UNIVERSITY of STIRLING

Scottish Vision Group 2024 Abstract Book

Stirling : 22 March - 24 March, 2024

Schedule of Events

Friday 22nd March

3.30pm-4pm : Welcome, Tea & Coffee

4-5pm : **Plenary Session** (led by **Dr Dhanraj Vishwanath**, St Andrews University)

Perceptual Experience and the Impact of AI on Vision Research

5-5.30pm : Tea & Coffee Break

5.30-6.30pm : Keynote Talk: **Prof Simon Rushton** (University of Cardiff)

What the journey to Loch Etive can tell us about normal and abnormal visual function

7.30pm : Dinner

Saturday 23rd March

Talk Session 1 (9.30am : 10.45am)

Talk 1: *Experiments with face familiarity*
Peter Hancock (University of Stirling) & Rosyl Somai

Talk 2: *Expertise in Face-matching and Trust in AI*
Yu Wa Ng (University of Glasgow), Reuben Moreton, Christoph Scheepers, Benjamin Gancz & Frank Pollick

Talk 3: *How human-like are robots really?*
Isabel M. Gillert (Heriot-Watt University), Prof. Gnanathusharan Rajendran & Dr. Louise S. Delicato

Talk 4: *From wings to wires: Memory for butterfly warning signals in humans and AI*
Federico De Filippi (University of St Andrews), Olivier Penacchio, Akira R. O'Connor & Julie M. Harris

Talk 5: *Acquisition of novel colour categories: Comparison of relational and perceptual learning*
Jasna Martinovic (University of Edinburgh)

10.45-11.15am : Tea & Coffee Break

Talk Session 2 (11.15am : 12.30pm)

Talk 6: *Exploring the decay of adaptation after-effects in time*
Aysha Motala (University of Stirling)

Talk 7: *Systematic non-stationarities in EEG spectral measures and their relationship to visual discrimination performance*
Martina Kopcanova (University of Dundee), Gregor Thut, Christopher S.Y. Benwell & Christian Keitel

Talk 8: *A dynamic link between respiration and arousal*
Daniel S. Kluger, Joachim Gross & **Christian Keitel** (University of Dundee)

Talk 9: *Decoding real-world visual scenes in EEG with LCD flicker glasses*
James Dowsett (University of Stirling)

Talk 10: *Improving sensory performance through multi-sensory cues in VR*
Mark Donoghue (University of Stirling), Ross Goutcher, Paul Hibbard & Kevin Swingler

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12.30-2.30pm : Lunch

1.30-2.30pm : Teaching Workshop

Talk Session 3 (2.30pm : 3.45pm)

Talk 11: *How robust is the threat bias for fearful facial expressions? An overview and consideration of evidence and theory thus far*
Abigail Webb (University of Suffolk) & Katie Gray

Talk 12: *Foraging on a grid: Investigating spatial biases in visual foraging tasks*
Manjiri Bhat (University of Essex), Anna Hughes & Alasdair Clarke

Talk 13: *Crossing the line: the effects of task-irrelevant features in a visual foraging task*
Anna Hughes (University of Essex), Elliot Richardson, Katie Quinn & Alasdair Clarke

Talk 14: *Exploring Individual Differences in Eye Movement Strategies*
Anna Nowakowska (University of Leicester), Alasdair D.F. Clarke & Amelia R. Hunt

Talk 15: *Symmetry in the eye of the beholder: how does rotation influence visibility?*
P. George Lovell (Abertay University) & Rebecca J. Sharman

3.45-4.15pm : Tea & Coffee Break

Talk Session 4 (4.15pm : 5.30pm)

Talk :16 *Experiencing Visual Loss*
Jake Bourgaize (University of Essex, Kings College, London), Guyan Sloane, Paul B Hibbard, & Jordi M Asher

Talk 17: *Impaired Visual Cognition in Progressive Supranuclear Palsy*
Alexis Cheviet, Alison Lane, Anthony Atkinson, Uma Nath, Claire MacDonald, Louise Wiblin & **Daniel T. Smith** (Durham University)

