 1-4. Next, in Models 9-12, we retested the revised hypothesis by comparing *ideational fluency* using only the sample of participants in the Conventional Space and Unconventional Space 2. Again, the results were robust. Figure 7a depicts the interaction effect in Model 2, using the performance percentiles calculated using the *z*-scores.

– Figure 7a about here –

As depicted in Figure 7a (based on Model 2 of Table 7), the Unconventional Spaces led to an increase in *ideational fluency* only when participants solved the unrelated (mask) task. In terms of magnitude, the *ideational fluency* of participants in the Unconventional Spaces was 15.62 percentile points higher than that of participants in the Conventional Space when solving the unrelated task (note that the 50th percentile represents the average score of all participants solving the unrelated task). This effect was similar for the results of Models 6 and 10 of Table 7.

Next, we tested the effect of the interaction term *Unconventional Space* x *Unrelated Task* on idea *originality* (for related task: $M = 1.24$, $SD = 1.39$; for unrelated task: $M = 0.24$, $SD = 0.66$). These results are presented in Table 8.

– Table 8 about here –

Model 1 only included *Unconventional Space* using all of the data we collected. Similar to the

results for *ideational fluency*, the coefficient for *Unconventional Space* was negative, but not statistically significant for idea *originality*. In Model 2, we added *Unrelated Task* and the interaction term *Unconventional Space* x *Unrelated Task*. Again, the coefficient for *Unrelated Task* was negative and statistically significant ($p < 0.01$), whereas the interaction term *Unconventional Space* x *Unrelated Task* was positive and significant ($p < 0.01$), supporting our revised hypothesis. In Models 3 and 4, we added our control variables, and the results were consistent.

In Models 5-8, we retested the revised hypothesis by comparing idea *originality* using only the sample of participants in the Conventional Space and Unconventional Space 1. The results were consistent with those found in Models 1-4. Subsequently, in Models 9-12, we retested the revised hypothesis by comparing idea *originality* using only the sample of participants in the Conventional Space and Unconventional Space 2. Once more, the results were robust. Figure 7b depicts the interaction effects in Model 2, using the performance percentiles calculated using the *z*-scores.

– Figure 7b about here –

As depicted in Figure 7b (based on Model 2 of Table 8), the Unconventional Spaces led to a performance increase in idea *originality* only when participants solved the unrelated task. In terms of magnitude, the idea *originality* of participants in the Unconventional Spaces was 11.52 percentile points higher than that of participants in the Conventional Space when solving the unrelated task. Again, this effect was similar for the results in Models 6 and 10 of Table 8. To sum, the results of Study 4 were consistent with the results we found in Studies 1-3 and showed robust support for the revised hypothesis.

7.3 Post-hoc Analysis: Examination of the cognitive anchoring effect in the related task of Study 4

Our revised theory regarding the negative impact of unconventional workspaces on divergent thinking performance for the related task posited that the relatedness between unconventional workspaces and potential solutions for the task increases the risk of cognitive anchoring (Billinger et al. 2014, Chrysikou and Weisberg 2005, Jansson and Smith 1991, Kohn and Smith 2011, Smith et al. 1993). In particular, because features of unconventional workspaces are likely to be more salient compared to those of conventional workspaces, even with similar occurrences of related objects or features (which were circular

in our studies) in both types of workspaces, we anticipate that individuals in unconventional workspaces will experience higher rates of cognitive anchoring by task-related objects or features when solving a related task compared to those in conventional workspaces.

Consistent with our conceptualization and operationalization of cognitive anchoring in the post-hoc analyses of Studies 1 and 2, in the context of Study 4, a participant mentioning an object in Table A5 (of the online appendix) as an early solution (i.e., top 5 solution) in the related (circle) task would be considered as evidence of cognitive anchoring. Based on our theoretical arguments for the revised hypothesis, we first tested whether participants in the Unconventional Spaces had more cognitively anchored answers as their early solutions when solving the related task, using a Poisson regression model. The results of this analysis are presented in Models 1 and 2 of Table 9. Model 1, which only included *Unconventional Space* as an explanatory variable, showed that participants in the Unconventional Spaces had higher incidences of cognitively anchored early solutions during their related task, as predicted by our theory ($p < 0.10$). Model 2 includes our control variables. The results were consistent.[14]

Next, we tested whether having a cognitively anchored answer as an early solution had a negative impact on divergent thinking performance in the related task, both in terms of *ideational fluency* and idea *originality*, as our theory would predict. For our tests, we ran OLS regressions with the normalized divergent thinking performance measures from Study 4 as the dependent variables and *Anchored answer* (=1 if a participant mentioned an object in Table A5 (of the online appendix) as a top five solution; =0, otherwise) as the independent variable. The results are presented in Models 3-6 of Table 9.

In line with our prediction, Model 3 showed that having an early answer that was anchored decreased *ideational fluency* ($p < 0.15$). Model 4, which included our control variables, replicated this result ($p < 0.10$). Models 5 and 6 show the results for *originality*. Similar to the results for *ideational fluency*, the

[14] We also ran analogous OLS regressions that regressed the fraction of *Inside-Room Solutions* (proportion of participant's solutions that included objects/features inside of their assigned workspace) on *Unconventional Space*. The coefficient estimates for *Unconventional Space* were positive and significant—0.122 ($p < 0.01$) and 0.124 ($p < 0.01$) for the models without and with controls, respectively—corroborating the results of our post-hoc analysis. See Table A6 in the online appendix for details on this analysis.

results of Models 5 and 6 indicated that having an early answer that was anchored also decreased *originality* ($p < 0.15$ for Model 5 and $p < 0.10$ for Model 6).[15] In summary, consistent with our revised theory, the results of our post-hoc analysis showed that cognitive anchoring is more likely to happen in unconventional workspaces and that cognitive anchoring is detrimental to divergent thinking.

