



## Optimizing the Workplace for Innovation: Using Brain Science for Smart Design

It seems two very different behaviors optimize creative thinking for innovation processes: high-focus work and restorative activities. We need to experience these on our own as well as with others. If we never rest, can't focus, or don't work with each other, we miss out on finding new ideas and fail to execute them. Organizations that value and design workplaces supporting all of these activities can improve their innovation efforts simply by having more ideas to consider. Explore the growing evidence that supports this and how, coupled with Haworth's workplace expertise, space design can cultivate the creativity necessary to spark innovation.

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Within our fast-paced global economy, organizations feel pressure to innovate. Regardless of industry, products, or services, it's humans that come up with new ideas for innovation. If we want people to innovate and before we can design for it, we need to understand how they create new ideas. First, let's debunk some myths about creativity and innovation:

- 1 Creativity is not a "gift." It is a skill. Skills can be developed and practiced.<sup>1</sup>
- 2 Creativity is not "right-brained." The creative process involves the whole brain, so workplaces should support the whole process.<sup>2</sup>
- 3 Creativity is the accumulation of many small ideas that lead to the big ideas we tend to laud as "innovative."<sup>3</sup>
- 4 Conflict between people with diverse and complementary knowledge sets can be constructive for innovation.<sup>4</sup>

If you're doubtful of these, read on. Recent research sheds light on how to design workspaces and workplaces to improve and optimize creative activities—the activities necessary for employees to create the next new ideas that spark innovation.

### Creating and Innovating: How Ideas Come to Market and Grow Knowledge

First things first: Creativity and innovation, as studied, are not synonymous. Researchers understand and study these as two separate concepts that work together. Creativity and innovation, both, are defined by novelty and usefulness—finding a new (novel) idea that is valued by others (usefulness).<sup>5</sup> *Creativity* is the process of coming up with the new and useful idea, and *innovation* is the process of making that idea a reality for others to use.<sup>6</sup> So, innovation starts with the discovery of creative ideas that then moves toward production or use of that idea to economically satisfy a specific need or market. If we want to optimize the front end of this process—how the individual and organization create new and useful ideas—we need to understand how new ideas come about.

### From new ideas...



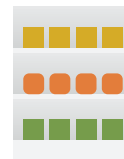
A person uses what they already know combined with new knowledge to generate new ideas.



Those ideas are shared with others.



Together, they determine if those new ideas are, in fact, new and also useful to a market.



If they are new and useful, together, they make those ideas a reality as new physical products or new ways of doing things.



Lastly, sharing new ideas, products, and ways of doing things—including lessons learned from failures—adds to knowledge; and, the process comes full circle.<sup>7</sup>

### ...to market.

1 Sawyer, 2012; Jackson et al., 2012; Chapman et al., 2017.

3 Hennessey and Amabile, 2010; Sawyer, 2012.

5 Hennessey and Amabile, 2010; Jung et al., 2010; Benedek et al., 2014.

7 Csikszentmihalyi, 2014; Sawyer, 2012.

2 Jung et al., 2010; Beaty et al., 2014; Beaty et al., 2015; Yoruk and Runco, 2014.

4 DeGraff and DeGraff, 2017.

6 Anderson, Potočnik, and Zhou, 2014.

## Developing and Practicing Creativity

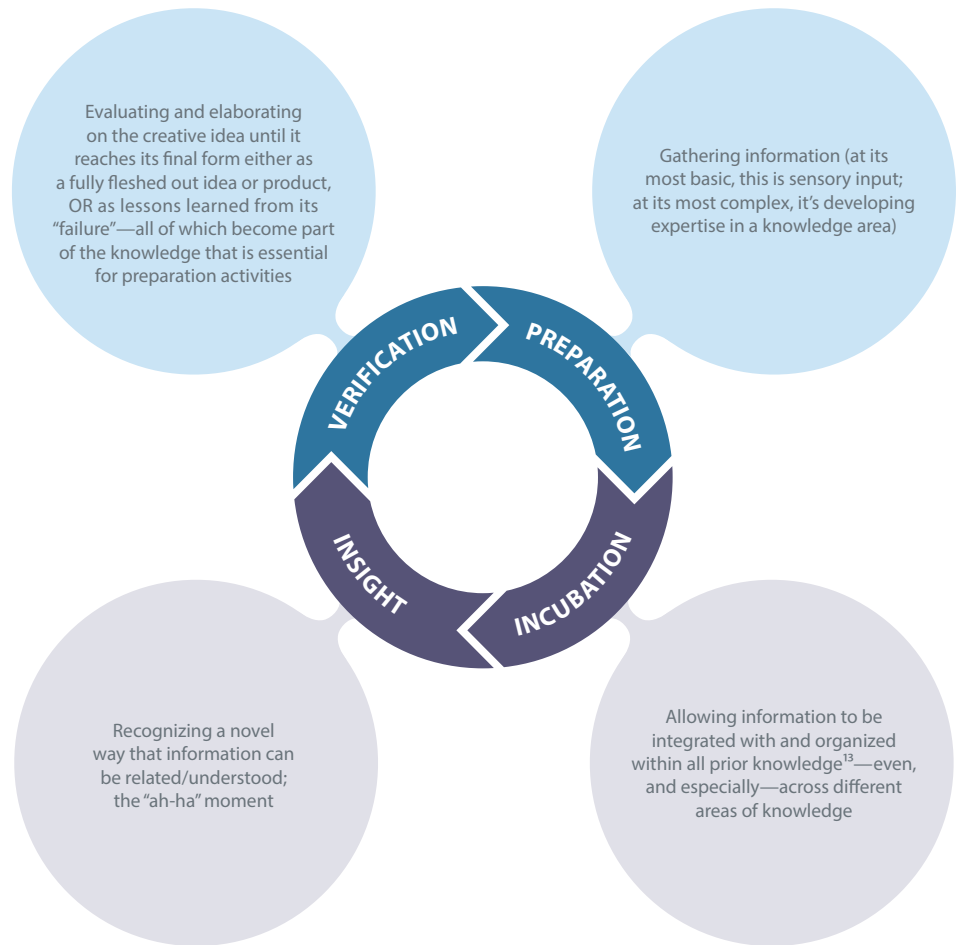
There are four stages of cognition involved in the creative process: preparation, incubation, insight, and verification.<sup>8</sup> Cycling among these stages forms a continuous feedback loop, generating novel ideas and evaluating those ideas *until our ideas are fully formed and vetted*.<sup>9</sup> Without spending time in all of these cognitive stages, creative ideas don't happen.

Luckily, we come by these fairly naturally—and by developing expertise, following the right work habits, and knowing how to combine ideas and select good ones, we can get better at it.<sup>10</sup> Unfortunately, too often, our workplaces don't provide what we need for those "right work habits." Starting with creative cognition can help us fix that.

Not surprisingly, our brains function in different ways for different kinds of cognition, and there are three neural networks (constellations of brain areas) most important to creative cognition: the executive control network, the default network, and the salience network. Knowing how these networks work together helps us understand what exactly those right work habits are, and how to design for them in the workplace.