Talk 18: *Do we perceive the physical structure of the world? A case study of a falling object*
Fulvio Domini (Brown University) & Abdul-Rahim Deeb

Talk 19: *A neurological basis for visual stress*
Arnold Wilkins (University of Essex)

Talk 20: *Binocular asymmetries*
Nicholas Wade (University of Dundee)

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6-6.30pm : MDPI Vision Early Career Researcher Prize Talk:
Maliha Ashraf (University of Cambridge)
Towards a Unified Model of Contrast Sensitivity

7.30pm : Dinner

Sunday 24th March

Talk Session 5 (9.30am : 10.45am)

Talk 21: *Bayesian Hierarchical Signal Detection Models: Opportunities and Pitfalls*
Martin Lages (University of Glasgow)

Talk 22: *Perceptual averaging on relevant and irrelevant featural dimensions*
Philip T. Quinlan (University of York), Dale J. Cohen & Keith Allen

Talk 23: *How to use asymptotic regression to learn more from your data*
Alasdair D. F. Clarke (University of Essex) & Amelia R. Hunt

Talk 24: *Dissociating the roles of category selective visual and medial parietal regions during recall of familiar visual stimuli: an EEG-fMRI fusion approach*
Catriona L. Scrivener (University of Edinburgh) & Edward H. Silson

Talk 25: *Stepping over obstacles: Exploring the effects of surface properties and visual uncertainty*
Zhong Jian Chee (University of Aberdeen), Daniela Ruseva, Constanze Hesse & Martin Giesel

..... **10.45-11.15am** : Tea & Coffee Break .....

Talk Session 6 (11.15am : 12.30pm)

Talk 26: *The effects of colour desaturation of food images on approach behaviour*
Daniela Ruseva (University of Aberdeen), Martin Giesel & Constanze Hesse

Talk 27: *Effects of light level and material appearance on hand movements*
Martin Giesel (University of Aberdeen), Daniela Ruseva & Constanze Hesse

Talk 28: *Modeling the regularity of cone arrays in the chicken*
John Troy (Northwestern University), Arnold Chen & Stephen Eglen

Talk 29: *Task-dependent contribution to edge-based versus region-based texture perception*
Elena Gheorghiu (University of Stirling), Cassandra Diggiss & Frederick A.A. Kingdom

Talk 30: *Attention does not modulate colour-specific numerosity adaptation*
Ramakrishna Chakravarthi (University of Aberdeen), Alexander Donald & Soren K Andersen

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12.30 : Buffet Lunch & Departure

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Invited Talks

Perceptual Experience and the Impact of AI on Vision Research (Dhanraj Vishwanath)

Dhanraj Vishwanath (University of St Andrews) will be leading the round table discussion on this topic. He will provide an overview and demonstrations of some current capabilities of AI systems, but the session is very much a discussion to kick of what looks to be a very stimulating meeting.
We would therefore like to invite you to give some thought to this topic in advance and be prepared to contribute your experience and/or questions. Example topics include but are not limited to:

1. Similarities and differences between human vision and current neural network models
2. The role of vision science in developing explainable and trustworthy AI
3. Understanding and using stimuli created by generative AI
4. Representations and world-models in human and computer vision
5. The role of perceptual experience and qualia in human vision, and their implications for understanding AI systems.

What the journey to Loch Etive can tell us about normal and abnormal vision function (Professor Simon Rushton)

Over the past few years I have strayed a long way out of my comfort zone and I've been exploring the use of MRI and MEG to understand vision. I'll cover a couple of pieces of work. We are all familiar with the idea that there are two visual pathways, a dorsal and ventral one, specialised for visually guided action and perception respectively. But is there a third one? At least four groups have independently suggested there is. I'll summarise some recent work that I've done with a couple of my postgrad students looking into this question and I'll touch on some intriguing individual differences. Turning to abnormal vision, most of us have an idea of what glaucoma is, a condition that impacts on vision, starting in the periphery. But what is the impact of retinal changes due to glaucoma on neural function, and how does neural function link to an impairment in visual function? Again I'll tell you about work I've been doing recently with colleagues and postgrads in Cardiff that provides some interesting insights. Hopefully the conclusion you will draw from the work I describe is that even those of us who are primarily interested in the behavioural side of vision can learn interesting things from neuroimaging, and further, that you don't have to give up a belief in the importance of an "ecological" approach to vision when you get involved in neuroimaging.

