

Brain scans reveal clues to black belt punching power

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'Punch', by Adam J. Merton on Flickr.

(Medical Xpress) -- Brain scans have revealed distinctive features in the brain structure of karate experts that are associated with how well they performed in a test of punching ability. It's thought the findings could explain how black belts are able to punch powerfully from close range.

Karate experts are able to generate extremely powerful forces with their punches, but how they do this is not fully understood. Previous studies have found that the force generated in a karate punch is not determined by muscular strength, suggesting that factors related to the control of muscle movement by the [brain](#) might be important.

Researchers from Imperial College London and UCL looked for differences in [brain structure](#) between 12 karate practitioners with a black belt rank and an average of 13.8 years' karate experience, and 12 people of similar age who exercised regularly but did not have any martial arts experience.

The researchers tested how powerfully the subjects could punch, but to make useful comparisons with the punching of novices they restricted the task to punching from short range - a distance of 5 cm.

As expected, the karate group punched harder. The power of their punches seemed to be down to timing: the force they generated correlated with how well the movement of their wrists and shoulders were synchronised.

Dr Ed Roberts, from the Department of Medicine at Imperial College London, who led the study, explained: "The karate black belts were able to repeatedly coordinate their punching action with a level of coordination that novices can't produce. We think that ability might be related to fine-tuning of neural connections in the cerebellum, allowing them to synchronise their arm and trunk movements very accurately."

[Brain scans](#) showed that the microscopic structure in certain regions of the brain differed between the two groups. Each brain region is composed of grey matter, consisting of the main bodies of nerve cells, and white matter, which is mainly made up of bundles of fibres that carry signals from one region to another.

The scans used in this study, called diffusion tensor imaging (DTI), detected structural differences in the white matter of parts of the brain called the cerebellum and the primary motor cortex, which are known to be involved in controlling movement. The differences measured by DTI in the cerebellum correlated with the synchronicity of the subjects' wrist and shoulder movements when punching.

The DTI signal also correlated with the age at which karate experts began training and their total experience of the discipline. These findings suggest that the structural differences in the brain are related to the black belts' punching ability.

"We're only just beginning to understand the relationship between brain structure and behaviour, but our findings are consistent with earlier research showing that the cerebellum plays a critical role in our ability to produce complex, coordinated movements," added Dr Roberts.

"There are several factors that can affect the DTI signal, so we can't say exactly what features of the white matter these differences correspond to. Further studies using more advanced techniques will give us a clearer picture."

The study was supported by the Medical Research Council, the Wellcome Trust, and the National Institute for Health Research Biomedical Research Centre at University College London Hospitals NHS Foundation Trust and University College London.

The findings are published today in the journal *Cerebral Cortex*.

Video: Martial Arts and the Mind

For a different take on the relationship between martial arts and the brain, watch the short Wellcome Collection film 'Martial Arts and the Mind'.

Many people think martial arts are solely about honing your fighting abilities, but could they really be more about developing the mind? The film features interviews with Tai Chi, Hapkido and Taekwondo practitioners, as well as a scientist and clinician who has been putting these ideas into practice when working with people with mental health issues.

More information: Roberts RE et al. Individuals differences in expert motor coordination associated with white matter microstructure in the cerebellum. *Cereb Cortex* 2012 (epub ahead of print).

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