The cerebral cortex changes with cognitive training

An international research project coordinated by Universidad Autónoma de Madrid has revealed that the brain changes physically in response to a cognitive training programme. The results, published in the journal *Brain Structure and Function*, reveal that individuals with a lower capacity benefited most.

Image: UAM

Changes after training in the cortical surface area
Division of the cortex into regions, according to the differential genetic influence
Changes after training on the surface and cortical thickness
Changes after training in the cortical thickness

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A research project coordinated by Universidad Autónoma de Madrid (UAM), with the participation of scientists from the Complutense University, Pompeu Fabra University, the Montreal Neurological Institute (Canada) and the University of California (USA), analysed the psychological and biological consequences of adapted cognitive training.

Using training sessions designed to stimulate the cognitive processes involved in short-term memory, the scientists observed contingent changes in the physical structure of the brain.
Specifically, they recorded a significant increase in the surface area and the thickness of the cerebral cortex in certain regions of the frontal and temporal lobes.

In accordance with the study, published in *Brain Structure and Function*, the regions where these changes were noted support the psychological processes needed to successfully complete the training sessions: short-term memory and resistance to interference and inhibition.

In addition, the researchers found that the individuals with a lower cognitive capacity benefited to a greater extent from the training, as their brains responded with greater intensity. In contrast, the brains of individuals with a greater cognitive capacity responded weakly to the training.

According to the authors, these results highlight the need to know the cognitive resources of an individual to help design training adapted to his or her personal characteristics. “Standard training can fail because it is not matched to the characteristics of the individual,” they say.

Roberto Colom, of the department of Biological Psychology and Health at UAM, said that “although the results of this research have been obtained with healthy young people, the applications for cognitively challenged individuals are clear.”

“For example,” he continues, “the loss of cortical thickness that occurs spontaneously with age could be lessened by personalized cognitive training programmes. Certain symptoms associated with disorders such as schizophrenia could also improve with short-term memory training.”

**Individualised training**

In this research, a group of healthy young people completed an exhaustive battery of twelve psychological tests before and after the cognitive training. The training took place over twelve weeks of intense individually supervised work. Substantial improvements were observed in the levels of difficulty that were successfully overcome session by session.

Records were also obtained of structural and functional magnetic resonance at the two different points in time, i.e. before and after training. The images of the brains of the participants were divided into a number of genetically significant regions and the changes in those subjects who had trained and the control group were then calculated. The comparison revealed the structural changes in the brain explained above (see diagram).

“Recent general criticism on the lack of effectiveness of the cognitive training programmes should not be applied directly to basic research. Complaints from a section of the scientific community have been focused on commercial programmes that claim to improve
intelligence or prevent degenerative disorders, but are not based on established facts," explains Colom.

“It should be stressed that the programmes should be personalised, adapted to the individual, if they are to be effective," he adds.

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