PLEASE NOTE THAT THIS DRAFT IS BASED ON THE CONTENTS OF THE ACADEMIC YEAR 2018-19 AND MUST BE TAKEN AS PROVISIONAL AND SUBJECT TO CHANGE IN ACADEMIC YEAR 2019-20

PS5237 Perception

Module Booklet 2018-19

School of Psychology and Neuroscience

Module Controller and Lecturer: Prof. Julie M. Harris (jh81@st-andrews.ac.uk)

Tue 30th Oct – Tue 27th Nov, 2018 [weeks 7-11]

This course will review the basics of visual perception, and then go more deeply into understanding why and how the brain processes visual information in the way that it does. In this course, I will cover several core areas of visual perception in detail, enabling you to understand how and why visual processing is specialised, and the implications this has for perception and cognition more broadly. The main focus will be on understanding the ways in which behavioural methods (we will cover some neuroscience methods too) can make powerful predictions that allow us to devise and develop theories of how visual information is processed by the human visual system.

You will attend lectures and afternoon practical sessions that are also linked to module PS3037. In addition, you will have a weekly specialised tutorial, for PS5237 students only, where we will cover the topics in more detail, and make sure that you are up to speed on the course content.

Some reading to get you started

A specific reading list for each week of the course is given in the pages below. If you would like to read around the topic before the course starts, these two 'popular science' books will introduce you to perception and hopefully give you a glimpse of why sensory researchers find it so interesting.

Groh, J. (2014) Making Space: How the Brain Knows Where Things Are. Harvard University Press. ISBN-13: 978 0674863217.

Morgan M. (2003) The Space Between our Ears. Weidenfeld & Nicholson, London. ISBN: 0 297 82970 X

The course will have a greater emphasis on scientific content and methods than these books. For a more 'scientific' introduction, take a look at this online (free access) book:

Kaiser, P. The Joy of Visual Perception
http://www.yorku.ca/eye/toc.htm

Skills

The module aims to allow you to gain knowledge and understanding in the area of visual perception. Afternoon sessions in particular will allow you to use knowledge gained from the lectures to enhance real understanding of how we obtain knowledge about the visual system by using experimental psychology techniques.

This module will also allow you to develop a range of transferable graduate skills. By attending both morning and afternoon sessions, and engaging seriously with the course material, you have the opportunity to develop the skills below.

Transferable Skills and Graduate Attributes

- Identify relevant techniques and concepts to solve advanced and complex problems. Tutorial 1.
- Discipline specific abilities in numeracy. Vision uses advanced mathematical concepts. You will be introduced to these gently and encouraged to explore and develop more general skills in this area. Lecture 2.
- Evaluate relevant best practices for the task at hand. Labs 1, 2.
- Engage directly with current research, developments and skills in the discipline. All weeks.
- Engage with primary and secondary material and differentiate between them. All weeks, in particular, Afternoon 3.
- Demonstrate independence of thought and reasoning. Tutorials 3 and 4, assessments.
- Present work and findings in a professional manner, with attention to detail. Tutorials 3 and 4.
- Work as part of a team. Afternoon sessions.
- Engage with the views and opinions of others. Afternoon sessions.
- Learn and use research skills Labs 1,2, afternoon 2.

Assessment
This course will be examined via a pair of coursework assignments.

Assignment Formatting: The assignments should be presented as follows: a title page stating the title of the work, student's matriculation number, the module number, and the date. There must be at least a 1" margin all round (top, bottom, right and left); the text must be in Arial font at 12 point, 1.5 line spaced. The reference list does not count towards the word limit.

Assignment 1, 40% of module mark (deadline 5pm, Wed 28th November)
Write a short essay on plasticity in the adult visual system. Discuss one or more pieces of evidence that demonstrate(s) the extent to which visual learning can impact on our visual function. You are expected to go beyond the course reading and material. You may use up to date material or classic evidence to support your arguments.
Word limit: 1000 words (does not include reference list).
Feedback on this work will be provided on or before Mon 10th Dec.

Assignment 2, 60% of module mark (deadline 5pm Wed 19th December)
Write a research proposal. Choose one research paper that is linked to the course material (if doubt about a 'link', I am happy to comment on your choice of paper before you make a firm decision). Consider how you would extend your chosen paper to ask a new, or follow-up question. Design an experiment to test it, include details of stimuli, procedure, and the results you might expect. How would the results address your hypothesis? Word limit: 2000 words (does not include reference list).

Feedback on this work will be provided on or before Wed 9th Jan.

Class Sessions

Tuesday 9am-11am	**Maths Lecture Theatre D**
Tuesday	**Afternoon sessions, Psychology 1.02-1.06** (you will be asked to attend 5 afternoon sessions in the 5 weeks, see below for timetable.
Thursday 10-11am	**Weekly PS5237 specialist tutorials.** Activities each week outlined below and on Moodle.