### EXECUTIVE CONTROL NETWORK

Powers goal-directed, narrowing, or convergent thinking that is necessary for completing tasks and making decisions. Much of preparation and verification involve this network and convergent thinking.<sup>12</sup>



### SALIENCE NETWORK

Acts as a gatekeeper for internal and external stimuli for convergent and divergent thinking.<sup>11</sup>

### DEFAULT NETWORK

Facilitates spontaneous, expansive, or divergent thinking necessary for making new connections across concepts and generating new ideas. Much of incubation and insight involve this network and divergent thinking.<sup>14</sup>

*"Inspiration prefers the prepared mind."* — Dr. Scott B. Kaufman and Carolyn Gregoire

People with deep knowledge of various areas of interest have more to draw upon for creative ideas. Why is this? First of all, they are curious and develop an openness to new experiences, which is closely tied to creative outcomes.<sup>15</sup> Their deep knowledge then provides more "material" from different areas of expertise from which to make new connections.<sup>16</sup>

8 Sawyer, 2012 ; Kaufman and Gregoire, 2015.

10 Sawyer, 2012.

13 Tomparry and Davachi, 2017.

16 Gabora and Carbert, 2015.

9 Cunningham et al., 2007; Gabora and Saab, 2011; Zelazo, 2015.

11 Menon, 2015.

14 Jung et al., 2013.

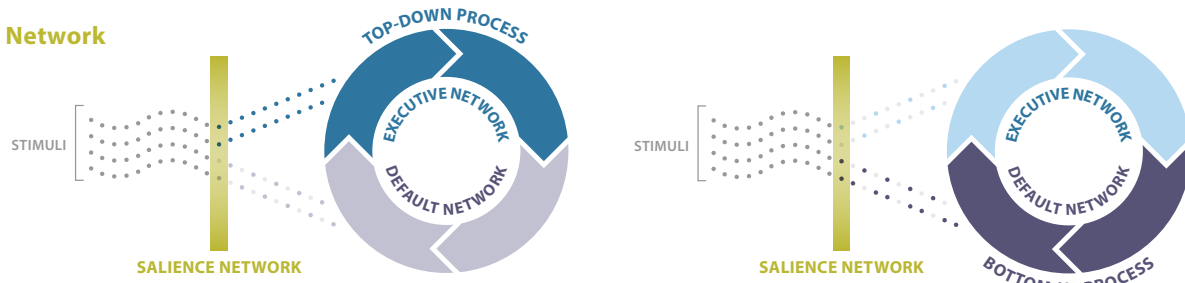
15 Kaufman, 2013; Madrid and Patterson, 2016; Kaufman et al., 2016.

12 Jung et al., 2013.

## Creativity Involves the Whole Brain

Since creative cognition involves the executive control, default, and salience networks, and these networks span across various regions of the brain, creativity involves the whole brain.<sup>17</sup> So how does our workplace impact convergent and divergent thinking? Through the salience network.

### Salience Network



The salience network monitors external and internal stimuli and passes information to the other networks and influences the way they are prioritized.<sup>18</sup> In short, it impacts *how we think* by telling us *what should get our attention*. Our salience network is designed to monitor stimuli and—when something new, different, out of place, occurs—lets us know by bringing it into our awareness. It can also be trained to monitor stimuli that matter to our own interests. We have some control over our salience network by directing our attention (a “top-down” process), but other times, it directs our attention for us (a “bottom-up” process). Whether a stimulus is relevant and desired, or not, depends on what you want to do and which cognitive mode you need to be in: convergent or divergent.

### Executive Control Network



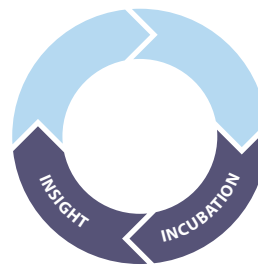
Focus (controlling our attention) is important to convergent thinking because, without intentional focus, learning, problem-solving, and evaluating—all important processes for the *preparation* and *verification* stages of creating new and useful ideas—are much more difficult. Intentionally focusing engages the executive control

network in order to help us complete tasks.<sup>19</sup> Unfortunately, we have limited cognitive capacities, and when/if the tasks at hand demand more attention than our capacities can manage, attention to and performance on those tasks tends to decline.<sup>20</sup> But, it can also depend on other factors, such as the difficulty of the tasks, duration of tasks, and perceived costs involved.<sup>21</sup>

Some good news: At the onset of a focus task, our brain starts to “learn” what to pay attention to (what’s relevant) and what to ignore (what’s irrelevant).<sup>22</sup> Our focus can get more efficient the longer we control our attention: Our brain starts to suppress what it doesn’t need to bring into awareness to perform the task.<sup>23</sup> Although, no matter how efficient our focus is, it still functions within limited capacities and can be susceptible to off-task stimuli.

So, it remains prudent to protect our ability to focus. Without the ability to effectively learn and build our knowledge, we have no foundation from which to draw new ideas. Without the ability to effectively test and refine our ideas, our new ideas won’t go anywhere. *Without focus work, there is no innovation.*

### Default Network



Resting replenishes resources and allows for divergent thinking for idea generation: *incubation* and *insight*. Research provides evidence that divergent thinking needs little intentional effort,<sup>24</sup> benefits from a range of stimuli,<sup>25</sup> requires less dependency on specific external stimuli (you can be “perceptually decoupled”—or oblivious to

your surroundings),<sup>26</sup> and functions best when emotions and engagement are low.<sup>27</sup> Resting and routine activities downgrade the executive control network,<sup>28</sup> allowing the default (or imagination)<sup>29</sup> network to get more active. It takes what we’ve learned, integrating it with what we already know<sup>30</sup> in unique ways. How do our brains make connections between varied and unlikely concepts? By being inefficient, says Dr. Rex Jung in *The New York Times*: “...in the regions of the brain related to creativity, there appears to be lots of little side roads with interesting detours, and meandering little byways.”<sup>31</sup>

Why is being inefficient important to creative thought? “In a way, the [imagination network] is like a scout, ranging about for prospective futures.”<sup>32</sup> Scouting is crucial to connect what we know with what “could be” into a new idea. By meandering the byways of the imagination network, cognition gets more spontaneous,<sup>33</sup> stumbling upon the desired connection responsible for the “ah-ha!” moment. It often happens when we least expect it. Without time and space to engage imagination, we’ll miss out on insights. *Without rest, there is no innovation.*

17 Menon, 2015.

18 Menon and Uddin, 2010; Oosterwijk, Touroutoglou, and Lindquist, 2015; Menon, 2015.

19 Lavie et al., 2004; McCabe et al., 2010; Christie and Schrater, 2015.

20 Randall, Oswald, and Beier, 2014; Buschman and Kastner, 2015.

21 Simon et al., 2016; Kool, Shenhav, and Botvinick, 2017; Krinsky et al., 2017.

22 Kiyonaga, Egner, and Soto, 2012; Buschman and Kastner, 2015.

23 Sörqvist, Stenfelt, and Rönnerberg, 2012; Hopf et al., 2006; Menon, 2015.

24 Beaty et al., 2014.

25 wiruchnipawan, 2015.

26 Baird et al., 2012; Christoff, 2012.

27 Harmon-Jones, Price, and Gable, 2012.

28 Dietrich, 2003; Dietrich, 2004b; Jung et al., 2009.

29 Kaufman, 2014.

30 Tompary and Davachi, 2017.

31 Cohen, 2010.

32 Kaufman, 2014.

33 Knight et al., 1999.

The salience network, then, is the key for how a workplace (and all its external stimuli) impacts the way we think and behave, including our creative work habits. For the convergent and divergent thinking necessary to creativity, we should include design that helps the salience network prioritize creative work habits ranging from focus to rest.

### Designing for Creative Rhythm: Focus, Rest, and In-Between

Because we need both focus and rest to foster the convergent and divergent thinking for the creative process, design considerations for workplaces should include how to manage stimuli for the whole process. Remember, whether a stimulus is relevant and desired or not depends on what you want to do and which cognitive mode you need to be in: convergent or divergent.

