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FACES, EMPATHY AND OWNERSHIP IN THE BRAIN

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Scientists in Switzerland and the UK have made valuable discoveries into how the human brain responds to faces, feels empathy for others, and represents the concept of the self. The researchers used functional magnetic resonance imaging (fMRI), which measures brain activity, to understand how the brain works in real time. The results, presented today (Sunday 13 July) at FENS 2008, will be relevant in disorders of social functioning such as autism and low self-esteem.

“Facial expressions play a major role in non-verbal social communication among humans and other primates,” explains Professor Patrik Vuilleumier, based at the Laboratory of Neurology & Imaging of Cognition in Geneva, Switzerland. But the way the brain responds to facial expressions is influenced by each person’s “attachment style” - the way they tend to respond to others during social interactions. There are three main types of attachment style – secure, anxious and avoidant. People with a secure attachment style tend to think their interactions with others are positive and trustful, while those with anxious attachment style may think others are hostile and tend to worry about being rejected. Those with avoidant attachment style prefer to distance themselves from others. The theory of attachment style was developed in the 1960s, but until now it’s not been clear how it relates to brain activity. “For the first time, our work has revealed differences in brain activity that may underlie these individual differences,” says Professor Vuilleumier.

Professor Vuilleumier and his team investigated the effects of attachment style by scanning participants’ brains while they took part in a game. Participants interacted with virtual partners, who were either on the same team as the participant or an opponent team. The virtual partners could either smile or look angry in response to success or failure of the participant. “Because attachment style is intimately related to the way people evaluate signs of alliance and opposition during social interactions, we predicted that attachment style might shape the affective appraisal of these facial signals,” explains Professor Vuilleumier.

This is exactly what happened. When virtual partners were perceived as allies, and smiled in response to participants’ success, brain regions involved in reward processing such as the ventral striatum and ventral tegmental areas were activated. However this activity was lower in participants with an avoidant attachment style. And when allied partners looked angry at participants’ failures, activity increased in the amygdala, which is associated with fear. “The response in the amygdala was

also influenced by personality factors, and was much stronger in participants who had an anxious attachment style," says Professor Vuilleumier. When virtual opponents smiled at failures or looked angry at success of the participant, activity increased in the superior temporal sulcus and the cingulate gyrus, areas of the brain associated with theory of mind (what others are thinking) and alertness respectively.

"These findings show for the first time that the same facial expression can produce different patterns of response in emotional brain areas when social context changes their social meaning," says Professor Vuilleumier. The work also demonstrates that attachment styles do have a basis in the brain. "These new results may ultimately help define appropriate intervention strategies in clinical disorders of attachment and social functioning, including autism and social phobias," explains Professor Vuilleumier.

Professor Tania Singer's work also has relevance to autism. She and her colleagues at the University of Zurich have been investigating empathy in patients with autism and alexithymia (a disorder that makes it difficult for sufferers to understand and describe their emotions). The team used questionnaires to assess participants' degree of alexithymia and empathy, comparing two groups: participants with autism spectrum disorder (ASD) and a control group of participants who did not have ASD. They found that participants with high alexithymia scores tended to show low empathy, regardless of whether they had ASD or not. Participants then had their brains scanned while looking at unpleasant pictures, and were told to think about their emotions during this task. The results showed that participants from both groups with high alexithymia and low empathy scores had lower brain activity in the anterior insula region of the brain, which is involved in self-reflection. "These data are interesting because they suggest that we need first to understand our own emotions to then understand the emotions of others, and that this interoceptive ability is associated with functions of the insula," says Professor Singer. "The anterior insula seems to support both the ability to represent your own feelings as well as the feeling states of others."

The results of the research also show that it is not whether a person has ASD that determines whether they have low empathy, but rather their degree of alexithymia. "We show that only alexithymic people have an empathic deficit," Professor Singer explains. "However, autistic spectrum disorder is very frequently associated with alexithymia." She plans to extend the work by investigating whether it's possible to train the brain to be more empathic. "We're using expert Buddhist monks to see which networks are involved in these empathic techniques," she says. "We're hoping to combine research on pathology, and training in normal adults, and see if we can apply training to pathologies."

At the University of Aberdeen in Scotland Professor Neil Macrae has been investigating how the concept of self is represented in the brain. "There's been a merging interest in how self-knowledge is represented in the brain, and how self influences processing of objects in the environment," explains Professor Macrae.

The concept of “self” is needed to help individuals distinguish themselves from the rest of their environment, but it’s also known that we tend to remember and like objects better when we associate them with ourselves. “That was the basis of [our work], to explore the notion that self can get extended to things that are external to oneself and our processing of these objects is influenced because of that association,” says Professor Macrae.

The team’s experiment looked at the brain activity of subjects while they sorted pictures of products found in supermarkets into two baskets – one self-owned and the other belonging to the experimenter. The brain areas involved in emotional processing were more active when participants were handling their “own” object. “The results showed that when people own objects in a quite incidental or arbitrary way, a sort of emotional association is formed between self and these items that typically produces two things: better memory for those items and activation in brain areas that are associated with emotional processing,” says Professor Macrae. “This may explain why people forge strange associations with objects that they come into association with, even objects that ostensibly have no value, because we tend to over-value or over-like things that are ours relative to things that are not.”

And this research won’t just help to explain why humans can be so obsessed with ownership – it may also tell us more about low self-esteem. “What happens to individuals who have low self-esteem or low self-worth? Do they project self to objects in the environment in the same sort of way? What sort of emotional connections might they forge with stuff in the environment?” asks Professor Macrae. He also plans to extend the research to look more closely at how self-association affects memory. “There’s a suggestion that where self-memory’s involved quite different brain regions [to those normally associated with memory] may be implicated, so we want to explore further what the identity of these regions may be in different sorts of contexts,” he says.

END

ABSTRACT A025.2, A025.3, A025.4

Notes to Editors
FENS 2008 is hosted by the Swiss Society for Neuroscience and will attract over 5,000 international delegates. The Federation of European Neuroscience Societies, founded in 1998, aims to advance research and education in neuroscience, representing neuroscience research in the European Commission and other granting bodies. FENS is the European partner of the American Society for Neuroscience. FENS represents a large number of national European neuroscience societies and has around 16000 members. http://fens2008.neurosciences.asso.fr/