Lectures and afternoon sessions

	Lectures **9am-11am Tuesdays**	**Afternoon sessions**
1 **Week 7**	**Concepts and Methods for Visual Perception** The problem of perception Theoretical principles Methods used in perception research Visual Psychophysics	**Lab 1 (with PS3037, 2pm)** Using Method of Constant Stimuli to explore a size-distance illusion. A computer-based lab using the Matlab programming language.
2 **Week 8**	**Spatial vision** Spatial representation Simple visual stimuli: the power of the sinusoidal grating Linking behaviour to neuroscience A model of early spatial vision: spatial frequency channels.	**Lab 2 (with PS3037, 2pm)** Using a Staircase Method to measure constrast sensitivity. This lab uses the FrACT software to measure constrast sensitivity using sinusoidal gratings. You will also explore simulated central visual field loss.
3 **Week 9**	**Vision and experience** Development of vision Restoring Vision Adult visual plasticity Effects of culture on visual perception.	**Further Methods in Vision (1pm)** Tutorial session on the methods of vision. We will cover the psychophysical methods used so far in detail, and review the lab classes so far.
4 **Week 10**	**Colour and lightness** What is colour? Theories of colour vision. Colour in the brain. Unusual colour experiences: synaesthesia.	**Presenting a paper (with PS3037, 2pm)** Read and discuss a paper. Read this paper before the session: Erskine, Mattingley & Arnold (2012) Synaesthesia and colour constancy. Cortex, 49, 1082-1088. **5pm-6pm** Masters-specific session: questions on Assignment 1.
5 **Week 11**	**Depth and Motion** Cues for 3D depth and distance Binocular vision Motion perception in the brain Complex motions	**Revision sessions** PS3037 revision session from 3.30-5pm. This could be valuable in clarifying specific concepts.
Week 12	**Additional Revision Session**	**10am Room 2.10** Masters-specific session: questions on Assignment 2.

PS5237 masters-only tasks and tutorials
Thursday 10-11am, room 2.10, Psychology

1 **Week 7**	**Concepts and Methods for Visual Perception** Before the tutorial. We will have a dicussion around which of the methods from this week's lecture you might use for each of: (a) testing a group of elderly participants to measure whether illusions reduce or increase with age; (b) imagine you are on a design team to design a new chocolate bar that is smaller than the current branded bar. Your task is to make the bar smaller, but ensure that most people do not notice the size change. How much smaller can the bar be?
2 **Week 8**	**Spatial vision** Tutorial: review of the course so far. Discussion: is it legitimate to link conclusions from human behavioural experiments to conclusions from neurophysiological experiments? Please read the chapter by Teller (week 1 reading) before the tutorial.
3 **Week 9**	**Vision and experience** Tutorial: how to write an essay. Before the tutorial I will give you sample essays from a past coursework. Your job is to mark them (using the marking guide), and we will discuss the essays at the tutorial.
4 **Week 10**	**Colour and lightness** Tutorial: how to write a project proposal. Before the tutorial I will give you sample project proposals from a past coursework. Your job is to mark them (using the marking guide), and we will discuss the work at the tutorial.
5 **Week 11**	**Depth and Motion** Tutorial: review of the course, including futher discussion on Labs and Paper Presentation sessions (afternoons).

Lectures, labs and tutorials are not compulsory, but you are recommended to attend all morning, afternoon and tutorial sessions. If you have a timetable clash, please talk to the lecturer as soon as possible.

Attendance recording
Attendance at lectures and labs in not compulsory. The University requires an attendance record to be taken twice for this module. Attendance will be recorded during tutorial 1 (1st November) and 5 (29th November).

Course reading

As well as the main textbook, each week there will be set readings linking the lecture material to recent research in the topic area. All the material, including papers presented in the afternoons, and practical classes, is examinable.

This reading list should not discourage you from further reading around the topics.

Course textbook: Mather, G. (2009) Foundations of Sensation and Perception. Psychology Press.

Week 7 [semester week – this is the first week of the course]

Mather, Chapter 1, 'General Principles'

Some general alternative reading can be found on a web-based vision book, “The Joy of Visual Perception”. Many of the sections will be relevant to this course: http://www.yorku.ca/eye/toc-sub.htm

This web site, by Michael Bach, allows you to explore a wide range of visual illusions, each with some background text, including hypotheses for why they might occur: http://www.michaelbach.de/ot/

Further reading

Goldstein, E.B. (1999), Sensation and Perception (5th Edition), Chapter 1. The sections on the ‘Physiological Approach to Perception’ and ‘What do other species experience?’ will allow you to explore the neuroscience of visual perception in more depth than we cover in the lecture. The ‘Psychophysical Approach’ section allows more detailed coverage than the Mather book.