#### The Challenge for “Top-Down” Attention: Irrelevant Stimuli Sabotaging Focus

The challenge to focusing for convergent thinking begins when unwanted, irrelevant stimuli divert our efforts to focus, even emotions. Highly intense emotions, whether positive or negative, will divert resources from efforts to intentionally focus.<sup>34</sup> Too much arousal overloads our cognition. For example, in a Haworth Human Performance Lab experiment, when arousal or stress was too high, performance on a time-sensitive, high-focus task was poor.<sup>35</sup> Top-down attention, indeed, needs a low to moderate amount of arousal for motivation, what we call “interest.”<sup>36</sup> Too little interest (boredom), and we won’t pay attention enough to perform well. You may have experienced a time when your thoughts drifted off during a meeting. That may be due to not enough arousal. Therefore, a good motivator for focus work is confronting achievable yet, challenging tasks.<sup>37</sup> It’s the “sweet spot” in terms of interest, engagement, or arousal. Since managing stimuli that doesn’t sabotage efforts to focus can be so challenging on many fronts, we need to protect people’s ability to focus for *preparation* and *verification*.

#### The Advantage of “Bottom-Up” Attention: Stimuli Sparking New Ideas

“Boredom,” however, isn’t always necessarily a bad thing. When our minds wander, our imagination network can kick in and do some work.<sup>38</sup> Because varied and novel stimuli feed the imagination network, when we’re bored it may be a signal that it’s time to take a break and soak in the surrounding stimuli (“bottom-up” attention). It could be just the right kind of stimuli that our imagination network can use to make unique and interesting connections across concepts we already know. Variety of stimuli serves a purpose—cueing the resting brain for imaginative thinking.

Oftentimes, when we want to “clear our head,” we seek a different space and activity (like a walk outdoors), daydream, or do something routine.<sup>39</sup> When we do this, we’re letting our brains noodle on potential ideas.<sup>40</sup> How many ideas have come to light when you were doing something routine, like commuting to work? Chances are your commute is very routine and you “go through the motions” with just enough awareness to get there—sometimes even arriving at work with little recollection of how exactly you got there. Such a routine task engages your imagination network.<sup>41</sup> While on “automatic pilot” for routine tasks, it seems the imagination network can get some tinkering done, sometimes arriving at that flash of insight. Just make sure you’re paying enough attention to your commute that you safely arrive at the correct location. Since our brains can do so much good stuff when we’re relaxed, we should encourage restorative behaviors at work for *incubation* and *insight*.

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Designing for the right creative work habits means creating spaces for focus, rest, and the in-between.

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#### Creative Rhythm and Peak Performance

It’s clear we must have both focus and rest for creative cognition. How fast we cycle between these modes of thinking and behaving depends on how well we can focus, how much rest we need, what we already know, what we need to know, and where we are in the creative process. The rhythm between focusing and resting can be slower, with longer periods in each state. Sleeping each night is an excellent example of a longer resting period that provides cognitive benefits for divergent thinking.<sup>42</sup> In the workplace, a popular study conducted by DeskTime revealed that the most productive employees (top 10 percent), on average, took a 15-minute break after working for about an hour.<sup>43</sup> Or, the creative rhythm can be quite fast—even to the point that we can’t tell which mode we’re in. We’re absorbing information, generating ideas, and refining them all at once—and it’s effortless. Here we have optimal focus with the least amount of effort (or cognitive load), thus freeing up resources otherwise used to control our attention for other kinds of cognition. These kinds of cognition include drawing on past experiences and procedural knowledge (all that *preparation* you did),<sup>44</sup> moral reasoning, working memory,<sup>45</sup> and spontaneous thought<sup>46</sup> from the imagination/default network<sup>47</sup> for whatever task is being performed. Now, we’ve got the whole brain involved, and it seems that convergent and divergent thoughts happen simultaneously,<sup>48</sup> and the executive control and default networks are cooperating instead of competing.<sup>49</sup> We are in the “in-between” space between high

34 Duncan and Barrett, 2007; Harmon-Jones, Gable, and Price, 2012; Alpert and Haber, 1960.

35 Johnson, 2017.

36 Yerkes and Dodson, 1908; Alpert and Haber, 1960; Crum, Salovey, and Achor, 2013.

37 Keller and Bless, 2008.

38 Baird et al., 2012; Smallwood et al., 2012; McMillan, Kaufman, and Singer, 2013.

39 Baird et al., 2012; McMillan, Kaufman, and Singer, 2013.

40 Dietrich, 2003; Dietrich, 2004a; Jung et al., 2009.

41 Lin et al., 2016; Vatansever, Menon, and Stamatakis, 2017.

42 Ellenbogen et al., 2007; Vartanian et al., 2014; Tompary and Davachi, 2017.

43 Gifford, 2014.

44 Beilock et al., 2002.

45 Fukuda and Vogel, 2011; Kiyonaga, Egner, and Soto, 2012.

46 Sawyer, 2012; Oosterwijk, Touroutoglou, and Lindquist, 2015.

47 Menon, 2015; Beaty et al., 2016.

48 Jung et al., 2013; Beaty et al., 2017.

49 Smallwood et al., 2012; Hughes et al., 2013; Beaty et al., 2017.

focus and rest. Researchers are starting to pull apart the conditions for this kind of creative performance.<sup>50</sup> But for now, there's some evidence that just the right amount of "buzz" or activity<sup>51</sup> combined with the intention to do some mind wandering<sup>52</sup> can help facilitate the ability to maintain enough focus and actively enlist the imagination.<sup>53</sup> We've reached peak performance! In this state, we also lose a sense of time; hours pass like they are minutes. However, if efforts to focus are sabotaged up front (or you are exhausted or the challenge is either too much or too little), you can forget about reaching peak performance.

### Smart Design for Workplace Creativity

Considering what science says about ways to support convergent and divergent thinking, and pooling our workplace design and strategy expertise at Haworth, we've developed the following model for better understanding workplace creativity and innovation. In this model, we see, on one side, the need to protect focus work; on the other side, the need to encourage down-time, and the in-between for the creative rhythm.

For creativity and innovation to flourish, employers should protect employees' ability to focus and encourage restorative behaviors in the workplace. Design considerations should address privacy, structure of activity, and user control, and include a variety of spaces with the freedom to choose appropriate spaces.<sup>54</sup>

CONVERGENT		DIVERGENT	
high attentional control (focus)		low attentional control (relax/recharge)	
PRIVACY			
full physical barriers	partial virtual barriers	none no barriers	
Privacy refers to how easily outside/irrelevant disruptions can occur. Focus requires some level of privacy from interruption and distraction. The more focus needed, the more privacy needed, while rest may vary in privacy needs. Some may seek solitude or to be immersed in a more public space with others, depending on individual recharging preferences.			
STRUCTURE OF ACTIVITY			
stable predictable spaces		spontaneous novel and flexible spaces	
Focus requires stability and predictable spaces where routine and ritual can assist in an efficient path to convergent thinking, whereas restorative states are less dependent upon routines and divergent thinking benefits from spontaneous activities and novel environments. Keep in mind, these are generalized; individuals will have preferences toward how much structure is best for focus and rest for themselves.			
USER CONTROL			
high insulate	embed	externalize	low access
Focus requires more control over the environment so that activities can be more personalized and predictable to preserve cognitive resources; restorative behaviors require less control over the environment. Access to people in spaces for serendipitous interactions are most important for group restorative spaces.			

### The Accumulation of Creative Ideas

So far, we've only been discussing how individuals come up with new ideas. If we only work alone and all we ever do is for ourselves, we miss out on the rest of the creative and innovative process that happens during and with knowledge sharing. We need others to build on our creative ideas and verify that they are useful for innovation to happen. So, the creative process applies to more than just individual cognition and behaviors; it also applies to group efforts to create and innovate. What fosters creativity alone fosters creativity done together. It's clear that we need to focus *and* we need to rest. At times, we need to do these alone and, at other times, we need to do them together.

### Knowledge Sharing: Creating and Innovating Together

When people in groups need to be creative, individual cognitive processes of creativity become externalized (this is called distributed cognition).<sup>55</sup> Periods of *preparation* or group learning require the whole group to focus; periods of *incubation* that lead to moments of *insight* can happen when we socialize; periods of vetting those insights for *verification* require the whole group to focus once again.