Towards a Unified Model of Contrast Sensitivity (Maliha Ashraf)

MDPI Vision Early Career Researcher Prize

CSFs represent the human visual system's ability to detect contrast variations and have found important applications in engineering, where they can be used to optimise designs to cater to human perceptual limits. A comprehensive CSF model requires consideration of stimulus parameters, including spatial and temporal frequencies, luminance, and colour, among others. Despite an extensive collection of contrast sensitivity measurements in the literature, no current model covers the full stimulus parameter space. The inception of ModelFest project more than two decades ago marked a pivotal moment in the research towards a unified visual detection modelling approach (Carney et al., 1999). The ambitious initiative laid the foundation for integrating diverse stimuli measurements under a cohesive framework. For CSF modelling specifically, the physiological models from Barten (1999) and the analytical Pyramid of Visibility models (Watson and Ahumada, 2016; Watson, 2018) have been key advancements in the research area. Our work on CSF during the last few years has been inspired by these approaches. The study by Wuerger et al. (2020) marks the beginning of our work on modelling CSF. This work emphasises the importance of colour modulations alongside spatial frequency and luminance. The work by Mantiuk et al. (2020) extends this framework to include background chromaticity effects and compared cone contrast and post-receptoral contrast encodings. In the proposed stelaCSF model (Mantiuk et al., 2022), achromatic contrast sensitivity was modelled by synthesising 11 distinct datasets. This work aimed for a robust and generalised model that could predict sensitivity across spatial and temporal frequencies, luminance, size and eccentricity. The latest

iteration of our work, the castleCSF model (Ashraf et al., 2024), combines the strengths of preceding studies and uses datasets from 18 studies to predict sensitivity to spatial and temporal frequencies, any arbitrary contrast modulation direction in the colour space, mean luminance and chromaticity of the background, eccentricity, and stimulus area with a mean error of 3.59 dB. One major feature of our model, distinguishing it from other current works, is its use of the same set of parameters to explain data from 18 different studies, demonstrating its robustness and generalisability. This model offers insights into the mechanisms affecting contrast sensitivity for different stimulus parameters using an analytical modelling approach informed by known behaviour of physiological components governing contrast sensitivity.

Keywords: contrast sensitivity functions, computational modelling

Funding information: Meta, European Research Council (ERC) under the European Union's Horizon 2020 research and innovation programme (grant agreement No. 725253–EyeCode), and EPSRC grants EP/P007503, EP/P007902

Teaching Workshop

Workshop on including climate awareness in our teaching

As well as providing one of our key-note talk, Simon Rushton (University of Cardiff) plays a leading role in the 1in5 project (www.1in5project.info) - a framework that allows the academic community to focus some of its collective brainpower on climate and biodiversity. We will be running an optional, informal workshop session, during the Saturday extended lunch break, to discuss how these topics can be integrated into our taught modules. Topics such as data visualisation; confidence with statistical arguments; our aesthetic appreciation of the natural environment; implications of climate change for disease and biodiversity, are all ones that vision scientists can take a lead on. This workshop will provide an opportunity to discuss how these themes can be integrated into our modules, and inspire students to engage with vision science.

Abstracts

Talk 1: Experiments with face familiarity

Peter Hancock & Rosyl Somai

Psychology, University of Stirling

What happens when we become familiar with a face (or anything else)? Expertise allows us to identify a friend (or a butterfly) at a glance. By making controlled changes to face images, we can study how the sensitivity to such changes differs between familiar and unfamiliar identities. For small changes, the difference is less noticeable on a familiar face, for large changes the effect reverses and familiar faces look more different. What sort of representations might underly such effects? I will report the results of testing several different deep neural net models, initially trained to recognise objects in the ImageNet set, and retrained to recognise faces. They are then tested with controlled changes to faces that are either in the original training set (familiar) or not (unfamiliar). It turns out that architecture has a strong effect on the outcome, with some showing large and often peculiar effects of familiarity while others show little difference.