Teller, D.Y. (1990) The domain of visual science. In ‘Visual perception: the neurophyiological foundations. Eds. Spillman, Werner, Academic Press, San Diego.

Week 8

Mather, Chapters 7, Visual Physiology, and 8, Spatial Vision

Spillman L. (2014) Receptive fields of visual neurons: the early years. Perception, 43, 1145-1176.

Pelli, D.G. & Bex, P. (2013) Measuring contrast sensitivity. Vision Research, 90, 10-14.

User manual for the Freiburg Vision Test (FrACT): http://www.michaelbach.de/fract/media/FrACT3_Manual.pdf

Further reading

Spillman. L., Dresp-Langley, B. & Tseng C. (2015) Beyond the classical receptive field: the effect of contexttual stimuli.

These papers give a more detailed account than the lecture (or textbook) of our knowledge of the visual processing hierarchy:

Goodale & Milner (1992) Separate visual pathways for perception and action. Trends. Neurosci, 15: 20-25.

De Haan, E.H.F., Jackson, S.R. & Schenk, T. (2018) Where are we now with ‘What’ and ‘How’? Cortex, 98, 1-7.

Goodale, M.A. & Milner, A.D. (2018) Two visual pathways – Where have they taken us and where will they lead in future? Cortex, 98, 283-292.

This is the paper on which the selective spatial frequency adaptation was based: Blakemore, C. & Campbell, F.W. (1969) On the existence of neurons in the human visual system selectively sensitive to the oientation and size of retinal images. Journal of Physiology, 203, 237-260.

Week 9

Mather, Chapter 14, Individual differences

Caplovitz, G.P. & Kastner, S. (2009) Carrot sticks or joysticks: video games improve vision. *Nature Neuroscience*, 12, 527-528.

Li, R., Polat, U., Makous, W., and Bavelier D. (2009) Enhancing the contrast sensitivity function through action video game training. *Nature Neuroscience,* **12**, 549–551.

Kalia, A., Lesmes, L.A., Dorr, M., Gandhi, T., Chatterjee, G., Ganesh, S. Bex, P.J. & Sinha, P. (2014) Development of pattern vision following early and extended blindness. Proc. Nat. Acad. Sci, 111, 2035-2039.

Further reading

An up-to-date survey of the main body of work in this area.
Bediou, B., Adams, D.M., Mayer, R.E., Tipton, E. Green, C.S. & Bavelier, D., (2018) Meta-Analysis of action video game impact on perceptual, attentional and cognitive skills. Psychological Bulletin, 144, 77-110.

Week 10

Mather, Chapter 12, Colour vision

Erskine, Mattingley & Arnold (2012) Synaesthesia and colour constancy. Cortex, 49, 1082-1088.

Gegenfurtner, K.R., Bloj, M. & Toscani, M. (2015) The many colours of 'the dress'. Current Biology *25*, R523–R548

Lafer-Sousa, R., Hermann, K.L. & Conway, B.R. (2015) Striking individual differences in color perception uncovered by 'the dress' photograph. Current Biology *25*, R523-R548.

Hurlbert, A. (2007) Colour constancy. *Current Biology*, 17, R906-T907. http://dx.doi.org/10.1016/j.cub.2007.08.022

Further reading

A more detailed twist on 'the dress':
Witzel, C, Racey, C. & O'Regan, K. (2017) The most reasonable explanation of 'the dess': implicit assumptions about illumination. Journal of Vision, 17, doi:10.1167/17.2.1

This reading goes beyond the lecture material, exposing you to recent research on colour processing and its links to form perception:

Moutoussis, K. (2015) The physiology and psychophysics of the color-form relationship: a review. Front. Psychol. doi:10.3389/fpsyg.2015.01407

Week 11

Mather, Chapter 11, Visual motion perception.

Mather, Chapter 10, Depth perception.

Snowden, R.J. & Freeman, T.C. (2004) The visual perception of motion. *Current Biology*, 14, R828-R831.

Todd, J. T. (2005) The visual perception of 3D shape. Trends in Cog. Sci., 8, 115-121.

Harris, J.M. (2004) Binocular vision: moving closer to reality. Phil. Trans. R. Soc. A., 362, 2721-2739.

Further reading

Burr, D. & Thompson, P. (2011) Motion psychophysics: 1985-2010. Vision Research, 51, 1431-1456.

Mather, Chapter 9, p 291-295. This tutorial on Bayesian Models of Visual Perception should give you a flavour for how we think about how different cues to depth are combined. This may help you understand this paper:

Lovell, P.G., Bloj, M. & Harris, J.M. (2012) Optimal integration of shading and binocular disparity for depth perception. Journal of Vision. 12, 1, p. 1-18. doi: 10.1167/12.1.1