Intense group focus work—what most think of as "brainstorming"—and what may look like seemingly "inefficient" processes are quite helpful to creative work habits: Socializing (dining together) or engaging in off-task activities (taking an architectural tour of a city or attending a performance) oftentimes yields unexpected questions, where meaning then develops afterwards while the group makes sense of those new questions in the verification stage.<sup>56</sup> Groups are less successful with innovation if their emphasis on engagement with one another is solely on one creative activity, e.g., brainstorming. Groups need time and space to learn, collectively, to identify the common knowledge across members, and to allow for connections between different pieces of knowledge among its members. Three well-known group processes mirror these needs: organizational learning (*preparation*),<sup>57</sup> brain writing (individualized *incubation* and *insight*),<sup>58</sup> and, of course, brainstorming (group *insight* and *verification*).<sup>59</sup> Much more is needed than just brainstorming. Protecting focus, encouraging restorative activities, and having the right tools for knowledge sharing become very important for group designated spaces.

50 Beaty et al., 2016.

53 Vannucci, Pelagatti, and Marchetti, 2017.

56 Sawyer, 2007.

59 wiruchnipawan, 2015.

51 Mehta, Zhu, and Cheema, 2012.

54 Nagy et al., 2016.

57 Sailer, 2014.

52 Golchert et al., 2016.

55 Sawyer, 2007.

58 Heslin, 2009.



### Benefits of Constructive Conflict

In addition, these kinds of group activities happen best under specific cultural conditions in an organization: 1) when failure is valued; and 2) when diverse perspectives are sought. When people trust that group members and their organization value failure and diverse perspectives,<sup>60</sup> they have the psychological safety<sup>61</sup> to share what they know. One way that a group workspace can facilitate this is to encourage physical movement during group focus activities. Moving within a protected focus space and among each other leads to less territorial behaviors. This can foster trust and more knowledge sharing while in that space, which in turn improves creativity.<sup>62</sup>

### Welcoming the Outside In

Lastly, movement should be encouraged outside the group in two ways: across other internal groups and with people external to the organization. This is when “collisions” or serendipitous interactions are more likely to occur. These spontaneous interactions generate knowledge sharing and learning with colleagues. Fruitful grounds for additional insights, these interactions allow for novel connections by affording more access to a variety of perspectives, knowledge, and expertise, both within and outside an organization.<sup>63</sup>

### Group Flow? Yes, It’s Possible

Yes, it is possible, but it can be difficult to achieve regularly. Group flow (or peak performance) requires several conditions. Members should all:

- 1 have similar skill levels
- 2 be able to obtain intense concentration simultaneously
- 3 perform close or deep listening
- 4 manage the paradox of individual autonomy/control with the flexibility to yield to the group needs
- 5 possess enough tacit knowledge of how the group best functions<sup>64</sup>

And, interestingly, there is this advice from Keith Sawyer: “Group flow is more likely when a group can draw a boundary, however temporary or virtual, between the group’s activity and everything else. Companies should identify a special location for group flow.”<sup>65</sup>

Innovation is more difficult to achieve without designated spaces for group focus and rest.

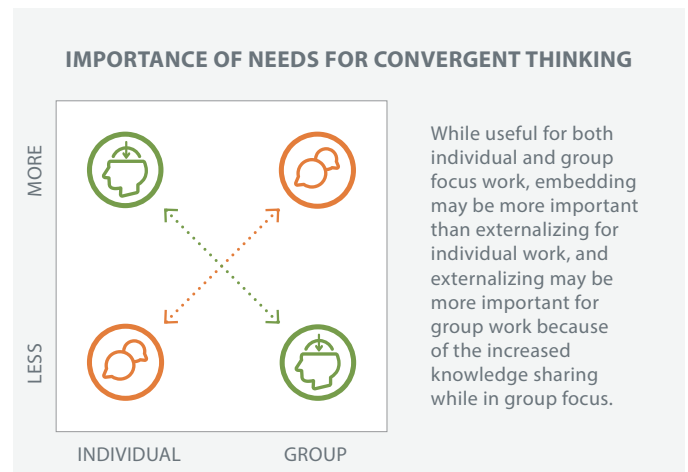
### Designing for the Whole Brain

Understanding the focus, rest, and transition needs of individuals and groups leads to the following design implications for fostering creativity and innovation in the workplace.

#### Workspace Focus Needs

Protecting focus work is necessary for *preparation* and *verification*. The workspace needs to have full or partial privacy to block external stimuli. Focus activities tend to be highly structured for efficiency, so we also want to make efficient use of the necessary cognitive resources for high-focus activities while in a workspace. Having user control over a workspace also allows for fine-tuning that is specific to the current focus activity. Addressing the following four issues can ensure these cognitive needs are being met:

 <b>Insulate</b>	 <b>Embed</b>
<p>Protect from distractions, allowing for focusing ease including actual structural barriers (walls, etc.) and virtual barriers (“do not disturb” cues, use of headphones, or enough distance to minimize disruptions from other activities)</p>	<p>Provide tools (analog and digital) to support memory recall, persistence, meaning, reminding, and provide a legible workplace that is easy to navigate</p>
 <b>Externalize</b>	 <b>Access</b>
<p>Provide ways for displayed thinking for sense-making, organization, and communicating to others (knowledge sharing)</p>	<p>Connect to information through tools or face-to-face interactions with others in an appropriate context for knowledge sharing that doesn’t interrupt focus</p>