– Table 9 about here –

8. Discussion and Conclusions

Understanding people-related factors that influence the performance of innovation processes is an important topic for both academics and practitioners (e.g., Bacevice et al. 2016, Cohen 2019, Girotra et al. 2010, Kagan et al. 2018, Kavadias and Sommer 2009, Sommer et al. 2020, Waber et al. 2014). In this study, we set out to examine a factor that influences individual performance in creative tasks: the *workspaces* where such activities take place. More specifically, we studied the causal relationship between unconventional workspaces and individuals' divergent thinking performance. Through four controlled experiments, we found that the effect of unconventional workspaces on divergent thinking performance is much more nuanced than widely believed. Particularly, in the high-tech industry, the trend of redesigning workspaces in unconventional ways has been growing, with the belief that such workspace designs will enhance employees' creativity (Meinel et al. 2017, Thoring et al. 2021). Our study shows that this belief may not always hold true, and that unconventional workspaces could, in fact, inhibit individuals' creativity under certain conditions.

Specifically, our experiment results showed that the effect of unconventional workspaces on divergent thinking performance depended on the *relatedness* between the potential solutions for the idea generation task and the features of the unconventional workspace. When solutions for an idea generation task could be readily inspired by features of the unconventional workspace, working in such a space had a negative effect on individual divergent thinking performance. On the contrary, when solutions to an idea generation task could *not* be readily inspired by features of an unconventional workspace, working in such

[15] Note that the results with the non-normalized dependent variables were significant at the 0.05 level.

a space had a positive effect on divergent thinking performance. In the latter case, the stimulating unconventional features of the space would have triggered processes that were conducive for divergent thinking without causing cognitive anchoring. Moreover, our post-hoc analyses provided evidence suggesting that the relatedness between the unconventional workspace and the task at hand resulted in cognitive anchoring, which overshadowed the potential of such workspaces to support creative thinking.

Our findings have important managerial implications. First, our results suggest that managers should not think of unconventional workspace designs as silver bullets for fostering individual creativity. They need to recognize the dual effects that unconventional workspace designs may have on individuals' divergent thinking performance. Unconventional workspace designs effective for one firm in promoting creativity may not yield the same results for another, given the varied nature of idea generation tasks across companies; a particular workspace design could be the source of creative inspiration for one idea generation task but a source of cognitive anchoring for another. Therefore, managers should not blindly copy the workspace designs of other organizations simply because such organizations are generating innovative outcomes. Our results show that unconventional workspace designs have positive effects on creative thinking only when the salient elements of the space do *not* provide related solutions to the idea generation task at hand. Understanding these nuances will help to create better workspaces for organizations striving for creative outcomes. For instance, when organizations are attempting to create radically different products, services, or brands, it is important to recognize the anchoring effects that the presence of previous products, symbols, and existing company assets may have on individuals exploring new solutions. Having said this, we contend that most tasks that require divergent thinking in real-world organizational contexts are not trivial, nor can their solutions be directly inspired by visual cues (as it was the case for the unrelated task featured in our study). Therefore, unconventional spaces hold meaningful potentials to support individuals' divergent thinking performance across a wide spectrum of idea generation endeavors in those contexts.

Second, although our experimental studies are focused on examining performance in individual ideation tasks, our results have useful implications for group brainstorming. Research in group brainstorming has shown that an effective way to carry out brainstorming sessions is to start with individual

ideation, followed by group idea generation, exchange, and discussion (Girotra et al. 2010, Kavadias and Sommer 2009). Hence, understanding the factors that positively affect individual ideation have direct implications for group brainstorming. Further work is needed to investigate the impact of workspaces on groups engaging in creative tasks.

Third, our results had unintended yet important implications for fostering creativity in virtual online settings. The COVID-19 pandemic has transformed the way employees work and has made virtual work a common practice. The literature on creativity has limited evidence on how creativity can be virtually fostered, if at all (Brucks and Levay 2022, Horvat and Uzzi 2022). Although not originally planned, we had to conduct two of our studies in an online environment. To our advantage, this alternative testbed proved to be useful for examining whether the effects of unconventional workspace designs on divergent thinking performance could be virtually realized. Beyond mere replication of Study 1 and the initial test of the revised hypothesis, the results of our online studies provide important implications for managers who may need to host live online sessions that demand creative thinking from remote participants. In such situations, the host may consider allowing participants to virtually "visit" an (unrelated) unconventional space prior to the session, as we did in Studies 2 and 3, to enhance the divergent thinking capabilities of the participants.

To the best of our knowledge, our study is the first to conduct a set of controlled experiments aimed at uncovering the effects of unconventional workspace designs on individual-level divergent thinking performance. Hence, our approach allows for causal inferences and establishes baseline results for future studies. However, like any empirical study, our research has some limitations worth discussing.