Keywords: Learning, Familiarity, Representation, DNNs, Simulation
External Funding:

Talk 2: Expertise in Face-matching and Trust in AI

Yu Wa Ng, Reuben Moreton, Christoph Scheepers, Benjamin Gancz, Frank Pollick

University of Glasgow

Research has shown that professionals outperform novices in face-matching, but with the increased use of facial recognition technology, there is a need to examine differences between professionals and novices in face-matching with Artificial Intelligence (AI) support. The current study recruited professionals (facial examiners, facial reviewers and police investigators) and novices (age-matched non-professionals) to examine their interactions with AI. Participants were shown face pairs and were asked to decide whether they were the faces of the same person or different people before and after seeing AI advice. Participants were asked to rate their confidence in their initial decision and trust in the AI after seeing AI advice. Findings show that professionals perform better than novices before and after AI advice is presented, however, both groups experienced a decrease in performance on inconsistently labelled trials where matched identities were labelled as different and non-matched identities were labelled as the same. Novices tended to have higher trust in AI than professionals but also experienced a decrease when AI provided incorrect advice. Independent of expertise, lower confidence predicted a change in decision after seeing advice.

Keywords: Expertise, Human-AI Interaction, Trust, Face-matching,
External Funding: Economic and Social Research Council (ESRC)

Talk 3: How human-like are robots really?

Isabel M. Gillert, Prof. Gnanathusharan Rajendran, Dr. Louise S. Delicato

Heriot-Watt University

We want to understand whether the Furhat, a robot with projected face images, can be used as a tool in face perception research. Images on the robot are programmable and interchangeable and could bridge the gap between real life constraints and the limitations of a laboratory. It could help us strengthen existing models of human face processing, and perception of trustworthiness that can be applied to affective computing and robot/human interaction.This study aims to understand scenarios in which a face is perceived to be human-like, or a machine/robot. Understanding the extent to which Furhat is perceived to be human-like allows evaluation of its use as a tool for face perception research.Six image categories were created: i) human faces, ii) physical Furhat, iii) virtual Furhat, iv) 50% morphs between human faces and the physical Furhat, v) 50% morphs between human faces and the virtual Furhat and vi) other robots (not Furhat). Participants are asked to rate each image on 6-point Likert scales for machine likeness, human likeness and trustworthiness. Each image is shown embodied (on a bust) and disembodied (in isolation). Results will aid stimuli selection for a neurophysiological follow-up study.

Keywords: face perception, human/robot interaction, trustworthiness
External Funding:

Talk 4: From wings to wires: Memory for butterfly warning signals in humans and AI

Federico De Filippi, Olivier Penacchio, Akira R. O'Connor, Julie M. Harris

School of Psychology & Neuroscience, University of St Andrews

Some animals advertise their toxicity using bright colours and salient stripes/spots ("warning patterns"). Their striking appearance is thought to warn off predators and discourage future attacks on similar prey. However, how warning patterns influence memory has never been documented. When glancing at a picture, people do not intuitively know what makes it memorable, but remember and forget the same images (i.e., high inter-subject consistency). Therefore, the likelihood of remembering an image ("memorability") may be computable from its pixels using machine vision models. We used a database of Lepidoptera (butterfly/moth), some of which carry warning patterns (aposematic: AP), and some which do not (non-aposematic: nAP). Observers studied images while providing subjective memorability ratings, followed by a recognition test ("Seen before?"). Memorability was computed as the proportion of subjects who recognised each image. AP species appeared subjectively memorable, but, on average, they were not better remembered. Remarkably, AP species led to high inter-subject consistency (Spearman's rho = .79), but consistency for nAP species was low (rho = .37). When exposed to object classification deep neural networks, AP and nAP species evoked different neural responses. These findings suggest that warning patterns might exploit shared mechanisms that underlie successes and failures in picture recognition.