60 Carmeli, Dutton, and Hardin, 2015.

62 Knight and Baer, 2014.

65 Sawyer, 2007.

61 Edmondson, 1999; Edmondson, 2004; Edmondson, 2016.

63 Sailer, 2014.

64 Sawyer, 2007.

### Workspace Restorative Needs

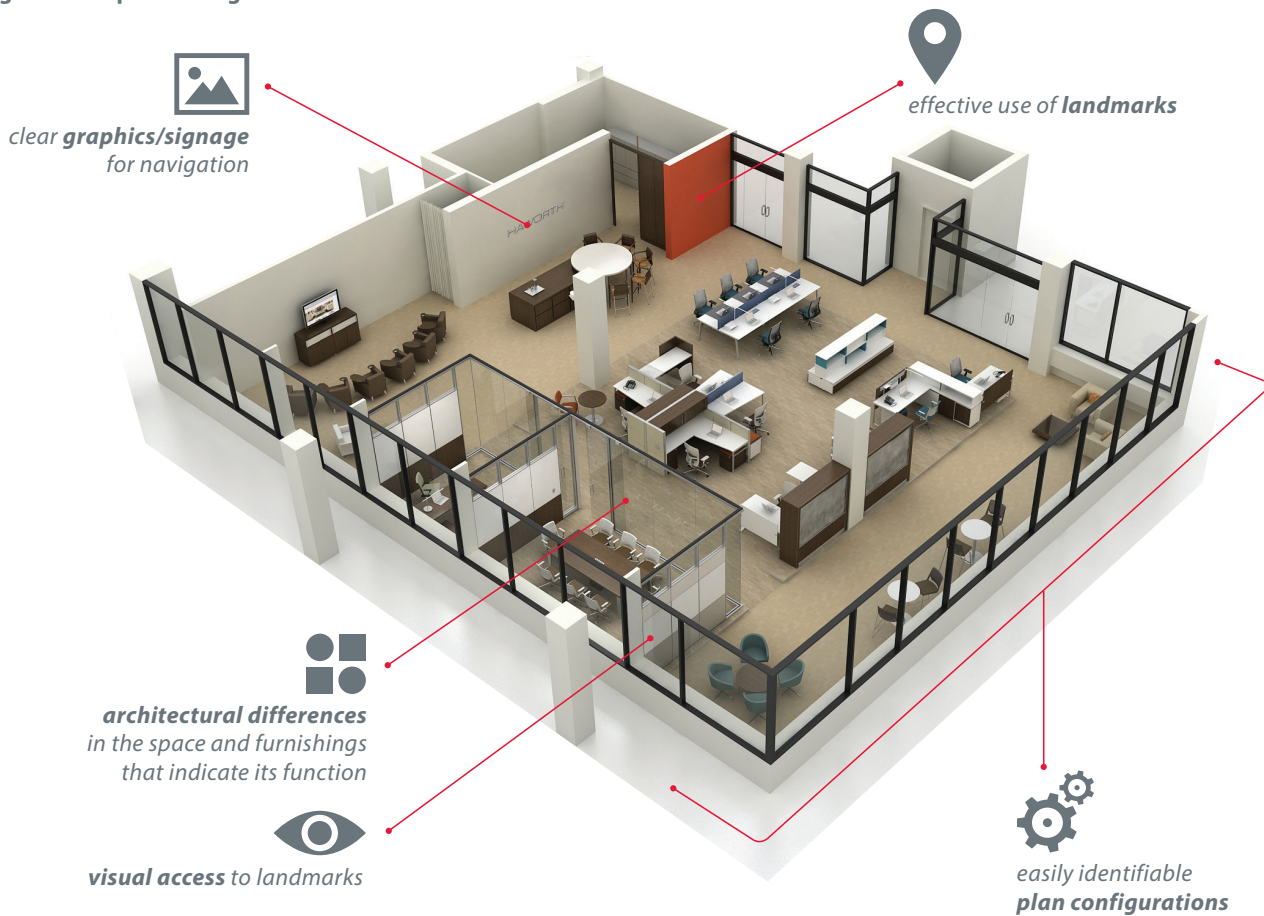
Fostering restoration for *incubation* and *insight* encourages our imagination network's "scouting" activities. Time and spaces that promote relaxation and desired distractions from focus work are necessary. These can range from "micro-breaks"—the short pauses in focus when we gaze off into the distance and daydream—to "macro-breaks"—when we move to new spaces seeking individual or group respite and restoration. Depending on the way we prefer to recharge and how much time is needed, these spaces can range in the amount of exposure to external stimuli. The longer we have, the less efficient we need to be, the more spontaneous activities may be. User control over the space is also less critical than during focus work, but people still will need some minimal access to tools for embedding and externalizing (e.g., Wi-Fi) because, when an insight occurs, opportunity to embed is helpful before the insight is lost.

### The Importance of Legibility to Embedding

If the goal is to protect, preserve, and optimize cognitive resources for creative work, navigating the workplace and workspaces within it should be intuitive and easy—in other words, legible. When space isn't legible, for example, a floorplan's simplicity (or complexity) can account for up to half of the difficulty people face navigating the space.<sup>66</sup> How so?

Familiar patterns for plan configurations are more readily detectable, but *without* specific markers to differentiate location in that plan configuration, difficulty increases for us to know where we are within the patterned space as cognitive resources are expended to orient ourselves. Once oriented and arrived at a desired location, is the intended use of that space obvious? If not, *additional* cognitive resources are expended to identify the activities that are best suited for that specific space, or the space goes unused. Not only do you have a space utilization problem, but employees have also expended valuable resources better used in the creative process. Thus, the argument for legibility in design.

Legible workplace design includes:<sup>67</sup>



66 Weisman, 1981.

67 O'Neill, 2016.



### Designing for Individual Creativity

In addition to designing for high focus and rest, consider the importance of how people need to transition between these—sometimes staying in those transition spaces to capitalize on just enough privacy for focusing, combined with just enough spontaneous activity to engage the imagination.

< FOCUS	PRIVACY		RESTORE >
<p><b>PHYSICAL BARRIERS</b> provide refuge, places to hide, and block disruptions</p>	<p><b>VIRTUAL BARRIERS</b> manage disruptions via “formal” space and “do not disturb” norms</p>	<p><b>NO BARRIERS</b> provide visual access to nature, long views, and “informal” space</p>	
< FOCUS	STRUCTURE OF ACTIVITY		RESTORE >
<p><b>STABLE</b> predictable space for ritual, and personalization to achieve calm and clarity</p>	<p><b>SPONTANEOUS</b> flexible space with varied stimuli such as objects/totems for inspiration</p>		
< FOCUS	USER CONTROL		RESTORE >
<p><b>HIGHER NEED FOR TOOLS/SENSORY CONTROL</b> facilitates efficiency/productivity, freedom from distraction, and adjustment for comfort</p>	<p><b>LOWER NEED FOR TOOLS/SENSORY CONTROL</b> allows for untethering, facilitating access to people and varied spaces</p>		
<p><b>Tools may include:</b> varied technology, whiteboards, surfaces    <b>Sensory control may include:</b> temperature, lighting, privacy</p>			

### Designing for Group Creativity

When designing spaces for groups, consider their additional needs beyond individual spaces and depending on the purpose—focusing, restoring, and transitioning.

FOCUS	TRANSITION	RESTORE
<p><b>EFFICIENCY</b> through small, adaptable, legible space and furniture insulated from group social space</p>	<p>transition spaces for changing modes via loitering and varied postures blend the opportunity to focus with just enough varied stimuli to prompt elaboration on ideas</p>	<p><b>INEFFICIENCY</b> allows for interpretation of space, no obvious ownership, and encourages many forms of interaction for free-flowing exchange of ideas</p>
<p><b>EMBED/EXTERNALIZE</b> captures idea growth (not generation), physical crystallization point of an idea, and display ownership/territory</p>		<p><b>NOVEL/SPONTANEOUS</b> activities are promoted by varied/flexible spaces with sensory changes: tactile, visual, auditory</p>
<p><b>TOOLS</b> for access to remote connectivity, real-time updates, and information at fingertips</p>		<p><b>TOOLS</b> to co-create, publicly document process</p>

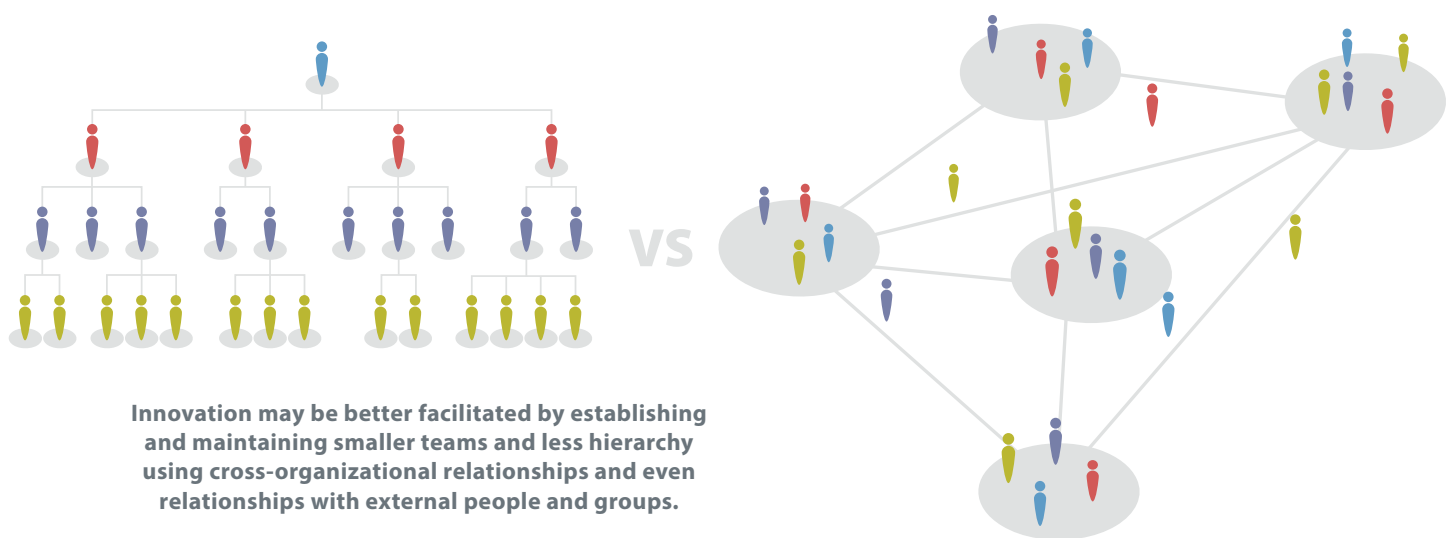
### Putting It All Together: Organizational Implications