First, this study took a *holistic* approach to conceptualizing conventional versus unconventional workspace designs, whereby we did not specify which individual features of the workspace (e.g., color, lighting, furniture) were most impactful in making a workspace more unconventional. This approach aligns with the literature on space design and experience design, which suggest that it is the holistic nature of the space what influences how people feel in such spaces (Kobe and Lehman 2021). However, it also limits us from providing specific guidelines on which objects or features to consider when designing unconventional workspaces. Nevertheless, we believe that the structured approach we followed when designing the two

distinct unconventional workspaces in Study 4—namely, basing our designs on space and experience design principles and conducting a comprehensive search and review of representative contemporary unconventional workspace designs—provides a first step toward an approach to design unconventional workspaces in organizations (Carrick and Sosa 2018, Doorley and Witthoft 2012, Kobe and Lehman 2021). Moreover, we believe that an experienced manager would be able to not only envision the type of workspace designs perceived as unconventional by employees, but also identify designs that are not directly related to the tasks employees would be carrying out within such a space. We believe such designs would serve as valuable starting points for creating unconventional workspaces that support creative thinking. It would be valuable, however, for future research to examine this topic further and identify features of workspaces that increase (positive) unconventionality.

Second, in our paper, we have conceptualized conventional and unconventional workspaces based on an evolutionary perspective which categorizes workspaces on their intended primary purpose (i.e., promoting productivity/efficiency versus creativity) and their representative characteristics (e.g., color, lighting, furniture, equipment, decorative objects, and atmosphere). However, whether those spaces are perceived as conventional or unconventional is ultimately in the eye of the beholder. For instance, for an employee who works in a modern technology or design firm, our unconventional spaces could be perceived less unconventional compared to an individual working in a firm where such unconventional spaces are rare or non-existent. Hence, further studies would be necessary to re-examine our results with subjects whose primary workspaces have significantly different degrees of unconventionality.

Third, although our study theorized about sub-mechanisms that could be driving the positive effect of unconventional workspaces on individuals' divergent thinking performance, our study did not focus on testing those mechanisms as mediators. The primary goal of this study was to establish a causal link between unconventional workspaces and divergent thinking performance and to provide conceptual and empirical evidence of an important boundary condition for such a relationship. Yet, we encourage future studies to delve deeper into our findings and examine the mechanisms that primarily contribute to our results. This will be also important for extending our findings to the team level of analysis. Would the effects we find

be positively or negatively moderated when *teams* are working on divergent thinking tasks in the spaces we studied? We encourage future work to extend our findings and study the impact of unconventional workspaces on creative problem solving in teams (e.g., Girotra et al. 2010, Kagan et al. 2018, Sommer et al. 2020).

Finally, our study examines only the immediate effects of unconventional workspaces on individuals' divergent thinking performance. However, it is possible that the stimulation from a workspace design matures over time as individuals adjust to their environments. Further research is needed to understand how long these effects last and what can be done to mitigate their maturation. However, even assuming that the effect of unconventional spaces decays for a focal individual over time with usage, their usefulness can still be significant in organizations. For instance, consider someone who has designed an unconventional office space for personal use. Over time, such an office space might not feel unconventional to the occupant. However, it could still be unconventional to others who visit the office for a creative problem-solving session; in such cases, the workspace may positively contribute these individuals' creative thinking.

Despite these limitations, we believe this study makes several important contributions to the literature on behavioral operations focused on how to improve innovation processes (e.g., Girotra et al. 2010, Kagan et al. 2018, Kavadias and Sommer 2009, Sommer et al. 2020), the literature on organization design focused on how workspaces influence organizational individuals' behaviors and performance (Bernstein and Turban 2018, Catalini 2018, Khazanchi et al. 2018, Lee 2019), and the literature on creativity (Acar and Runco 2011, Amabile 1996, Lu et al. 2017, Zhou and Hoever 2014, Thoring et al. 2021). We especially hope that our paper sheds new light on the relationship between workspace designs and employee creativity and opens exciting opportunities for understanding the micro-processes of innovation and creativity.

References

Acar, O. 2021. The making of creative breakthroughs, California Management Review. Berkeley, CA.

Acar, S, MA Runco. 2011. Creative abilities: Divergent thinking. *Handbook of Organizational Creativity*. Amsterdam, Netherlands: Elsevier: 115-139.

Amabile, TM. 1988. A model of creativity and innovation in organizations. *Research in Organizational Behavior*, 10(1): 123-167.

Amabile, TM. 1996. *Creativity in context*. Boulder, CO: Westview Press.

Amabile, TM. 1997. Entrepreneurial creativity through motivational synergy. *The Journal of Creative Behavior*, 31(1): 18-26.

Amabile, TM, SG Barsade, JS Mueller, BM Staw. 2005. Affect and creativity at work. *Administrative Science Quarterly*, 50(3): 367-403.

Bacevice, P, L Burow, M Tribner. 2016. 7 factors of great office design. Retrieved March 31, 2020, https://hbr.org/2016/05/7-factors-of-great-office-design: Harvard Business Review.

Baird, B, J Smallwood, MD Mrazek, JW Kam, MS Franklin, JW Schooler. 2012. Inspired by distraction: Mind wandering facilitates creative incubation. *Psychological Science*, 23(10): 1117-1122.

Bernstein, ES, S Turban. 2018. The impact of the 'open' workspace on human collaboration. *Philosophical Transactions of the Royal Society B: Biological Sciences*, 373(1753): 1-8.

Billinger, S, N Stieglitz, TR Schumacher. 2014. Search on rugged landscapes: An experimental study. *Organization Science*, 25(1): 93-108.

Boudreau, KJ, T Brady, I Ganguli, P Gaule, E Guinan, A Hollenberg, KR Lakhani. 2017. A field experiment on search costs and the formation of scientific collaborations. *Review of Economics and Statistics*, 99(4): 565-576.

Boudreau, KJ, N Lacetera, KR Lakhani. 2011. Incentives and problem uncertainty in innovation contests: An empirical analysis. *Management Science*, 57(5): 843-863.

Brucks, MS, J Levav. 2022. Virtual communication curbs creative idea generation. *Nature*, 605: 108-112.