Keywords: memorability, animal patterning, computer vision

External Funding: BBSRC (Biotechnology and Biological Sciences Research Council), United Kingdom Research and Innovation, EASTBIO Doctoral Training Partnership

Talk 5: Acquisition of novel colour categories: Comparison of relational and perceptual learning

Jasna Martinovic

University of Edinburgh

Colour categories are acquired through learning, but the nature of this process is not fully understood. To simulate colour category acquisition, adult learners acquire a boundary within an area of colour space that would normally be labelled with a single basic colour term (e.g. GREEN) based on accuracy feedback. This task can be performed under different learning regimes either learning from a fixed number of evenly spaced colour samples, which promotes relational learning, or from samples randomly drawn from the colour region on each learning set, which is akin to perceptual learning. Here, I compared learning efficiency and subsequent discrimination performance for groups of participants that acquired the boundary under relational and perceptual learning regimes. As expected, relational learning was much more efficient and its error patterns aligned with the use of existing relational categorical knowledge (bluer; greener). Meanwhile, perceptual learning was substantially less efficient and failed to show clear-cut influences from existing categories. However, delayed matching-to-sample performance across the newly acquired boundary was extremely similar between the two learner groups, with both exhibiting superior cross-category discrimination. Thus, acquired distinctiveness across the boundary manifests similarly irrespective of the learning mechanisms that are engaged in acquiring it.

Keywords: colour, categories, learning
External Funding:

Talk 6: Exploring the decay of adaptation after-effects in time

Aysha Motala

University of Stirling

Previous work has identified psychophysical rebound after-effects to several properties of time, namely, duration and temporal frequency (Motala, 2018; 2020). Recent work has even found that adapting to different temporal frequencies can elicit after-effects when tested with single durations, in vision and audition. In the following, we used a rapid adaptation paradigm to explore similarities and differences in the decay of adaptation after-effects to temporal frequency across vision and audition. We find that manipulating the delay between the adaptation and test phase does impact the magnitude of rebound after-effects, and that these vary considerably across audition and vision, indicating differences in the underlying mechanisms for how time is processed in different sensory domains.

Keywords: time perception, sensory perception
External Funding:

Talk 7: Systematic non-stationarities in EEG spectral measures and their relationship to visual discrimination performance.

Martina Kopcanova, Gregor Thut, Christopher S.Y. Benwell, Christian Keitel

University of Dundee

Spontaneous fluctuations in rhythmic brain activity have been linked to variations in task performance. A part of these fluctuations has been attributed to long-term (>1hr) monotonous trends in the power and frequency of alpha rhythms (8-13Hz). Here we tested whether these time-on-task changes in EEG activity are limited to the alpha band and whether they influence task performance. Thirty-six participants performed 900 trials of a two-alternative forced choice visual discrimination task with confidence ratings while their EEG was recorded. Pre- and post-stimulus spectral power (1-40Hz) and aperiodic (non-rhythmic) components were compared across blocks of the experimental session and tested for relationships with behavioural performance. We found that time-on-task effects on rhythmic EEG activity were primarily localised within the alpha band, with alpha power increasing and alpha frequency decreasing over time. Importantly, time-on-task effects mediated relationships between single-trial reaction times and both alpha frequency and power. However, time-on-task effects were dissociated from other EEG signatures of behavioural performance, including predictors of single-trial decision confidence. Our results provide evidence for the presence of separable time-varying and performance-related EEG signatures primarily in the alpha band. Hence, distinct functional properties exist for the same EEG signatures during task-performance, potentially underpinned by different neural networks.