While the degree of innovation needs may vary across different organizations, all organizations need to innovate. In addition to addressing employees' needs through smart workplace design for optimal creative performance, organizational culture is equally important. The structural and social norms of organizational culture<sup>68</sup> set the stage for innovation by coordinating creative efforts among its members. Group creativity norms include respectful engagement,<sup>69</sup> diversity in knowledge and perspectives, expecting frequent failures, and skillful management of deadlines understanding that high-pressure timelines can block creativity.<sup>70</sup>

These may be better facilitated in organizations (or parts of an organization) that have less hierarchy. We see some of these qualities arise within coworking environments<sup>71</sup>—environments that seem to be innovation factories. Based on what we know about individual creativity, group creativity, and innovation, this means establishing and maintaining smaller teams and less hierarchy using cross-organizational relationships and even relationships with external people and groups.

Creating a network structure for people that emphasizes both strong and weak ties allows for the kind of activities and relationships that are hallmarks of creativity: access to diverse knowledge for idea generation (weak ties)<sup>72</sup> and the resources to move those ideas to fruition (strong ties).<sup>72</sup> Team members should be encouraged to span boundaries across an organization to other internal members of other groups as well as with external members<sup>73</sup> at different times of the creative process.

An important factor in an organization's culture is how it is embodied in the built environment.<sup>74</sup> Why? Because an organization's workplace communicates an organization's values and its culture.<sup>75</sup> Thus, design solutions for an innovative culture should take into consideration individual and group creative rhythm needs, protecting focus work, and encouraging restorative activities. Employees experience happiness when their workplace and workspaces convey that they are valued by their organization and when they can focus on their work.<sup>76</sup> Given the right places, spaces, and tools for the creative rhythm of innovation, people can be free to do what they need to do to best create and innovate. When we are free to create and innovate, good things happen—for all of us.



68 Hartnell, Ou, and Kinicki, 2011.

69 Carmeli, Dutton, and Hardin, 2015.

70 Amabile, Hadley, and Kramer, 2002.

71 Rief et al., 2016.

72 Perry-Smith and Shalley, 2003; Baer, 2010.

73 Harvey, Peterson, and Anand, 2014.

74 Miller, Casey, and Konchar, 2014.

75 Kupritz, 2017.

76 O'Neill, 2017.

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## References

- Alpert, R, and R N. Haber. “Anxiety in Academic Achievement Situations.” *The Journal of Abnormal and Social Psychology* 61, no. 2 (September 1, 1960): 207–15.
- Amabile, Teresa, Constance N. Hadley, and Steven J. Kramer. “Creativity Under the Gun.” *Harvard Business Review*. Boston, MA, August 2002.
- Anderson, Neil, Kristina Potočnik, and Jing Zhou. “Innovation and Creativity in Organizations: A State-of-the-Science Review, Prospective Commentary, and Guiding Framework.” *Journal of Management* 40, no. 5 (2014): 1297–1333.
- Baer, Markus. “The Strength-of-Weak-Ties Perspective on Creativity: A Comprehensive Examination and Extension.” *Journal of Applied Psychology* 95, no. 3 (2010): 592–601.
- Baird, Benjamin., Jonathan. Smallwood, Michael. D. Mrazek, Julia. W. Y. Kam, Michael. S. Franklin, and Jonathan. W. Schooler. “Inspired by Distraction: Mind Wandering Facilitates Creative Incubation.” *Psychological Science* 23, no. 10 (2012): 1117–22.
- Beatty, Roger E., Mathias Benedek, Paul J. Silvia, and Daniel L. Schacter. “Creative Cognition and Brain Network Dynamics.” *Trends in Cognitive Sciences*, 2016.
- Beatty, Roger E., Alexander P. Christensen, Mathias Benedek, Paul J. Silvia, and Daniel L. Schacter. “Creative Constraints: Brain Activity and Network Dynamics Underlying Semantic Interference during Idea Production.” *NeuroImage* 148 (March 1, 2017): 189–96.
- Beatty, Roger E, Mathias Benedek, Scott Barry Kaufman, and Paul J Silvia. “Default and Executive Network Coupling Supports Creative Idea Production.” *Scientific Reports* 5 (January 17, 2015): 1–14.
- Beatty, Roger E, Mathias Benedek, Robin W Wilkins, Emanuel Jauk, Andreas Fink, Paul J Silvia, Donald A Hodges, Karl Koschutnig, and Aljoscha C Neubauer. “Creativity and the Default Network: A Functional Connectivity Analysis of the Creative Brain at Rest.” *Neuropsychologia* 64C (September 20, 2014): 92–98.
- Beilock, Sian L., Thomas H. Carr, Clare MacMahon, and Janet L. Starkes. “When Paying Attention Becomes Counterproductive: Impact of Divided versus Skill-Focused Attention on Novice and Experienced Performance of Sensorimotor Skills.” *Journal of Experimental Psychology: Applied* 8, no. 1 (2002): 6–16.
- Benedek, Mathias, Emanuel Jauk, Markus Sommer, Martin Arendasy, and Aljoscha C Neubauer. “Intelligence, Creativity, and Cognitive Control: The Common and Differential Involvement of Executive Functions in Intelligence and Creativity.” *Intelligence* 46 (September 2014): 73–83.