Cardoso, C, P Badke-Schaub. 2011. The influence of different pictorial representations during idea generation. *The Journal of Creative Behavior*, 45(2): 130-146.

Carrick AM, ME Sosa. 2018. Eight Inc. and Apple retail stores. INSEAD Case Study Reference No. 617-0065-1, INSEAD, Fontainebleau, France.

Catalini, C. 2018. Microgeography and the direction of inventive activity. *Management Science*, 64(9): 4348-4364.

Ceylan, C, J Dul, S Aytac. 2008. Can the office environment stimulate a manager's creativity? *Human Factors and Ergonomics in Manufacturing & Service Industries*, 18(6): 589-602.

Chan, TH, J Mihm, M Sosa. 2021. Revisiting the role of collaboration in creating breakthrough inventions. *Manufacturing & Service Operations Management*, 23(5): 1005-1024.

Chrysikou, EG, RW Weisberg. 2005. Following the wrong footsteps: Fixation effects of pictorial examples in a design problem-solving task. *Journal of Experimental Psychology: Learning, Memory, and Cognition*, 31(5): 1134-1148.

Cohen, J. 2019. How to foster creativity in the workplace. Retrieved March 31, 2020, https://www.wework.com/ideas/growth-innovation/foster-creative-culture: WeWork.

Crilly, N, C Cardoso. 2017. Where next for research on fixation, inspiration and creativity in design? *Design Studies*, 50: 1-38.

de Bono, E. 2010. *Lateral Thinking*. London, UK: Penguin Books.

De Dreu, CK, M Baas, BA Nijstad. 2008. Hedonic tone and activation level in the mood-creativity link: Toward a dual pathway to creativity model. *Journal of Personality and Social Psychology*.

Diehl, M, W Stroebe. 1987. Productivity loss in brainstorming groups: Toward the solution of a riddle. *Journal of Personality and Social Psychology*, 53(3): 497–509.

Diehl, M, W Stroebe. 1991. Productivity loss in idea-generating groups: Tracking down the blocking effect. *Journal of Personality and Social Psychology*, 61(3): 392.

Dijksterhuis, A, T Meurs. 2006. Where creativity resides: The generative power of unconscious thought.

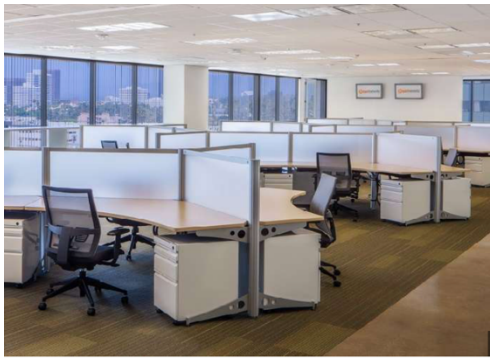
Consciousness and Cognition, 15(1): 135-146.
Doorley, S, S Witthoft. 2012. *Make Space: How to Set the Stage for Creative Collaboration*. Hoboken, NJ: John Wiley & Sons.
Dul, J, C Ceylan. 2014. The Impact of a creativity-supporting work environment on a firm's product innovation performance. *Journal of Product Innovation Management*, 31(6): 1254-1267.
Duncker, K. 1945. On problem sovling. *Psychological Monographs*, 58(Whole No. 270).
Ederer, F, G Manso. 2013. Is pay for performance detrimental to innovation?. *Management Science*, 59(7): 1496-1513.
Elsbach, KD, MG Pratt. 2007. The physical environment in organizations. *Academy of Management Annals*, 1(1): 181-224.
Fleming, L. 2001. Recombinant uncertainty in technological search. *Management Science*, 47(1): 117.
Girotra, K, C Terwiesch, KT Ulrich. 2010. Idea generation and the quality of the best idea. *Management Science*, 56(4): 591-605.
Guilford, JP. 1967. *The nature of human intelligence*. New York, NY: McGraw-Hill.
Haapakangas, A, V Hongisto, J Varjo, M Lahtinen. 2018. Benefits of quiet workspaces in open-plan offices–Evidence from two office relocations. *Journal of Environmental Psychology*, 56: 63-75.
Hagtvedt, LP, K Dossinger, SH Harrison, L Huang. 2019. Curiosity made the cat more creative: Specific curiosity as a driver of creativity. *Organizational Behavior and Human Decision Processes*, 150.
Hargadon, A, RI Sutton. 1997. Technology brokering and innovation in a product development firm. *Administrative Science Quarterly*, 42(4): 716-749.
Harris, R. 2019. Defining and measuring the productive office. *Journal of Corporate Real Estate*, 21(1)71.
Hirt, ER, EE Devers, SM McCrea. 2008. I want to be creative: Exploring the role of hedonic contingency theory in the positive mood-cognitive flexibility link. *Journal of Personality and Social Psychology*.
Horvát, EÁ, B Uzzi. 2022. Virtual collaboration hinders a key component of creativity. *Nature*, 605.
Jansson, DG, SM Smith. 1991. Design fixation. *Design Studies*, 12(1): 3-11.
Kagan, E, S Leider, WS Lovejoy. 2018. Ideation–execution transition in product development: An experimental analysis. *Management Science*, 64(5): 2238-2262.
Kallio, TJ, K-M Kallio, AJ Blomberg. 2015. Physical space, culture and organisational creativity–a longitudinal study. *Facilities*, 33(5/6): 389-411.
Katok, E, S Leider, K Donohue. 2018. *The Handbook of Behavioral Operations*. John Wiley & Sons.
Kavadias, S, SC Sommer. 2009. The effects of problem structure and team diversity on brainstorming effectiveness. *Management Science*, 55(12): 1899-1913.
Khazanchi, S, T Sprinkle, SS Masterson, N Tong. 2018. A spatial model of work relationships: The relationship-buidling and relationship-straining effect of workspace design. *Academy of Management Review*, 43(4): 590-609.
Kobe T, R Lehman. 2021. *Return on experience*. Novato, CA: Oro Editions.
Kohn, NW, SM Smith. 2011. Collaborative fixation: Effects of others' ideas on brainstorming. *Applied Cognitive Psychology*, 25(3): 359-371.
Kornish, LJ, KT Ulrich. 2011. Opportunity spaces in innovation: Empirical analysis of large samples of ideas. *Management Science*, 57(1): 107-128.
Lee, S. 2019. Learning-by-moving: Can reconfiguring spatial proximity between organizational members promote individual-level exploration? *Organization Science*, 30(3): 467-488.
Lee, S, P Meyer-Doyle. 2017. How performance incentives shape individual exploration and exploitation: Evidence from microdata. *Organization Science*, 28(1): 19-38.
Lee, YS. 2016. Creative workplace characteristics and innovative start-up companies. *Facilities*, 34.
Levinthal, DA. 1997. Adaptation on rugged landscapes. *Management Science*, 43(7), 934-950.
Liu, H, J Mihm, ME Sosa. 2018. Where do stars come from? The role of star vs. non-star collaborators in creative settings. *Organization Science*, 29(6): 989-1236.
Lu, JG, M Akinola, MF Mason. 2017. "Switching On" creativity: Task switching can increase creativity by reducing cognitive fixation. *Organizational Behavior and Human Decision Processes*, 139.
Maier, L, CV Baccarella, TF Wagner, M Meinel, T Eismann, KI Voigt. 2022. Saw the office, want the job:

