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Neurohistory in the Laboratory

The following abstract presents the results of an experiment conducted in conjunction with the neurohistory workshop at the Rachel Carson Center for Environment and Society on 6–7 June 2011.

Brain activity can provide important clues about how we are affected by various stimuli, because different parts of the brain will be activated in response to different emotional and cognitive demands. This study was concerned with investigating what influence environment has on our mental states. In this case, the participants were not exposed to different environments directly, but rather asked to visualize environments with particularly strong positive or negative associations for them. For example, a positive environment might be a sunny balcony in summer and a negative environment might be a crowded subway car in winter.

Insights from such studies could be useful for helping improve environments—whether in hospitals or at the workplace—so that they have a more positive effect on our well-being. Likewise, knowledge about how people respond to their surroundings may be applied in a historical context to human interaction with natural and artificial environments of the past.

This experiment used functional magnetic resonance imaging (fMRI) to record brain activity while participants visualized different environments. The technology measures changes in oxygen-rich vs. oxygen-poor blood in the brain to determine which areas are being activated. In this experiment, activated regions included the visual cortex, which processes visual information, and the supplementary motor area, which is involved with controlling movement. The left prefrontal cortex, which is involved with certain functions of language, memory, and emotion, was also important.

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Cognitive Demands on Brains Fall as Healing Properties of Environments Rise: Evidence from fMRI

There is a growing body of evidence indicating the impact of environment on restoration from stress and illness, as well as on the recovery tempo after injuries and surgeries. To maximize the healing qualities of an environment, we need to better understand its cognitive, emotional, and neural effects on people. In the present study we wanted to go beyond existing behavioral and physiological measures (such as the correlation between the type of scenery visible from a hospital patient's room and the rate of recovery from illness), creating a link between field research on optimal healing environments and brain research using fMRI technology. We based our study on a paradigm involving mental imagery. Prior to the main experiment, all participants imagined and described in writing the phenomenological characteristics of a (1) beneficial and a (2) non-beneficial environment that was part of their episodic memory. We are interested in the impact of environments on healthy people as well as those who are sick, so we asked subjects to imagine beneficial environments. (All subjects spoke German, so we used *wohltuend* and *nicht wohltuend*.) Analyses revealed common activations in the visual cortex (VC) and in the supplementary motor area (SMA) for both conditions. An additional activation of the left prefrontal cortex (LPFC) was observed for the "non-beneficial" condition. Activations in the VC and SMA probably correspond to the mental imagery processing specific to visual and motor modalities. We suggest that imagining a "non-beneficial" scenario requires additional neural processing. Additionally, since the left prefrontal cortex may play a role in inhibiting negative emotions, the observed activation in the "non-beneficial" condition may also be an indicator of emotion regulation strategy. Lack of the activation in LPFC in the "beneficial" condition could be understood as a cortical relief, suggesting that human beings may find some environments more health promoting than others because the former place fewer psychological and energetic demands on the cortex.

Keywords: optimal healing environment, mental imagery, cognition, functional magnetic resonance imaging