- Buschman, Timothy J., and Sabine Kastner. "From Behavior to Neural Dynamics: An Integrated Theory of Attention." *Neuron* 88, no. 1 (October 7, 2015): 127–44.
- Carmeli, Abraham, Jane E Dutton, and Ashley E Hardin. "Respect as an Engine for New Ideas: Linking Respectful Engagement, Relational Information Processing and Creativity among Employees and Teams." *Human Relations* 68, no. 6 (2015): 1021–47.
- Chapman, Sandra B., Jeffrey S. Spence, Sina Aslan, and Molly W. Keebler. "Enhancing Innovation and Underlying Neural Mechanisms Via Cognitive Training in Healthy Older Adults." *Frontiers in Aging Neuroscience* 9, no. 314 (October 9, 2017): 1–11.
- Christie, S Thomas, and Paul Schrater. "Cognitive Cost as Dynamic Allocation of Energetic Resources." *Frontiers in Neuroscience*, no. 289 (2015): 1–15.
- Cohen, Patricia. "Charting Creativity: Signposts of a Hazy Territory." *New York Times*, 2010.
- Crum, Alia J., Peter Salovey, and Shawn Achor. "Rethinking Stress: The Role of Mindsets in Determining the Stress Response." *Journal of Personality and Social Psychology* 104, no. 4 (2013): 716–33.
- Csikszentmihalyi, Mihaly. "Society, Culture, and Person: A Systems View of Creativity." In *The Systems Model of Creativity: The Collected Works of Mihaly Csikszentmihalyi*, 47–61. Dordrecht: Springer Netherlands, 2014.
- Cunningham, William A., Philip David Zelazo, Dominic J. Packer, and Jay J. Van Bavel. "The Iterative Reprocessing Model: A Multilevel Framework for Attitudes and Evaluation." *Social Cognition* 25, no. 5 (October 7, 2007): 736–60.
- DeGraff, Jeffrey Thomas, and Stoney DeGraff. *The Innovation code: The Creative Power of Constructive Conflict*. Oakland, CA: Barret-Koehler Publishers, 2017.
- Dietrich, Arne. "Functional Neuroanatomy of Altered States of Consciousness: The Transient Hypofrontality Hypothesis." *Consciousness and Cognition* 12, no. 2 (June 2003): 231–56.
- . "Neurocognitive Mechanisms Underlying the Experience of Flow." *Consciousness and Cognition* 13, no. 4 (December 2004): 746–61.
- . "The Cognitive Neuroscience of Creativity." *Psychonomic Bulletin & Review* 11, no. 6 (2004): 1011–26.
- Duncan, Seth, and Lisa Feldman Barrett. "Affect Is a Form of Cognition: A Neurobiological Analysis." *Cognition & Emotion* 21, no. 6 (2007): 1184–1211.
- Edmondson, Amy. "Psychological Safety and Learning Behavior in Work Teams." *Administrative Science Quarterly* Jun 44, no. 2 (1999): 350.
- Edmondson, Amy C. "Psychological Safety, Trust, and Learning in Organizations : A Group-Level Lens." In *Trust and Distrust In Organizations: Dilemmas and Approaches*, edited by Karen S. Cook Roderick M. Kramer. Russel Sage Foundation, 2004.
- . "Wicked-Problem Solvers." *Harvard Business Review*, 2016.
- Ellenbogen, Jeffrey M, Peter T Hu, Jessica D Payne, Debra Titone, and Matthew P Walker. "Human Relational Memory Requires Time and Sleep." *Proceedings of the National Academy of Sciences of the United States of America* 104, no. 18 (May 1, 2007): 7723–28.
- Fukuda, Keisuke, and Edward K Vogel. "Individual Differences in Recovery Time from Attentional Capture." *Psychological Science* 22, no. 3 (March 2011): 361–68.
- Gabora, Liane, and Nicole Carbert. "Cross-Domain Influences on Creative Innovation: Preliminary Investigations." *Unpublished Manuscript*, 2015.
- Gabora, Liane, and Adam Saab. "Creative Interference and States of Potentiality in Analogy Problem Solving" (2011). In *Proceedings of the Annual Meeting of the Cognitive Science Society*, 1–6, 2011.
- Gifford, Julia. "The Secret of the 10% Most Productive People? Breaking!" *DeskTime Insights*, 2014.
- Golchert, Johannes, Jonathan Smallwood, Elizabeth Jefferies, Paul Seli, Julia M. Huntenburg, Franziskus Liem, Mark E. Lauckner, et al. "Individual Variation in Intentionality in the Mind-Wandering State Is Reflected in the Integration of the Default-Mode, Fronto-Parietal, and Limbic Networks." *NeuroImage* 146, no. November (2016): 226–35.
- Harmon-Jones, Eddie, Philip A. Gable, and Tom F. Price. "The Influence of Affective States Varying in Motivational Intensity on Cognitive Scope." *Frontiers in Integrative Neuroscience* 6, no. September (2012): 1–5.
- Harmon-Jones, Eddie, Tom F. Price, and Philip A. Gable. "The Influence of Affective States on Cognitive Broadening/Narrowing: Considering the Importance of Motivational Intensity." *Social and Personality Psychology Compass* 6, no. 4 (April 2, 2012): 314–27.
- Hartnell, Chad A., Amy Yi Ou, and Angelo Kinicki. "Organizational Culture and Organizational Effectiveness: A Meta-Analytic Investigation of the Competing Values Framework's Theoretical Suppositions." *Journal of Applied Psychology* 96, no. 4 (2011): 677–94.

- Harvey, S., R. S. Peterson, and N. Anand. "The Process of Team Boundary Spanning in Multi-Organizational Contexts." *Small Group Research* 45, no. 5 (May 19, 2014): 506–38.
- Hennessey, Beth A., and Teresa M. Amabile. "Creativity (2010 Annual Review of Psychology)." *Annual Review of Psychology* 61 (2010): 569–98.
- Heslin, Peter A. "Better than Brainstorming? Potential Contextual Boundary Conditions to Brain Writing for Idea Generation in Organizations." *Journal of Occupational and Organizational Psychology* 82 (2009): 129–45.
- Hopf, J.-M., C. N. Boehler, S. J. Luck, J. K. Tsotsos, H.-J. Heinze, and M. A. Schoenfeld. "Direct Neurophysiological Evidence for Spatial Suppression Surrounding the Focus of Attention in Vision." *Proceedings of the National Academy of Sciences* 103, no. 4 (January 12, 2006): 1053–58.
- Hughes, Robert W, Mark J Hurlstone, John E Marsh, François Vachon, and Dylan M Jones. "Cognitive Control of Auditory Distraction: Impact of Task Difficulty, Foreknowledge, and Working Memory Capacity Supports Duplex-Mechanism Account." *Journal of Experimental Psychology Human Perception & Performance* 39, no. 2 (2013): 539–53..
- Jackson, Joshua J., Patrick L. Hill, Brennan R. Payne, Brent W. Roberts, and Elizabeth A. L. Stine-Morrow. "Can an Old Dog Learn (and Want to Experience) New Tricks? Cognitive Training Increases Openness to Experience in Older Adults." *Psychology and Aging* 27, no. 2 (2012): 286–92.
- Johnson, Beck. "Research Brief: Good Stress, Bad Stress, and High Focus Work Performance." Holland, MI, 2017.
- Jung, Rex E., Judith M. Segall, H. Jeremy Bockholt, Rane A. Flores, Shirley M. Smith, Robert S. Chavez, and Richard J. Haier. "Neuroanatomy of Creativity." *Human Brain Mapping* 31, no. 3 (2009): NA-NA.
- Jung, Rex E, Brittany S Mead, Jessica Carrasco, and Rane A Flores. "The Structure of Creative Cognition in the Human Brain." *Frontiers in Human Neuroscience* 7 (January 2013): 330.
- Jung, Rex E, Judith M Segall, H Jeremy Bockholt, Rane A Flores, Shirley M Smith, Robert S Chavez, and Richard J Haier. "Neuroanatomy of Creativity." *Human Brain Mapping* 31, no. 3 (March 2010): 398–409.
- Kaufman, Scott Barry, and Carolyn Gregoire. *Wired to Create: Unraveling the Mysteries of The Creative Mind*. New York, NY: Perigee, 2015.
- Kaufman, Scott Barry. "Opening up Openness to Experience: A Four-Factor Model and Relations to Creative Achievement in the Arts and Sciences." *The Journal of Creative Behavior* 47, no. 4 (December 1, 2013): 233–55.
- Kaufman, Scott Barry, Lena C. Quilty, Rachael G. Grazioplene, Jacob B. Hirsh, Jeremy R. Gray, Jordan B. Peterson, and Colin G. DeYoung. "Openness to Experience and Intellect Differentially Predict Creative Achievement in the Arts and Sciences." *Journal of Personality* 84, no. 2 (April 2016): 248–58.
- Keller, Johannes, and Herbert Bless. "Flow and Regulatory Compatibility: An Experimental Approach to the Flow Model of Intrinsic Motivation." *Personality and Social Psychology Bulletin* 34, no. 2 (2008): 196–209.
- Kiyonaga, Anastasia, Tobias Egner, and David Soto. "Cognitive Control over Working Memory Biases of Selection." *Psychonomic Bulletin & Review* 19, no. 4 (August 2012): 639–46.
- Knight, Andrew P., and Markus Baer. "Get Up, Stand Up: The Effects of a Non-Sedentary Workspace on Information Elaboration and Group Performance." *Social Psychological and Personality Science* 5, no. 8 (November 1, 2014): 910–17.
- Kool, Wouter, Amitai Shenhav, and Matthew M. Botvinick. "Cognitive Control as Cost-Benefit Decision Making." In *The Wiley Handbook of Cognitive Control*, edited by Tobias Egner, 167–89. Chichester, UK: John Wiley & Sons, Ltd., 2017.
- Knight, Robert T., W. Richard Staines, Diane Swick, and Linda L. Chao. "Prefrontal Cortex Regulates Inhibition and Excitation in Distributed Neural Networks." *Acta Psychologica* 101, no. 2–3 (April 1999): 159–78.
- Krimsky, Marissa, Daniel E. Forster, Maria M. Llabre, and Amishi P. Jha. "The Influence of Time on Task on Mind Wandering and Visual Working Memory." *Cognition* 169 (December 2017). Elsevier: 84–90.
- Kupritz, Virginia W. "The Communicative Nature of Space in Organizations." In *Cultural Influences on Architecture*, 58–89. IGI Global, 2017.
- Lavie, Nilli, Aleksandra Hirst, Jan W. de Fockert, and Essi Viding. "Load Theory of Selective Attention and Cognitive Control." *Journal of Experimental Psychology: General* 133, no. 3 (2004): 339–54.
- Lin, Chin-Teng, Chun-Hsiang Chuang, Scott Kerick, Tim Mullen, Tzyy-Ping Jung, Li-Wei Ko, Shi-An Chen, Jung-Tai King, and Kaleb Mcdowell. "Mind-Wandering Tends to Occur Under Low Perceptual Demands During Driving." *Scientific Reports* 6 (2016): 21353.
- Madrid, Hector P., and Malcolm G. Patterson. "Creativity at Work as a Joint Function between Openness to Experience, Need for Cognition and Organizational Fairness." *Learning and Individual Differences* 51, no. October (August 2016): 409–16.