Keywords: EEG, oscillations, time-on-task
External Funding: SGSSS

Talk 8: A dynamic link between respiration and arousal

Daniel S. Kluger, Joachim Gross, Christian Keitel

Psychology, University of Dundee

Viewing brain function through the lens of other physiological processes has critically added to our understanding of human embodied cognition. Further advances though may need a closer look at the interactions between these physiological processes themselves. Here we characterise the interplay of the highly periodic, and metabolically vital respiratory process and fluctuations in arousal neuromodulation, a process classically seen as non-periodic. In data of three experiments (N = 56 / 27 / 25) we tested for covariations in tidal volume (respiration) and pupil size (arousal). After substantiating a robust coupling in the largest dataset, we further show that coupling strength decreases during task performance compared with rest, and that it mirrors a decreased respiratory rate when participants take deeper breaths. Taken together, these findings suggest a stronger link between respiratory and arousal processes than previously thought. Moreover, these links imply a stronger coupling during periods of rest, and the effect of respiratory rate on the coupling suggests a driving role. Consequentially, studying the role of neuromodulatory arousal on cognition, including visual attention and perception, may also need to consider respiratory influences.

Keywords: performance, attention, embodiment, arousal, respiration
External Funding: RSE

Talk 9: Decoding real-world visual scenes in EEG with LCD flicker glasses

James Dowsett

University of Stirling

Neuroimaging studies of visual perception are often limited in ecological validity by the constraints of the methods we use; typically participants are stationary, fixating on a screen and view briefly presented stimuli etc. Mobile EEG systems allow neural recordings of freely moving subjects in natural environments, which can inform our understanding of how the brain deals with the complexity and variability of the real-world. In recent years we have been developing a method using visual flicker from LCD glasses to provide a robust signal in mobile EEG recordings. By driving the visual cortex at the frequency of the brain's natural endogenous oscillations (alpha, gamma etc.), we can recover a signal (SSVEP) which contains a surprising amount of information about the visual scene the participant is viewing. By analysing the complex waveform shape of SSVEPs we can accurately decode the visual scene the participant is looking at. Decoding works with as little as 5 seconds of data, and can decode where the participant is standing from a selection of locations across multiple days, despite differences in luminance/time of day. This effect is specific to certain frequencies, which can inform our understanding of the role of neural oscillations in real-world visual processing.

Keywords: EEG, SSVEP, Real-world, neural oscillations
External Funding:

Talk 10: Improving sensory performance through multi-sensory cues in VR

Mark Donoghue, Ross Goutcher, Paul Hibbard and Kevin Swingler

University of Stirling

Situational awareness is essential in critical tasks like hazard detection and prioritization but performance in such tasks can be limited due to the constraints of natural human perception. However, AI computer vision can aid in these tasks to enhance perceptual performance. For example, deep learning algorithms can supplement human vision in environments that make natural perception difficult. However, implementing such systems by introducing secondary data feeds to the user runs the risk of overwhelming them with information, which may reduce rather than enhance performance. Recent advancements in spatial computing could avoid such problems by presenting secondary data feeds in a way that is easy to integrate with natural percepts to highlight task critical information. This presentation will demonstrate how spatial computing can aid with a potential computer vision system augmenting human perception where information is conveyed to the user spatially. This sensory augmentation system enhances scene understanding and performance in target detection tasks by applying concepts of directed attention and sensory cue acquisition. Visual, audio and haptic cues are presented to a user in a simulated synthetic and natural VR environment. Results show that application of augmentation cues improved visual search behaviour, with these cues allowing for faster orienting behaviour and reducing the need for recursive search. This provides a proof-of-concept for a potential AI-enabled sensory augmentation device.

Keywords: Virtual Reality, Augmented Reality, Vision Search, Multisensory perception

External Funding: DASA

Talk 11: How robust is the threat bias for fearful facial expressions? An overview and consideration of evidence and theory thus far

Abigail Webb, Katie Gray

University of Suffolk

Evolutionary-based theories posit that fearful facial expressions possess a special status in the human visual system. Biases for detecting and responding to fearful faces are considered key tools for threat avoidance, thought to occur via unconscious and rapid processing pathways. However, findings from perceptual and psychophysical studies vary significantly, in that preferences for processing fearful compared to other facial emotions are not reliably observed across, or within, studies of different experimental paradigms. Our systematic literature review explores these effects across dimensions including (but not limited to): paradigm, task type, stimulus duration, response mode, gaze direction and image property manipulation. We include studies of attentional cueing, crude detection, visual search, eye movement, and suppression techniques for unconscious stimulus presentation. Findings thus far show that preferential biases for attending, responding to, and detecting fearful expressions are not reliably observed, and that their occurrence does not seem traceable to any specific set or combination of experimental design features. Our findings contribute to ongoing debates regarding the empirical techniques used to investigate unconscious and rapid processing of visual stimuli and raise crucial questions about the empirical basis of the threat bias for fearful faces, and the robustness of its theoretical underpinnings.

