Researchers show how positive stimuli provide benefits to the distracted brain

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Researchers at the Beckman Institute at the University of Illinois have identified how your mind processes and differentiates between positive and negative distractions when you're trying to get a job done. Credit: Julie McMahon

You're walking up your driveway, laden down with groceries, your cell phone glued to your ear. Your mother has just shared your elderly aunt's phone number, and you're repeating it as you walk to the door of your house. Suddenly a stray dog, barking and snarling, races across the lawn. Are you able to remember the number?

Rewind the situation and, instead of the barking dog, see a cute puppy bounding across the yard. Do you remember the number now?

Researchers at the Beckman Institute for Advanced Science and Technology at the University of Illinois at Urbana-Champaign are investigating how your brain processes distractions when you're trying to get a job done.

Their paper, "Brain Activity and Network Interactions Linked to Valence-Related Differences in the Impact of Emotional Distraction," was recently published in *Cerebral Cortex*.

According to Alexandru Iordan, graduate student in neuroscience and co-author of the paper, most studies have concentrated on how negative distractions (the barking dog) impact our ability to complete a task. But few studies have focused on how positive distractions (the cute puppy) impact that ability.

"We knew from previous investigations that negative distractions interfere with our ability to stay focused on the task at hand," said Iordan. "However, we didn't know what happens with positive distractions in terms of performance and the brain mechanisms."

The research, led by Florin Dolcos, assistant professor of psychology at Illinois and member of Beckman's Cognitive Neuroscience Group, not only investigated the difference between positive and negative distractions, but also used the MRI machines at the Biomedical Imaging

Center (BIC) in the Beckman Institute to evaluate how the brain responds during these distractions.

Study participants were shown a series of images of people's faces and were asked to hold them in mind for a few seconds. After a short delay, they were asked to indicate if they had seen specific faces or not. During the delay, the participants were shown a mixture of positive, neutral, and negative images; the negative and positive images were selected to produce overall similarly intense responses.

The brain responses were recorded to evaluate which parts of the brain were activated when the distracting images were shown.

The findings indicate that both positive and negative images affect the brain, but that positive distractions are linked to increased performance, compared with negative distraction. In other words, seeing the cute puppy grabs your attention, but will not interfere with completing the task at hand (remembering your aunt's phone number).

"The main result is that the positive distractions do not interfere with working memory performance," said Iordan, "in fact, they actually help compared to the negative distractions, even though they may produce equally intense emotional responses."

The explanation for this lies in the way our brains are hard-wired. "Positive stimuli are less imperative than the negative ones, because the immediate costs of not paying attention to them are typically smaller. For instance, evolutionarily, not paying attention to a potential food source is usually less dramatic than not paying attention to something dangerous, like a predator," said Dolcos.

Consistent with this idea, the study found changes in two brain regions that are involved in working memory and attention, the dorso-lateral

prefrontal and the lateral parietal cortices.

"These areas stay in tune with each other when we try to keep information active in our mind," Iordan explained.

"Negative distractions strongly reduced activity in these regions. However, positive distractions had less impact on activity in these regions and increased activity in the ventro-lateral prefrontal cortex, an area associated with emotion control. This may explain why we perform better under positive distraction—because those distractions have less detrimental effects in brain areas involved in the ability to stay focused on the tasks at hand, and they increase activity in areas that are helping us to cope with distraction," said Iordan.

Another brain region, the medial prefrontal cortex, also showed responses consistent with this difference in urgency between positive and negative stimuli. "The medial prefrontal cortex is involved in emotion and self-referential processing. Here, we've seen that the responses to the negative stimuli occurred slightly earlier than the responses to the positive ones," added Iordan.

The effects were visible also in the way these different brain regions communicated with each other. "One fascinating thing about the brain is that the same region may behave differently in different contexts," said Iordan. "It's not only about what a brain region itself does, but also about how a brain region communicates with other regions in specific contexts—and this influences our behavior."

The researchers found that the medial prefrontal and the lateral parietal cortices behaved differently when subjects viewed negative as opposed to positive distractors.

"We found that the medial prefrontal cortex communicated more with

the lateral parietal cortex under negative distraction. This increased communication does not usually happen during such tasks, because these two regions are part of different brain networks. This might also explain why negative stimuli were more impairing to working memory performance," said Iordan.

By identifying the activity in these regions, the researchers hope that they can develop methods to help those who have emotional disorders such as anxiety or depression. Dolcos hopes that future research will create training to change the response of these areas of the brain, in order to prevent clinical depression and anxiety.

"These areas, together with others identified in our research, could be used as markers to be monitored in interventions that target improved responses that reduce the impact of emotional challenges," said Dolcos. "It is important to find such markers for both positive and negative emotions, because they are both changed in depression and anxiety, which are characterized by increased sensitivity to negative emotions and reduced response to positive emotions.

"At the end of the day, we want to find ways to help people feel good. That's why we work on both aspects, enhance the positive and reduce the negative emotions, to stay healthy. Also, a lot of what we do in our research is about prevention. We can identify such markers in people who are healthy but might be at risk, and then target these markers in interventions. We all know that, in the long run, we are better off also preventing than intervening only when people are already sick. This is also the case with emotional disorders, such as depression and anxiety" Dolcos said.

More information: *Cerebral Cortex*, cercor.oxfordjournals.org/cont … rcor.bhv242.abstract

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