



**Scientific Report on the ERNI-HSF funded workshop,
The Insular Cortex: Current status of its anatomy and function**

University of Granada, Spain

April 29th –May 1st 2010

Summary

The aim of the Insular cortex workshop was to bring together leading researchers from different aspects of scientific research on the insula cortex to discuss the current status of the research findings and ideas on the anatomy and function of the insula cortex. The workshop also provided an opportunity for in depth discussions and exchange of ideas amongst researchers on the diversity of the functions of the Insula.

The meeting included 11 oral presentations with discussion sessions and a variety of posters were on display from many of the student bursary recipients and early career research scientists. 18 students and early career researchers were awarded travel bursaries to cover the cost of their travel and accommodation to attend the workshop. There was also no registration fee for participants at the workshop, which again encouraged the attendance of early career researchers.

The workshop was held in the Carmen de la Victoria in Granada, Spain and local organisation and administration was kindly organised by Prof. Juan Lupianez of the University of Granada. Professor Stephen Jackson, Dr Chris Dijkerman and Professor Hans-Otto Karnath were also involved in organising the meeting. 68 participants attended including 9 invited speakers, 4

organisers and an ESF representative, Professor Albert Gjedde. The venue, the Carmen de la Victoria, was outstanding and an ideal location for a workshop such as this.

Scientific content and discussion

The primary aim of the workshop was to bring together a group of scientists working on the structure, function and connectivity of the insular cortex in a variety of contexts and to discuss the current state of the art in the respective fields. The contributing speakers at the workshop were from a wide range of disciplines including anatomy, physiology, neurology, psychiatry, neuropsychology and cognitive neuroscience.

The workshop began on the Thursday evening with welcome drinks and buffet. This allowed all participants of the workshop to get together and meet each other at the venue. The two opening oral presentations on Friday morning were themed on the anatomy of the insula and current research and findings. The first presentation was by Henry Evrard (Max Planck Institute, Tuebingen) who discussed architectonics and hodology of the insula in the macaque monkey. Henry discussed detailed insula anatomy and architecture and also presented some data from recent fMRI studies in the anaesthetised monkey. The second presentation was by Simon Eickhoff (Research Centre, Juelich) who gave an excellent introduction to human Insula neuroanatomy. This was followed with some data describing the histological organisation and probabilistic maps of this region. The final part of Simon's presentation described some meta-analysis data aiming to integrate the anatomical knowledge with the analysis and interpretation of functional imaging results and lesion data. Both these talks presented some new and exciting data on developments on the understanding of the anatomy of the insula cortex and promoted some interesting discussions.

Antoine Bechara (University of Southern California) unfortunately had to withdraw from the meeting at the last minute due to personal issues and so was unable to present. However, Antonio Verdejo-Garcia, a previous colleague of Antoine's and based at the University of Granada, very kindly offered to present Antoine's talk in his place. In order to accommodate this we had to reschedule the talk for later in the day and so Stephen Jackson (University of Nottingham) instead gave his talk before lunch. Stephen Jackson presented some very

interesting fMRI and connectivity analysis data from a number of studies examining the role of the insula and cingulate cortices in swallowing and the urge to tic in Tourette syndrome. Meta analysis data was also presented which again linked both the insula and cingulate cortices to several behavioural urges.

Discussions on the morning's talks carried on over lunch, which was served in the restaurant of the Carmen de la Victoria. After lunch Kristian Keysers (Netherlands Institute for Neuroscience) linked both experiencing bodily sensations and viewing those of others to areas of the anterior insula by presenting results from fMRI, DTI and connectivity analysis data. Marcel Brass (Ghent University) followed this by giving an overview of relevant brain imaging research suggesting that the anterior insular cortex is involved in the voluntary control of behaviour. In particular, he focused on the potential role of the anterior insular cortex in the intentional control of action. A tea break in the garden allowed for further discussion and was followed by the final talk of the day. This was the rescheduled presentation by Antonio Verdejo-Garcia (University of Granada). Antonio presented the data that Antoine wished to share with the audience and discussed the role of the insula in addictions. He presented some recent evidence to suggest that the insula plays a critical role in the conscious urges to take drugs.