Keywords: face perception, fearful faces, perception
External Funding: Economic and Social Research Council

Talk 12: Foraging on a grid: Investigating spatial biases in visual foraging tasks

Manjiri Bhat, Anna Hughes, Alasdair Clarke

University of Essex

In typical visual foraging experiments participants are tasked with collecting targets of two possible classes. Studies have found that participants interchangeably forage both target types in feature search (where one factor distinguishes targets from distractors), but not in conjunction search (where two factors distinguish targets from distractors). There also appears to be a spatial strategy component to this behaviour: participants tend to use "reading-like" strategy, predominantly moving to nearby targets in horizontal- and vertical directions. As most previous research has presented targets on a grid, it remains unclear whether this reflects a cognitive preference for cardinal directions. We explore this question by investigating foraging patterns in both feature, and conjunction conditions, where items are displayed on a (i) classic grid, (ii) rotated grid, or (iii) uniformly random structure. We aim to investigate whether: (A) participants demonstrate a bias towards cardinal directions across all conditions, or (B) whether this preference is only prevalent in the classic grid condition. Our results suggest a strong influence of the stimulus arrangement on participant behaviour, indicating that the observed patterns in the inter-target directions are predominantly driven by preferences to select nearby items rather than some innate preference for following cardinal directions.

Keywords: Foraging, Spatial bias, Cardinal directions
External Funding: SeNSS

Talk 13: Crossing the line: the effects of task-irrelevant features in a visual foraging task

Anna Hughes, Elliot Richardson, Katie Quinn, Alasdair Clarke

University of Essex

Visual foraging is a task in which participants search for multiple instances of targets in their environment: in the most commonly used paradigm, they are tasked with finding all exemplars of two different classes of targets on a 2D display. Previous research has shown that behaviour in this task can be affected by the difficulty of the search and the value assigned to the targets. Our own modelling work has also shown that proximity is an important factor in determining behaviour, with participants preferentially selecting nearby targets. Here, we show that behaviour can also be affected by task-irrelevant features of the display. Participants carried out classic conjunction foraging trials, but on some trials, a white line was added to the display, either spanning the entire vertical midline or the horizontal midline. We find that participant strategies are affected by these irrelevant features, with participants selecting targets in an order that reduces the number of times they cross the line compared to a control condition without any lines present. This suggests participants may be splitting the stimulus into two "patches", and may help to link work on modelling target-by-target behaviour in visual foraging with the literature on optimal patch leaving behaviour.

Keywords: foraging, search
External Funding:

Talk 14: Exploring Individual Differences in Eye Movement Strategies

Anna Nowakowska, Alasdair D.F. Clarke, Amelia R. Hunt

School of Psychology and Vision Sciences, University of Leicester

An efficient use of fixations entails prioritizing information gain. Our prior research consistently uncovered substantial individual differences in a particular measure of search inefficiency, namely: what proportion of the first five fixations were directed to places in which peripheral vision could have verified the target was absent. In this study, we examined individual differences within a large sample (n=267) who undertook the split-half search task alongside other measures. Our findings can eliminate many potential explanations for such individual differences, and provide an opportunity to explore search behaviour beyond this particular definition of efficiency, to understand the relationship between different strategies and characteristics. Participants self-reported strategy yielded particularly interesting findings: Over half of the participants spontaneously reported partitioning of the search area into two halves as part of their approach. Most of these participants described a deliberate strategy of examining the easy side initially and then, if unsuccessful, shifting focus to hard side. This is an explicit description of the opposite of an optimal strategy. Conversely, efficient searchers were more inclined to report employing no strategy at all. This suggests that many inefficient searchers, rather than lacking thoughtfulness or deliberation in their eye movements, might instead be "over-thinking" the task.