- McCabe, David P, Henry L Roediger III, Mark A Mcdaniel, David A Balota, and David Z Hambrick. "The Relationship Between Working Memory Capacity and Executive Functioning: Evidence for a Common Executive Attention Construct." *Neuropsychology* 24, no. 2 (2010): 222–43.
- McMillan, Rebecca L., Scott Barry Kaufman, and Jerome L. Singer. "Ode to Positive Constructive Daydreaming." *Frontiers in Psychology* 4 (2013): 626.
- Mehta, Ravi, Rui (Juliet) Zhu, and Amar Cheema. "Is Noise Always Bad? Exploring the Effects of Ambient Noise on Creative Cognition." *Journal of Consumer Research* 39, no. 4 (December 1, 2012): 784–99.
- Menon, Vinod. "Salience Network." *Brain Mapping: An Encyclopedic Reference* 2 (2015): 597–611.
- Menon, Vinod, and Lucina Q. Uddin. "Saliency, Switching, Attention and Control: A Network Model of Insula Function." *Brain Structure & Function* 214, no. 5–6 (June 2010): 655–67.
- Miller, Rex, Mabel Casey, and Mark Konchar. *Change Your Space, Change Your Culture*. 1st ed. Hoboken, NJ: Wiley-Blackwell, 2014.
- Nagy, Gabor, Michael O'Neill, Beck Johnson, and Mike Bahr. "Designing for Focus Work." Holland, MI: Haworth, Inc., 2016.
- O'Neill, Michael. "Workspace Design and the Pursuit of Happiness." Holland, MI: Haworth, Inc., 2017.
- O'Neill, Michael. "The Emerging Need for Legibility in Workplace Design." Holland, MI: Haworth, Inc., 2016.
- Oosterwijk, Suzanne, Alexandra Touroutoglou, and Kristen A. Lindquist. "The Neuroscience of Construction." In *The Psychological Construction of Emotion*, edited by Lisa Feldman Barrett and James A. Russell, 111–43. New York, New York, USA: Guilford, 2015.
- Perry-Smith, Jill E., and Christina E. Shalley. "The Social Side of Creativity: A Static and Dynamic Social Network Perspective." *The Academy of Management Review* 28, no. 1 (2003): 89–106.
- Randall, Jason G., Frederick L. Oswald, and Margaret E. Beier. "Mind-Wandering, Cognition, and Performance: A Theory-Driven Meta-Analysis of Attention Regulation." *Psychological Bulletin* 140, no. 6 (2014): 1411–31.
- Rief, Stefan, Klaus-Peter Stiefel, Agnes Weiss, Gabor Nagy, and Beck Johnson. "Harnessing the Potential of the Coworking." Holland, MI: Haworth, Inc., 2016.
- Sailer, Kerstin. "Organizational Learning and Physical Space: How Office Configurations Inform Organizational Behaviors." In *Learning Organizations*, edited by Ariane Berthoin, Peter Meusbürger, and Laura Suarsana, 103–27. Springer Netherlands, 2014.
- Sawyer, R. Keith. *Explaining Creativity: The Science of Human Innovation*. 2nd ed. New York, New York, USA: Oxford University Press, 2012.
- . *Group Genius: The Creative Power of Collaboration*. Philadelphia, PA: Persus Books, 2007.
- Scott Barry Kaufman. "The Controlled Chaos of Creativity." *Scientific American*. New York, NY, June 2014.
- Simon, Sharon S., Erich S. Tusch, Phillip J. Holcomb, and Kirk R. Daffner. "Increasing Working Memory Load Reduces Processing of Cross-Modal Task-Irrelevant Stimuli Even after Controlling for Task Difficulty and Executive Capacity." *Frontiers in Human Neuroscience* 10 (380). Frontiers (2016): 1–13.
- Smallwood, Jonathan, Kevin Brown, Ben Baird, and Jonathan W. Schooler. "Cooperation between the Default Mode Network and the Frontal–parietal Network in the Production of an Internal Train of Thought." *Brain Research* 1428 (January 2012): 60–70.
- Sörqvist, Patrik, Stefan Stenfelt, and Jerker Rönnerberg. "Working Memory Capacity and Visual-Verbal Cognitive Load Modulate Auditory-Sensory Gating in the Brainstem: Toward a Unified View of Attention." *Journal of Cognitive Neuroscience* 24, no. 11 (November 28, 2012): 2147–54.
- Tompson, Alexa, and Lila Davachi. "Consolidation Promotes the Emergence of Representational Overlap in the Hippocampus and Medial Prefrontal Cortex." *Neuron* 96, no. 1 (2017): 228–41.
- Vannucci, Manila, Claudia Pelagatti, and Igor Marchetti. "Manipulating Cues in Mind Wandering: Verbal Cues Affect the Frequency and the Temporal Focus of Mind Wandering." *Consciousness and Cognition* 53 (August 1, 2017): 61–69.
- Vartanian, Oshin, Fethi Bouak, J L Caldwell, Bob Cheung, Gerald Cupchik, Marie-Eve Jobidon, Quan Lam, et al. "The Effects of a Single Night of Sleep Deprivation on Fluency and Prefrontal Cortex Function during Divergent Thinking." *Frontiers in Human Neuroscience* 8 (2014): 214.
- Vatansever, Deniz, David K. Menon, and Emmanuel A. Stamatakis. "Default Mode Contributions to Automated Information Processing." *Proceedings of the National Academy of Sciences* October (October 23, 2017): 201710521.
- Weisman, J. "Evaluating Architectural Legibility: Way-Finding in the Built Environment." *Environment and Behavior* 13, no. 2 (March 1, 1981): 189–204.
- wiruchnipawan, wannawiruch. "Unexpected Distractions: Stimulation or Disruption to Creativity." Harvard University, 2015.
- Yerkes, Robert M., and John D. Dodson. "The Relation of Strength of Stimulus to Rapidity of Habit-Formation." *Journal of Comparative Neurology and Psychology* 18, no. 5 (November 1, 1908): 459–82.

Yoruk, Sureyya, and Mark Runco. "The Neuroscience of Divergent Thinking." *ANS: The Journal for Neurocognitive Research*, 2014.

Zelazo, Philip David. "Executive Function: Reflection, Iterative Reprocessing, Complexity, and the Developing Brain." *Developmental Review* 38 (2015): 55–68.

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