Creativity in the Brain

Creativity can often feel spontaneous and out of our control. It can hit us all at once, seemingly coming out of nowhere. Then there’s writer’s block. The struggling, uninspired artist. The elusive solution. Scientists have long been trying to understand creativity by uncovering its biological basis. What is happening in the brain when we have that lightbulb moment? To tackle that question, we first have to ask: what needs to happen in the brain to switch on the light?

There are several processes that come together in a moment of creativity. Let’s take a challenge that is typical in the days leading up to a grocery store run: what meal can you make out of what you have in your house already? One process that is going to be engaged is memory. It could be helpful to remember meals you’ve made in the past, recipes you’ve read, and what you have left in your pantry. Another process that is engaged is attention. Attention is important to help us filter through the nearly infinite things we could be considering in any moment. When trying to come up with your meal for the night, you want to be focusing on the relevant ingredients and ideas (and not get distracted by the jar of expired olives or the thing for work you still need to finish up). The third process involved in creativity is cognitive control, which helps coordinate memory and attention while holding onto the ultimate goal (in this case tonight’s meal). Its relationship to creativity is a little complicated – you need at least some cognitive control to be able to problem solve, but too much may actually get in the way of creativity.

There are a couple of theories about what is happening in the brain during the creative process. One (called the embodied theory of creativity) is that the motor system is important with helping us generate ideas. This concept is rooted in evolutionary theories – humans have been figuring out how to use tools for a long, long time. Whether it is how to get two rocks to spark a fire or how to play a chord on a guitar, people have consistently engaged with objects to achieve goals in all kinds of contexts. There are regions in the brain that help us plan and carry out motor functions like playing the guitar. Interestingly, studies have shown that these brain regions can be active even without movement. The embodied theory of creativity argues that before we can take a creative action, we first activate these brain regions to simulate possible actions and movements we could take. The same motor systems that allow us to ultimately take the action can run through the different possibilities without us needing to move at all. Studies of creativity have found that motor systems in the brain are active during certain types of creative tasks, like imagining or creating a musical improvisation (1). Even more compellingly, in a study with jazz musicians, researchers altered activity in the brain area that send signals to our muscles to take an action (called primary motor cortex). When this region was stimulated, enhancing its function, the musician’s solos became more creative (1,2). This study suggests that the motor system not only helps us complete actions but also helps us to produce creative actions.

Another theory of creativity is the disinhibition theory. This theory suggests that having less cognitive control leads to greater creativity. Cognitive control is what allows us to complete complex tasks by suppressing action and attention not related to the goal at

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hand. It also allows for the selection of information that is relevant to the task and the initiation of processes that are necessary to complete it. For example, think about what happens once you finally get to the grocery store to get materials for dinner. Cognitive control is what allows you to ignore the birthday cakes and focus on the food items that you might need for dinner. It also allows you to think about the last time you made this meal, focusing on the ingredients you used and not the other details of making the meal, like whether were you tired from a long day or what music was playing while you cooked. Disinhibition theory argues that less cognitive control is what allows for creativity. Too much cognitive control can make you rigid and not open to other creative options. For instance, say you are following a recipe but don’t have one of the ingredients – too much cognitive control might get in the way of finding a good substitute as you are so stuck on following the recipe exactly. There is quite of bit of research that backs up this theory, including studies with patients that have damage to their frontal lobes (an area in the front of the brain that is generally responsible for cognitive control) and studies in healthy people. In multiple cases, damage to the frontal lobe area led to greater creativity and interest in art (3). Studies with healthy people without damage found that decreased thickness of the left frontal lobe was associated with more creativity (3). Also, temporarily increasing the activity of the lateral prefrontal cortex, another region involved in cognitive control, decreased how creative and novel people were in completing a task (4).

Over the past several decades, research on how creativity works in the brain has developed rapidly. Scientists are still learning about how attention, memory, and cognitive control come together to create those magic lightbulb moments. So far, it seems like there may be some unexpected brain areas involved (like those involved in movement) and that a balance of just enough cognitive control may be required. As neuroscientists uncover more about the creative processes in the brain, hopefully we will be able to maximize our chances to solve life’s problems, big and small.

References: