

SINAPSE

PhD Project Proposal Template for PhDs starting in 2008

SINAPSE Centre (i.e. primary university to which this studentship will be attached*):

School of Psychology, University of Dundee

First supervisors: contact details

Name: Dr Madeleine M. Keehner and Dr Martin H. Fischer
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Second supervisor: contact details

Name: Dr David J. Turk
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Speciality of first supervisors:

MK: spatial reasoning & abilities; medical education
MF: user-friendly visualization

Speciality of second supervisor:

Neuro-imaging techniques (fMRI, PET);
neurological case studies

PROJECT

Title:

Better clues from useful views - Effects of task and image format on spatial reasoning and clinical skills for neuro-imaging

Planned start date (year of intake):

2008

Likely background of suitable student (eg. Neuroscience, MR Physics, Chemistry, Psychology) and essential skills required prior to starting this PhD:

Background in Neuroscience or Cognitive Psychology; skilled in experimental methods and statistical analysis.

*usually this would be the university in which the first supervisor is based.

Summary of proposed project (205 words)

Background: The brain's anatomical structure and functional activations can be depicted with several methods (2D or 3D sections, flattened or glass brains, etc.). These depictions are used in a range of contexts. Clinicians identify altered anatomical structures, medical students learn about neuro-anatomy, and cognitive researchers localize functional activations. A widely neglected issue across all these approaches is the effect of data visualization styles and individual skills on brain image assessment. The ability to mentally represent 3D structures depends on interface design as well as visualization skills and spatial abilities.

Aims:

- to determine how different image formats support spatial reasoning skills for neuro-imaging
- to propose guidelines for user-friendly image rendering
- to develop effective training for interpreting brain images

Methods: Behavioural experiments present 2-D and 3-D brain images that are interactive or non-interactive. We systematically vary image features (e.g., colour, texture, shading) to explore their effects on performance in different spatial reasoning and learning contexts. Using neuro-imaging, we then compare brain activity of domain novices and experts as they interpret more and less user-friendly brain images.

Outcomes: Following up on our previous research¹⁻⁴, we develop recommendations for data visualization and medical training in neuro-imaging. We identify brain structures involved in spatial expertise and reasoning.

Key references

1. **Fischer**, M. H. (2000). Do irrelevant depth cues affect the comprehension of bar graphs? *Applied Cognitive Psychology*, 14, 151-162.
2. Hegarty, M., **Keehner**, M., Cohen, C. A., Montello, D. R., & Lippa, Y. (2007). The role of spatial cognition in medicine: Applications for selecting and training professionals. In G. Allen (Ed), *Applied spatial cognition: From research to cognitive technology* (pp. 285-315). Mahwah, NJ: Lawrence Erlbaum Associates.
3. **Keehner**, M.M., Guerin, S.A., **Turk**, D.J., Miller, M., Hegarty, M. (2006) Modulation of neural activity by angle of rotation during imagined spatial transformations. *NeuroImage*, 33, 391-398.
4. **Keehner**, M., Khooshabeh, P., & Hegarty, M. (forthcoming). Interactive visualizations and individual differences among users. In F. Dong, G. Ghinea, & S. Y. Chen (Eds.) *User centered design for medical visualization*. Hershey, PA: Idea Group Inc.

In what way does this PhD proposal meet the SINAPSE criteria

This project on brain image analysis helps develop much-needed guidelines for both data visualization and medical training. It offers cross-disciplinary, cross-centre career development for a doctoral student. By improving patient diagnosis and making Scotland a leader in brain image usability research, the project prepares the ground for substantial follow-up funding from both basic and applied sources.

Name of the local SINAPSE Centre Lead with whom you have discussed this project (Leads are listed on the Call for Proposals): Dr Richard Lerski

PhD Studentship in Psychology (Autumn 2008)

A 3-year PhD studentship is available in the School of Psychology at the University of Dundee, funded by SINAPSE (Scottish Imaging Network: A Platform for Scientific Excellence). The successful candidate will work on the project:

Better clues from useful views: Effects of task and image format on spatial reasoning skills for neuroimaging

Expected start date: between 1st October 2008 and 31st January 2009.

Stipend: **£16162**, including UK/EU fees of £3300 (non-UK/EU students are not excluded from the scheme but the difference between home and international fees would have to be self-funded).

Application **deadline: 21st January 2008**. Interviews to be held in February 2008.

Strong candidates are likely to have a background in psychology, cognitive science, neuroimaging, human factors, educational technologies or visualization design.

For a description of the project and guidelines for applying, please visit the SINAPSE website: www.dcn.ed.ac.uk/bic/sinapse/sinapse.asp. Interested candidates should contact Dr Martin Fischer (M.H.Fischer@Dundee.ac.uk) or Dr Madeleine Keehner (M.M.Keehner@Dundee.ac.uk) at the University of Dundee in the first instance.

Project Description: The brain's anatomical structure and functional activations can be depicted with a range of methods (2-D cross-sections, 3-D whole brains, flattened or "glass" brains, etc.). These depictions are used in a variety of contexts and for a variety of purposes. While clinicians identify altered anatomical structures, medical students learn about neuroanatomy, and cognitive researchers seek to localize functional activations. A widely neglected issue across all of these approaches is the effect of data visualization styles and individual skills on brain image assessment. The ability to mentally represent 3-D structures and relations depends on interface and image design as well as visualization skills and spatial abilities. The aims of the research project are to determine how different image formats support spatial reasoning skills for neuroimaging, to propose guidelines for user-friendly image rendering, and to develop effective training for interpreting brain images. Using behavioural experiments you will present 2-D and 3-D brain images that are interactive or non-interactive, and systematically vary image features (e.g., colour, texture, shading) to explore effects on performance in different spatial reasoning and learning contexts. Using functional neuroimaging, you will compare brain activity of domain novices and experts as they interpret more and less user-friendly brain images. Theoretical outcomes: the research will lead to a better understanding of the cognitive processes involved in interpreting these kinds of images and the identification of brain structures involved in spatial expertise and reasoning. Applied outcomes: it is envisaged that the project will lead to recommendations for data visualization and medical training in neuroimaging contexts.