How Our Brain Preserves Our Sense of Self

One brain region is crucial for our ability to form and maintain a consistent identity both now and when thinking about the future

We are all time travelers. Every day we experience new things as we travel forward through time. As we do, the countless connections between the nerve cells in our brain recalibrate to accommodate these experiences. It's as if we reassemble ourselves daily, maintaining a mental construct of ourselves in physical time, and the glue that holds

together our core identity is memory.

Our travels are not limited to physical time. We also experience mental time travel. We visit the past through our memories and then journey into the future by imagining what tomorrow or next year might bring. When we do so, we think of ourselves as we are now, remember who we once were and imagine how we will be.

A study, published in the journal *Social Cognitive and Affective Neuroscience* (*SCAN*), explores how one particular brain region helps to knit together memories of the present and future self. When people sustain an injury to that area, it leads to an impaired sense of identity. The region—called the ventral medial prefrontal cortex (vmPFC)—may produce a fundamental model of oneself and place it in mental time. When the region does so, this study suggests, it may be the source of our sense of self.

Psychologists have long noticed that a person's mind handles information about oneself differently from other details. Memories that reference the self are easier to recall than other forms of memory. They benefit from what researchers have called a self-reference effect (SRE), in which information related to oneself is privileged and more salient in our thoughts. Self-related memories are distinct from both episodic memory, the category of recollections that pertains to specific events and experiences, and

semantic memory, which connects to more general knowledge, such as the color of grass and the characteristics of the seasons.

SREs, then, are a way to investigate how our sense of self emerges from the workings of the brain—something that multiple research groups have studied intensely. For example, previous research employed functional magnetic resonance imaging (fMRI), a method that uses blood flow and oxygen consumption in specific brain areas as a measure of neural activity, to identify regions that were activated by self-reference. These studies identified the medial prefrontal cortex (mPFC) as a brain region related to self-thought.

This area, the mPFC, can be further divided into upper and lower regions (called dorsal and ventral, respectively), and it turns out that each one makes different contributions to self-related thought. The dorsal section plays a role in distinguishing self from other and appears to be task-related, whereas the ventral section, the vmPFC, contributes more to emotional processing.

In the *SCAN* study, the researchers used the self-reference effect to assess memories of present and future selves among people who had brain lesions to the vmPFC. The scientists worked with seven people who had lesions to this area and then compared them with a control group made up

of eight people with injuries to other parts of the brain, as well as 23 healthy individuals without brain injuries. By comparing these groups, the scientists could investigate whether brain lesions in general or those to the vmPFC specifically might affect SREs. All people in the study underwent a thorough neuropsychological evaluation, which confirmed that they were within normal ranges for a variety of cognitive assessments, including measures of verbal fluency and spatial short-term memory. The researchers then asked the participants to list adjectives to describe themselves and a well-known celebrity, both in the present and 10 years in the future. Later, the participants had to recall these same traits.

The researchers discovered that people in their control group could recall more adjectives linked to themselves in the present and future than adjectives linked to the celebrity. In other words, scientists found that the self-reference effect extends to both the future and the present self. Although there was some variation in the group—people with brain injuries to areas other than the vmPFC were somewhat less able to recall details about their future self when compared with healthy participants—the self-reference effect still held true.

Results were distinctly different, however, for the participants with injuries to the vmPFC. People with lesions

in this area had little or no ability to recall references to the self, regardless of the context of time. Their identification of adjectives for celebrities in the present or future was also significantly impaired when compared with the rest of the participants' responses. In addition, people with vmPFC lesions had less confidence about an individual's ability to possess traits than other people in the study. All of this evidence points to a central role for the vmPFC in the formation and maintenance of identity.

The new findings are intriguing for several reasons. Brain lesions can help us understand the normal function of the region involved. Lesions of the vmPFC are associated with altered personality, blunted emotions, and a number of changes in emotional and executive function. Injury to this area is most often associated with confabulations: false memories that people recite to listeners with great confidence. Although it may be tempting for someone to view confabulations as deliberate or creative falsehoods, people who tell them actually are unaware that their stories are false. Instead it is possible their confusion could stem from misfunctioning memory retrieval and monitoring mechanisms.

More broadly, the study helps us understand how self-related memories—recollections key to maintaining our core sense of identity—depend on the function of the vmPFC. But

what about our past selves? Curiously, in previous studies that asked people to consider their past selves, there was no more activation of the mPFC than when considering someone else. Our past selves seem foreign to us, as if they were individuals apart from us.

One idea that scientists have put forward to understand this distinction is that perhaps we are not very kind in our judgments of our past selves. Instead we may be rather critical and harshly judgmental of our previous behavior, emotions and personal traits. In these situations, we may use our past primarily to construct a more positive self-image in the present. Put another way, because we may recognize flaws in our past self's behavior, we tend to distance ourselves from the person we once were.

Bringing the present and future into the spotlight, then, is central to understanding the way our brain and thoughts build our current identities. In many ways, it makes sense that the mPFC is important in this process of recalling present details and imagining future ones that build on our recollections. The prefrontal cortex, including the mPFC and its subdivisions, forms a network in the brain that is involved

in future planning. That network also includes the hippocampus, a brain structure that is central to episodic memory formation and that can track moments as sequential events in time. In past work, researchers have found that manipulating the activity of the hippocampus alters creative and future imaginings, which suggests an important role for brain structures supporting memory in imagining the future. In fact, although we often think of memory as the brain's accurate and dispassionate recording device, some scholars have characterized it as a form of imagination.

Future thought is a vital component of being human. Its importance in our culture is embodied in the mythological figure and pre-Olympian god Prometheus (whose name means “fore-thinker”), patron of the arts and sciences. According to Greek legend, he shaped humans out of clay and bestowed them with fire and the skills of craftsmanship. These are acts that illustrate the power of imagining a novel future. Although there is debate as to whether thinking about the future is an exclusively human feature—birds such as Western Scrub-Jays, for example, appear to anticipate and plan for future food needs—it is clear that future thought has played a significant role in human evolution. This ability may have contributed to the development of language, and it has a key part in human interactions, where the vmPFC is central to evaluating and taking advantage of social context.

Now, thanks to this new research, we have a better idea than ever about the way a small region within our brains is able to build and hold this core ability to maintain our identity.