The effect of creative workspace design on organizational attractiveness. *Journal of Environmental Psychology*, 80: 1-15.
McCoy, JM, GW Evans. 2002. The potential role of the physical environment in fostering creativity. *Creativity Research Journal*, 14(3-4): 409-426.
Meinel, M, L Maier, T Wagner, KI Voigt. 2017. Designing creativity-enhancing workspaces: A critical look at empirical evidence. *Journal of Technology and Innovation Management*, 1(1): 1-12.
Miron-Spektor, E, F Gino, L Argote. 2011. Paradoxical frames and creative sparks: Enhancing individual creativity through conflict and integration. *Organizational Behavior and Human Decision Processes*, 116(2): 229-240.
Myerson, J, P Ross. 2006. *Space to work: New office design*. London, UK: Laurence King Publishing.
Murray, N, H Sujan, ER Hirt, M Sujan. 1990. The influence of mood on categorization: A cognitive flexibility interpretation. *Journal of Personality and Social Psychology*, 59(3): 411-425.
Nijstad, BA, CK De Dreu, EF Rietzschel, M Baas. 2010. The dual pathway to creativity model: Creative ideation as a function of flexibility and persistence. *European Review of Social Psychology*, 21(1).
Palvalin, M, T van der Voordt, T Jylhä. 2017. The impact of workplaces and self-management practices on the productivity of knowledge workers. *Journal of Facilities Management*, 15(4): 423-438.
Piotrowski, CM. 2016. Designing commercial interiors. Hoboken, NJ: John Wiley & Sons.
Runco, M. 2011. Divergent Thinking. In M. Runco, S. Pritzker (Eds.), Encyclopedia of Creativity: 400-403. Online: Elsevier Science & Technology.
Savino, T, AM Petruzzelli, V Albino. 2017. Search and recombination process to innovate: A review of the empirical evidence and a research agenda. *International Journal of Management Reviews*, 19(1).
Silvia, PJ, BP Winterstein, JT Willse, CM Barona, JT Cram, KI Hess, JL Martinez, CA Richard. 2008. Assessing creativity with divergent thinking tasks: Exploring the reliability and validity of new subjective scoring methods. *Psychology of Aesthetics, Creativity, and the Arts*, 2(2): 68-85.
Singh, J, L Fleming. 2010. Lone inventors as sources of breakthroughs: Myth or reality? *Management Science*, 56(1): 41-56.
Smith, SM, TB Ward, JS Schumacher. 1993. Constraining effects of examples in a creative generation task. *Memory & Cognition*, 21(6): 837-845.
Sommer, SC, E Bendoly, S Kavadias. 2020. How do you search for the best alternative? Experimental evidence on search strategies to solve complex problems. *Management Science*, 66(3): 1395-1420.
Stallworth, OE, BH Kleiner. 1996. Recent developments in office design. *Facilities*, 14(1/2): 34-42.
Stegmeier, D. 2008. *Innovations in office design: The critical influence approach to effective work environments*. New York, NY: Wiley.
Thompson B, D Jonas. 2008. *Workplace design and productivity: Are they inextricably linked?.* London, UK: Royal Institution of Chartered Surveyors.
Thoring, K, M Gonçalves, RM Mueller, P Desmet, P Badke-Schaub. 2021. The architecture of creativity: Toward a causal theory of creative workspace design. *International Journal of Design*, 15(2).
Turner, G, J Myerson. 1998. *New workspace, new culture: Office design as a catalyst for change*. Brookfield, VA: Gower Publishing.
Waber, B, J Magnolfi, G Lindsay. 2014. Workspaces that move people. *Harvard Business Review*, 92(10).
Zhou J, IJ Hoever. 2014. Research on workplace creativity: A review and redirection. *Annual Review of Organizational Psychology and Organizational Behavior*, 1(1): 333-359.

Figures and Tables

Figure 1. Examples of "unconventional" vs. "conventional" workspaces

a. Representative example of a conventional workspace



b. Unconventional workspace: Google office in Dublin, Ireland



c. Unconventional workspace: Meta office in California, USA

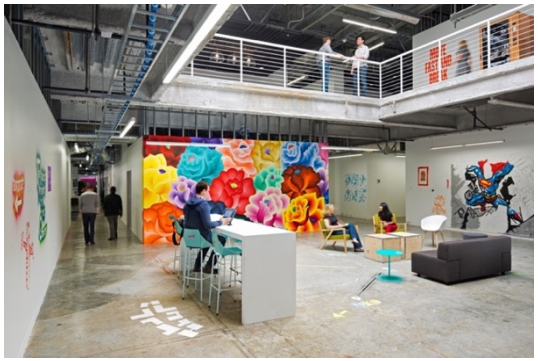


Figure 2. Panoramic view of the (a) Unconventional Space and the (b) Conventional Space (Study 1)

a. Unconventional Space

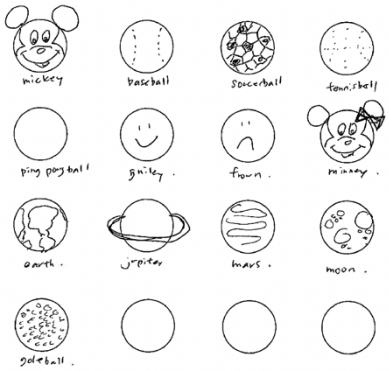


b. Conventional Space



Figure 3. Examples of solutions provided by participants of the Unconventional Space in Study 1

a. Example 1



b. Example 2

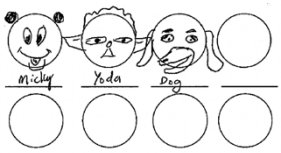
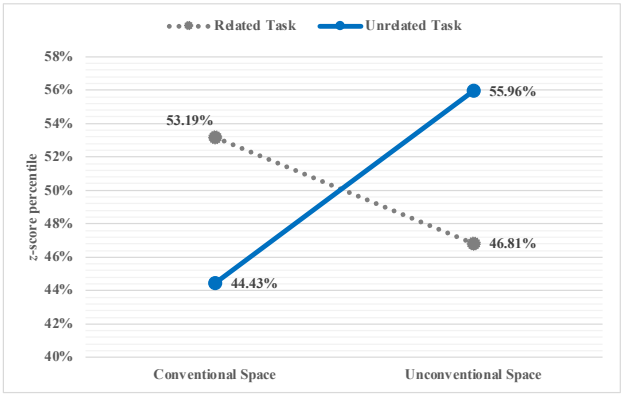


Figure 4. Front wall of the Unconventional Space in Study 1



Figure 5. Illustration of interaction effects of workspace and task relatedness on (a) *ideational fluency* and (b) *originality* (results of Table 6, Models 2 and 6)

a. Ideational fluency



b. Originality

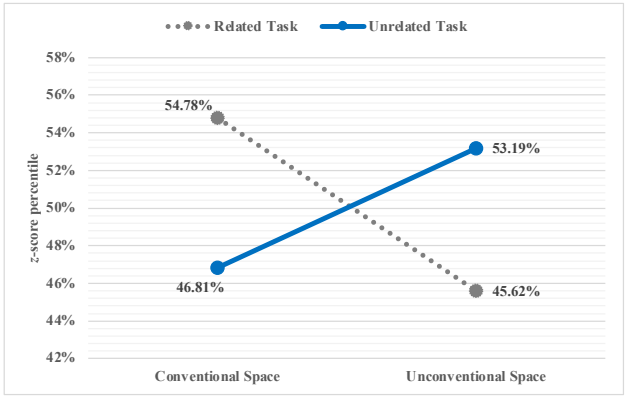
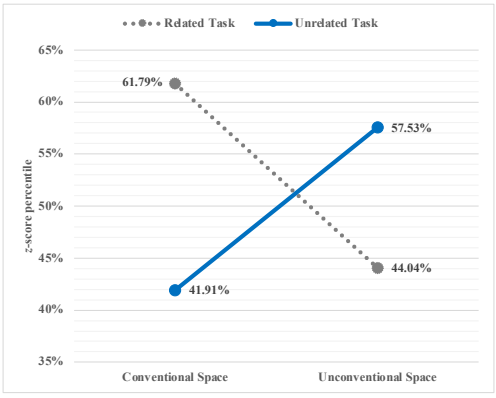


Figure 7. Illustration of interaction effects of workspace and task relatedness on (a) *ideational fluency* and (b) *originality* (results of Table 7, Models 2 and 6)

a. Ideational fluency



b. Originality

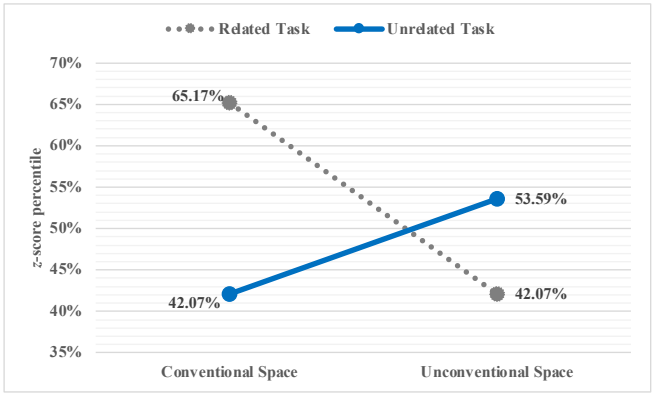


Figure 6. Photos of the (a) Unconventional Space 1, (b) Unconventional Space 2, and (c) Conventional Space (Study 4)

a. Unconventional Space 1



b. Unconventional Room 2



c. Conventional Room



Table 1. Poisson regression estimates for divergent thinking performance (Study 1)

