Press Release

Give and Take: How We Recognise Interactions

Tübingen neuroscientists investigate how actions that relate between individuals are recognised and represented in the brain

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Social behaviour relies on interactions with others. How does our brain perceive and process these interactions? Until recently, psychologists and neuroscientists have mainly investigated the neuronal processing of individual actions. A team of neuroscientists of three Tübingen research institutes has now shown that social interactions are represented as pairs of actions of the interacting partners in the human brain. The study, whose results may influence future autism research, will be published in *PNAS*.

Dancing, shaking hands, playing ballgames – all activities of this kind rely on interconnected action pairs of at least two persons, such as „giving and taking“ or „throwing and catching“. How does the brain process interactions in which the actions of several individuals are interrelated? Do we recognise interactions such as these by correlating the individual partners' motions on a very basic, perception-based level? Or do we first analyse their actions cognitively and attribute a meaning to them?

A collaborative study of neuroscientists belonging to the Tübingen Max Planck Institute for Biological Cybernetics (MPI BC), the Hertie Institute for Clinical Brain Research (HIH) and the Werner Reichardt Centre for Integrative Neuroscience (CIN) has tackled these questions. The researchers utilised of a virtual reality environment, in which a life-sized three-dimensional animated avatar performed various actions: some clearly recognisable as parts of an action pair, others action mixes in between. The researchers exploited an adaptation effect: unclear stimuli will be differently interpreted based on what stimuli had been in effect earlier. For instance, if probands are repeatedly shown a “giving” gesture and are subsequently confronted with an unclear mix of a “giving” and “throwing”, they will interpret the action mix as “throwing” in the majority of trials.

The researchers were intrigued to not only find this adaptation effect with regard to the first part of a social action sequence, such as “giving”, or “throwing”. The effect also occurred when the matching second part of the sequence was shown first: “taking” or “catching” in these instances. It appears that the very neurons responsible for representing “giving” also respond to its matching opposite “taking”. The action pair “giving-taking” is

University of Tübingen
Dr. Karl Guido Rijkhoek
Director Public Relations Department

Antje Karbe
Press Officer
Phone +49 7071 29-76789
antje.karbe[at]uni-tuebingen.de
www.uni-tuebingen.de/aktuell

Werner Reichardt Centre for Integrative Neuroscience (CIN)
Dr. Paul Töbelmann
Science Communication and Public Outreach
Phone +49 7071 29-89108
paul.toebelmann@cin.uni-tuebingen.de
www.cin.uni-tuebingen.de

Max Planck Institut for Biological Cybernetics
Beate Fülle
Head of Communications
Telefon +49 7071-601 777
beate.fuelle@tuebingen.mpg.de
www.kyb.tuebingen.mpg.de

Hertie Institute for Clinical Brain Research (HIH)
Dr. Mareike Kardinal
Head of Communications
Telefon +49 7071 29-88800
mareike.kardinal@medizin.uni-tuebingen.de
www.hih-tuebingen.de

represented as one unit in the brain. Further control experiments showed that only those actions which are part of a matching pair will trigger the above-mentioned adaptation effect, while completely different actions such as “dancing” will not.

“In the human brain, giving and taking are represented together”, affirms Stephan de la Rosa fro, the MPI for Biological Cybernetic, who conceived the study and performed the experiments together with Leonid Fedorov (HIH/CIN). “Our results show that there are neurons that very likely respond similarly to both halves of an action pair”, says Fedorov’s supervisor Martin Giese (HIH/CIN). Concerning the impact of their findings, the authors are optimistic: “In many autistic disorders, the perception of social interactions such as those we have investigated here is impaired. We believe that our results may be an important step on the way to a better understanding of these socio-cognitive disorders.”

In the study, the sequence of actions such as 'catch' (left) and 'take' (right) was morphed, i.e. offset against each other. The researchers took advantage of the effect that the perception of a morph (middle left, middle right) changes after either 'taking' or' catching' was considered longer. Image: S. de la Rosa

Short interview about the publication: http://www.kyb.tuebingen.mpg.de/press-news-and-events/meet-your-scientist/stephan-de-la-rosa.html

Publication: Leonid Fedorov, Dong-Seon Chang, Martin Giese, Heinrich Bülthoff, Stephan de la Rosa: Adaptation Aftereffects Reveal Representations for Encoding of Contingent Social Actions. *Proceedings of the National Academy of Sciences* (in press).

Author contact:
Dr. Stephan de la Rosa
Max Planck Institute for Biological Cybernetics
Tel.: +49 (0)7071 601 606
delarosa@tuebingen.mpg.de

Prof. Dr. Martin Giese
Hertie Institute for Clinical Brain Research (HIH) / Werner Reichardt Centrum Centre for Integrative Neuroscience (CIN)
Tel.: +49 7071 29-89124
martin.giese@uni-tuebingen.de

The University of Tübingen
The University of Tübingen is one of eleven universities judged excellent under the German government’s Excellence Initiative, and ranks well in international comparisons. Tübingen is one of the world’s foremost locations for neuroscientific research. Along with translational immunology and cancer research, microbiology and infection research, and molecular plant biology, it makes Tübingen a cutting-edge center of research in the Life Sciences. Further areas of core research are in Machine Learning, Geoscience and Environmental Science;

Archaeology and Anthropology; Language and Cognition; and Education and the Media. More than 27,700 students from Germany and around the world are currently enrolled at the University of Tübingen, enjoying a broad spectrum of some 300 different study programs.

The Werner Reichardt Centre for Integrative Neuroscience (CIN)
The Werner Reichardt Centre for Integrative Neuroscience (CIN) is an interdisciplinary institution at the University of Tübingen funded by the DFG's German Excellence Initiative program. Its aim is to deepen our understanding of how the brain generates functions and how brain diseases impair them, guided by the conviction that any progress in understanding can only be achieved through an integrative approach spanning multiple levels of organization.

Max-Planck-Institute for Biological Cybernetics
The Max Planck Institute for Biological Cybernetics works in the elucidation of cognitive processes. It employs about 300 people from more than 40 countries and is located at the Max Planck Campus in Tübingen, Germany. The Max Planck Institute for Biological Cybernetics is one of 84 research institutes that the Max Planck Society for the Advancement of Science maintains in Germany and abroad.

The Hertie Institute for Clinical Brain Research (HIH)
Founded in 2001, the Hertie Institute for Clinical Brain Research (HIH) was brought to life by an agreement between several entities: the non-profit Hertie Foundation, the State of Baden-Württemberg, the University of Tübingen and its Medical Faculty, and the University Hospital of Tübingen. The HIH deals with one of the most fascinating fields of today´s research: the decoding of the human brain. The main question is how certain diseases affect brain functions. In its daily work, the HIH builds the bridge from basic research to clinical application. Its goal is to facilitate new and more effective strategies for diagnosis, therapy and prevention. At present, the HIH is home to a total of 21 professors and about 380 employees.