The second day of presentations started with a discussion of somatosensory processing in the insula by Chris Dijkerman (Utrecht University). Chris gave an overview of the role of the insula in somatosensory processing in terms of body representations. He described fMRI data, lesion data and TMS data and discussed whether perceptual learning and recognition and perceptual and affective representations of our own body are independent or related. Next Catherine Reed (Claremont McKenna College) presented some neuroimaging evidence describing the role of the insula in tactile object recognition. Catherine discussed the involvement of the insula in tactile pattern discrimination and tactile object recognition from the results from both MEG and fMRI studies. The final presentation before lunch saw Manos Tsakiris (Royal Holloway, University of London) presenting some very interesting data on face recognition. Manos discussed data from a series of experiments applying the rubber hand illusion to the face.

Lunch on the second day of the workshop was again served in the restaurant of the Carmen de la Victoria and was followed by informal discussions of the morning session in the gardens. This was followed by Hans-Otto Karnath (University of Tuebingen) who provided evidence to support the hypothesis that the right insular cortex contributes to our sense of limb ownership and self-awareness of actions. Using examples from patients with a right-sided stroke, he discussed how lesion analysis techniques could be used to examine the role of the insula in human body scheme representations. One of the highlights of the meeting was the final presentation where Bud Craig (Barrow Neurological Institute) presented a whole range of functional and anatomical evidence to identify a homeostatic afferent system of awareness in the insula. This concluded the oral presentations.

10 people registered to present a poster and these were on display throughout the two days. The posters covered a broad range of topics on the insular cortex and were mainly presented by junior researchers. Participants were encouraged to discuss the posters in the tea and lunch breaks. There was also a poster presentation session scheduled at the end of the final day in the discussion session. Feedback from all involved was extremely positive and the organisers are confident that the primary aims of the meeting were met and the workshop led to a great deal of networking and scientific discussion. Researchers from diverse fields of neuroscience reviewed and discussed the converging evidence on insular function and the role of the insular cortex in human behaviour.

On Sunday 2nd May, immediately following the insula cortex workshop, a one-day workshop on the neural and cognitive basis of hallucinations was also held in the Carmen de la Victoria, Granada. This workshop was organised by Martine van Zandvoort and Chris Dijkerman.

Programme

Thursday 29/4/10

19.00 Welcome Reception
Gardens of the Carmen de la Victoria

Friday 30/4/10

09.30 Opening remarks

10.00 – 12.45 SYMPOSIUM I
Session Chair: Prof Juan Lupianez

10.00 **Henry Evrard**

10.45 Coffee Break

11.15 **Simon Eickhoff**
Insular anatomy – a basis for diversity or integration?

12.00 **Stephen Jackson**
Investigations into the functional anatomy of urges

12.45 Lunch

14.30 – 16.30 SYMPOSIUM II
Session Chair: Prof. Stephen Jackson

14.30 **Christian Keysers**

15.15 **Marcel Brass**
The hidden side of intentional action: The role of the anterior insular cortex

16.00 Tea

16.30 **Antoine Bechara**
The hidden island of addiction: The Insula

Saturday 1/5/10

- 09.30 – 12.15 SYMPOSIUM III
Session Chair: Prof Hans-Otto Karnath
- 09.30 **Chris Dijkerman**
Somatosensory processing and the insula
- 10.15 **Catherine Reed**
- 11.00 Coffee break
- 11.30 **Manos Tsakiris**
The insular body: a neurocognitive model of body-ownership
- 12.15 Lunch
- 13.45 – 16.00 SYMPOSIUM IV
Session Chair: Dr Chris Dijkerman
- 13.45 **Hans-Otto Karnath**
Right insula for our sense of limb ownership and self-awareness of actions
- 14.30 **A.D. (Bud) Craig**
The unique role of the insula in human awareness of feelings from the body
- 15.30 Tea
- 16.00 Discussion and closing remarks