DV: Divergent thinking performance	Model 1 (Ideational fluency)	Model 2 (Ideational fluency)	Model 3 (Originality)	Model 4 (Originality)
INDEPENDENT VARIABLE				
Unconventional Space	-0.190**	-0.183**	-0.419**	-0.468**
	(0.081)	(0.089)	(0.178)	(0.193)
CONTROL VARIABLES				
Gender (=1 if male)		-0.006		0.198
		(0.112)		(0.258)
Age		0.001		0.014
		(0.006)		(0.014)
Education dummies		Included		Included
Science/Engineering training dummy		Included		Included
Table dummies		Included		Included
Constant	2.603***	2.889***	1.173***	0.941
	(0.053)	(0.387)	(0.109)	(0.872)
Observations	50	50	50	50

Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

Table 2. Post-hoc Analysis: Did the salient circular features of the Unconventional Space produce cognitive anchoring? (Study 1)

DV: Divergent thinking performance (*ideational fluency*) in the Unconventional Space	Model 1	Model 2
INDEPENDENT VARIABLE		
Early Disney or Pixar character drawing (=1 if drew as one of the first five drawings)	-0.425**	-0.564*
	(0.191)	(0.291)
CONTROL VARIABLES		
Gender, Age, Education dummies, Science/Engineering training dummy, and Table dummies		Included
Constant	2.472***	2.651***
	(0.065)	(0.594)
Observations	24	24

Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

Table 3. Poisson regression estimates for divergent thinking performance (Study 2)

DV: Divergent thinking performance	Model 1 (Ideational fluency)	Model 2 (Ideational fluency)	Model 3 (Originality)	Model 4 (Originality)
INDEPENDENT VARIABLE				
Unconventional Space	-0.078***	-0.071**	-0.321***	-0.323***
	(0.028)	(0.029)	(0.090)	(0.091)
CONTROL VARIABLES				
Gender (=1 if male)		-0.028		0.165†
		(0.030)		(0.091)
Age		-0.003***		-0.001
		(0.001)		(0.003)
Education dummies		Included		Included
Science/Engineering training dummy		Included		Included
Constant	2.626***	2.628***	0.454***	0.622***
	(0.020)	(0.073)	(0.058)	(0.225)
Observations	375	375	375	375

Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

Table 4. Post-hoc Analysis: Did the Features of the Unconventional Space Produce Cognitive Anchoring? (Study 2)

DV: Divergent thinking performance (*ideational fluency*) in the Unconventional Space	Model 1	Model 2
INDEPENDENT VARIABLE		
Early spaced-inspired answer (=1 if provided as one of the first five solutions)	-0.126***	-0.098**
	(0.042)	(0.043)
CONTROL VARIABLES		
Gender, Age, Education dummies, and Science/Engineering training dummy		Included
Constant	2.599***	2.355***
	(0.026)	(0.110)
Observations	189	189

Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

Table 5. Poisson regression estimates for divergent thinking performance (Study 3)

DV: Divergent thinking performance	Model 1 (Ideational fluency)	Model 2 (Ideational fluency)	Model 3 (Originality)	Model 4 (Originality)	Model 5 (Originality top 10%)	Model 6 (Originality top 10%)
INDEPENDENT VARIABLE						
Unconventional Space	0.133***	0.148***	1.018*	1.027*	0.520***	0.555***
	(0.047)	(0.047)	(0.677)	(0.683)	(0.143)	(0.144)
CONTROL VARIABLES						
Gender (=1 if male)		-0.070		0.166		-0.001
		(0.048)		(0.630)		(0.142)
Age		-0.001		0.002		-0.002
		(0.002)		(0.025)		(0.006)
Education dummies		Included		Included		Included
Sci./Engineering training dummy		Included		Included		Included
Constant	1.512***	1.534***	-4.154***	-19.73	-0.883***	-0.569
	(0.034)	(0.128)	(0.577)	(4148.624)	(0.113)	(0.377)
Observations	375	375	375	375	375	375

Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1

Table 6. OLS regression estimates for divergent thinking performance (*ideational fluency* and *originality*) using pooled data from Studies 2 and 3

	Dependent Variable: *Ideational fluency*				Dependent Variable: *Originality*			
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8
INDEPENDENT VARIABLES								
Unconventional Space (US)	0.061	-0.164†	0.079	-0.147†	-0.032	-0.228**	-0.029	-0.227**
	(0.073)	(0.103)	(0.072)	(0.102)	(0.073)	(0.103)	(0.073)	(0.103)
Unrelated Task (UT)		-0.224**		-0.238**		-0.195*		-0.222**
		(0.102)		(0.102)		(0.103)		(0.103)
US x UT		0.451***		0.452***		0.392***		0.394***
		(0.145)		(0.144)		(0.146)		(0.145)
CONTROL VARIABLES								
Gender (=1 if male)			-0.126*	-0.117†			0.060	0.069
			(0.073)	(0.073)			(0.074)	(0.074)
Age			-0.004†	-0.003			-0.001	-0.000
			(0.003)	(0.003)			(0.003)	(0.003)
Education dummies			Included	Included			Included	Included
Science/Engineering dummy			Included	Included			Included	Included
Constant	-0.030	0.083	0.027	0.105	0.016	0.115†	0.013	0.087
	(0.051)	(0.073)	(0.186)	(0.189)	(0.051)	(0.073)	(0.188)	(0.190)
Observations	750	750	750	750	750	750	750	750

Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1, †p<0.15

Table 7. OLS regression estimates for divergent thinking performance (*ideational fluency*) (Study 4)

	All Data				Conventional & Unconventional Space 1				Conventional & Unconventional Space 2			
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**	**Model 11**	**Model 12**
INDEPENDENT VARIABLES												
Unconventional Space (US)	-0.062	-0.447***	-0.050	-0.416**	-0.085	-0.537***	-0.082	-0.498***	-0.032	-0.361*	-0.018	-0.284†
	(0.117)	(0.161)	(0.118)	(0.165)	(0.134)	(0.185)	(0.136)	(0.190)	(0.135)	(0.186)	(0.137)	(0.194)
Unrelated Task (UT)		-0.527***		-0.492**		-0.459**		-0.406**		-0.341*		-0.243
		(0.189)		(0.195)		(0.187)		(0.195)		(0.190)		(0.199)
US x UT		0.785***		0.739***		0.910***		0.827***		0.673**		0.540*
		(0.230)		(0.238)		(0.263)		(0.271)		(0.266)		(0.281)
CONTROL VARIABLES												
Gender (=1 if male)			0.038	0.036			0.073	0.071			0.038	0.040
			(0.116)	(0.115)			(0.143)	(0.141)			(0.142)	(0.142)
Age			-0.016	-0.013			-0.023†	-0.019			-0.004	-0.003
			(0.014)	(0.014)			(0.015)	(0.015)			(0.019)	(0.019)
Education dummies			Included	Included			Included	Included			Included	Included
Science/Engineering dummy			Included	Included			Included	Included			Included	Included
Constant	0.042	0.298**	0.344	0.627†	0.043	0.266**	0.380	0.576	0.016	0.182	-0.122	0.113
	(0.096)	(0.132)	(0.403)	(0.410)	(0.096)	(0.131)	(0.450)	(0.452)	(0.096)	(0.132)	(0.551)	(0.563)
Observations	333	333	333	333	221	221	221	221	221	221	221	221

Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1, †p<0.15

Table 8. OLS regression estimates for divergent thinking performance (*originality*) (Study 4)

	All Data				Conventional & Unconventional Space 1				Conventional & Unconventional Space 2			
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**	**Model 7**	**Model 8**	**Model 9**	**Model 10**	**Model 11**	**Model 12**
INDEPENDENT VARIABLES												
Unconventional Space (US)	-0.158	-0.587***	-0.108	-0.564***	-0.081	-0.583***	-0.035	-0.529***	-0.223*	-0.559***	-0.229*	-0.564***
	(0.116)	(0.160)	(0.115)	(0.160)	(0.134)	(0.184)	(0.132)	(0.183)	(0.134)	(0.185)	(0.137)	(0.194)
Unrelated Task (UT)		-0.586***		-0.661***		-0.510***		-0.541***		-0.348*		-0.352*
		(0.188)		(0.188)		(0.186)		(0.187)		(0.188)		(0.199)
US x UT		0.873***		0.924***		1.010***		0.985***		0.689***		0.679**
		(0.229)		(0.230)		(0.261)		(0.261)		(0.265)		(0.280)
CONTROL VARIABLES												
Gender (=1 if male)			0.095	0.092			0.092	0.089			-0.067	-0.067
			(0.113)	(0.111)			(0.139)	(0.135)			(0.143)	(0.142)
Age			0.007	0.010			0.002	0.007			0.006	0.007
			(0.014)	(0.013)			(0.015)	(0.014)			(0.019)	(0.018)
Education dummies			Included	Included			Included	Included			Included	Included
Science/Engineering dummy			Included	Included			Included	Included			Included	Included
Constant	0.107	0.391***	-0.254	0.113	0.041	0.289**	-0.317	-0.057	0.113	0.282**	-0.217	0.085
	(0.096)	(0.131)	(0.393)	(0.396)	(0.096)	(0.130)	(0.438)	(0.435)	(0.095)	(0.131)	(0.553)	(0.563)
Observations	333	333	333	333	221	221	221	221	221	221	221	221

Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1, †p<0.15

Table 9. Post-hoc Analysis: Examination of the cognitive anchoring effect in the related task of Study 4

	Dependent Variable: *Number of anchored answers in top 5*		Dependent Variable: *Ideational fluency*		Dependent Variable: *Originality*	
	Model 1	**Model 2**	**Model 3**	**Model 4**	**Model 5**	**Model 6**
INDEPENDENT VARIABLES						
Unconventional Space	0.191*	0.192*				
	(0.105)	(0.110)				
Anchored answer (=1 if had anchored answer in top 5)			-0.014†	-0.016*	-0.004†	-0.004*
			(0.009)	(0.009)	(0.002)	(0.002)
CONTROL VARIABLES						
Gender (=1 if male)		-0.032		0.005		0.001
		(0.103)		(0.005)		(0.001)
Age		0.004		0.000		0.000*
		(0.013)		(0.001)		(0.000)
Education dummies		Included		Included		Included
Science/Engineering dummy		Included		Included		Included
Constant	0.827***	0.812**	0.097***	0.092***	0.011***	0.004
	(0.088)	(0.326)	(0.009)	(0.018)	(0.002)	(0.005)
Observations	168	168	168	168	168	168

Standard errors in parentheses. ***p<0.01, **p<0.05, *p<0.1, †p<0.15