List of speakers

Stephen Jackson (Organiser)	University of Nottingham, UK
Chris Dijkerman (Organiser)	Utrecht University, The Netherlands
Juan Lupianez (Organiser)	University of Granada, Spain
Hans-Otto Karnath (Organiser)	University of Tuebingen, Germany
A.D Craig	Barrow Neurological Institute, USA
Henry Evrard	Max Planck Institute, Germany
Simon Eickhoff	Research Centre Juelich, Germany
Marcel Brass	Ghent University, Belgium
Manos Tsakiris	Royal Holloway University, UK
Catherine Reed	Claremont McKenna College, USA
Christian Keysers	Netherlands Institute for Neuroscience, The Netherlands
Antonio Verdejo-Garcia	University of Granada, Spain

Registered participant list

Amy Parkinson	University of Nottingham, UK
Georgina Jackson	University of Nottingham, UK
JeYoung Jung	University of Nottingham, UK
Turki Abualait	University of Nottingham, UK
Catherine Preston	University of Nottingham, UK
Henry Chase	University of Nottingham, UK
Jason Martin	University of Tuebingen, Germany
Julia Suchan	University of Tuebingen, Germany
Catherine Jones	Brighton and Sussex Medical School, UK
Paula Trotter	University of Manchester, UK
Christophe Lopes	Bern University, Switzerland
Thomas Ethofer	University of Tuebingen, Germany
Wendy Adams	Bangor University, UK
Lena Palaniyappan	University of Nottingham, UK
Anna Murphy	University of Manchester, UK

Manuela Selitto	University of Bologna, Italy
Elisa Canzoneri	University of Bologna, Italy
Irma Khachidze	Beritashvili Institute of Physiology, Republic of Georgia
Alfred Veldhuis	Utrecht University, The Netherlands
Haike Van Strallen	Utrecht University, The Netherlands
Irene Perini	University of Gothenburg, Sweden
India Morrison	University of Gothenburg, Sweden
Hakan Olausson	University of Gothenburg, Sweden
Johan Wessberg	University of Gothenburg, Sweden
Stefan Vogt	Lancaster University, UK
Martyn Bracewell	Bangor University, UK
Martine van Zandvoort	Utrecht University, The Netherlands
Helena Wasling	University of Gothenburg, Sweden
Mirko Uljarevic	University of Cardiff, UK
Denis Tatone	University of Bologna, Italy
Jessica Eccles	Brighton and Sussex Medical School, UK
Francis McGlone	Liverpool University, UK
Leon Claeys	Genappe, Belgium
Silvia Salerno	Bron, France
Ruben Azevedo	University of Rome, Italy
Milagros Gallo	University of Granada, Spain
Roxana Baclesanu	University of Berlin, Germany
Maria Tortosa Molina	University of Granada, Spain
Monica Trivino	University of Granada, Spain
Maria Ruz	University of Granada, Spain
Elisa Martin Arevalo	University of Granada, Spain
Maryem Torres	University of Granada, Spain
Pedro M Paz-Alonso	University of Granada, Spain
Mariagrazia Capizzi	University of Granada, Spain
Paola Cappucci	University of Granada, Spain
Sonia Alguacil	University of Granada, Spain
Maria Hurtado	University of Granada, Spain
Raquel Garcia	University of Granada, Spain

Clara Aranda	University of Granada, Spain
Fiona Macpherson	University of Glasgow, UK
Frederique De Vignenont	Institute Jean-Nicod, France
Aidoo Armstrong	National Paralympic Committee, Ghana
Epkolo Akpowomano	Amputee football federation of Africa, Nigeria
Eva Hoogland	European Science Foundation
Manuel Castillo	University of Granada, Spain