Keywords: visual search,eye movements, strategy
External Funding: ESRC

Talk 15: Symmetry in the eye of the beholder: how does rotation influence visibility?

P. George Lovell, Rebecca J. Sharman

Psychology Division, School of Applied Sciences, Abertay University, Dundee. DD11HG

Symmetry is a salient visual feature that can be detected very quickly, yet many camouflaged animals are bilaterally symmetrical in shape and camouflage (i.e. moths, butterflies, tigers). This begs the question, does symmetry interfere with camouflage, making hidden objects more visible? Experimental investigations of symmetry often utilise two-dimensional fronto-parallel targets, such studies omit the effects of pattern distortion and occlusion that occur when 3D targets are rotated. We measure the detectability of symmetrical spherical targets as orientation is manipulated. We also vary the quality of concealment (termed good and adequate) afforded by the background against which the targets are hidden. We find that the "cost" of symmetry (faster detection times) only occurs in viewer-relative rotations of 15deg or less, beyond this level of rotation the detectability of targets is no better than for targets with no symmetry. The 15 deg limit with our stimuli seems to be true for both good and adequate backgrounds and for vertical- and horizonal-axis symmetry. We conclude that for three dimensional targets the symmetry noticeable in many species may only interfere with concealment when the viewer and target are co-located such that the perception of bilateral symmetry is maximised, i.e. when you view the tiger eye-to-eye.

Keywords: camouflage, crypsis, symmetry, visual search
External Funding:

Talk 16: Experiencing Visual Loss

Jake Bourgaize, Guyan Sloane, Paul B Hibbard, and Jordi M Asher

University of Essex, King College London, University of Stirling

Visual field loss (VFL) is a reduction in the space an individual can see. Understanding how VFL presents could assist diagnosis and intervention to prevent critical blindness, yet how VFL presents is contested. While popularly illustrated as blackness overlaying part of the visual field, the recent "Carving Hypothesis" claims affected areas of the visual field are absent from (rather than obscured in) conscious perception. We investigated the visual experience of 44 individuals with VFL, using semi-structed interviews and a novel "Walkway Task". Participants described via what they could see when viewing an image of a busy high street. Four themes were identified: (1) VFL onset (2) the type and level of detail perceived in the blind field (3) the shape and boundary of the blind field and (4) the consistency of awareness of VFL. Despite initial claims that "nothing" can be seen in the blinded field, some visual information, such as light intensity, could be consistently and reliably reported. Furthermore, interviewees reported they are not always aware of their VFL despite their knowledge of its existence, until a collision or injury brings it back to conscious awareness. This improved understanding of the nature of perceptual experience in VFL may be beneficial for its diagnosis and treatment.

Keywords: Hemianopia, Scotoma, Blindness, Stroke, Perception
External Funding: NIHR204706

Talk 17: Impaired Visual Cognition in Progressive Supranuclear Palsy

Alexis Cheviet, Alison Lane, Anthony Atkinson, Uma Nath, Claire MacDonald, Lousise Wiblin and Daniel T. Smith

Dept of Psychology, Durham University

Progressive Supranuclear Palsy (PSP) is a rare neurodegenerative disease, affection 5 / 100,000 people. It is often misdiagnosed as Parkinson's disease (PD) because it shares many of the motor symptoms typically associated with PD. However, the prognosis and treatment for PSP and PD are very different, and earlier and more accurate differential diagnosis is a high priority for patients. While many of the motor symptoms of PD and PSP are similar, it has been argued that PSP might have a unique profile of visuo-spatial impairment. To test this idea people with PSP (n=20) and PD (N=26) were asked to completed a battery of tests of visuospatial cognition: the Bells Test, easy feature search, difficult feature search and conjunction search to measure attention, continuous response measures of colour and spatial position to measure visuospatial short term memory, and a test of facial emotion recognition. PSP was associated with very significant deficits of visual search and impaired negative emotion recognition compared to PD. PD and PSP groups had had similarly reduced VSWM capacity, but VSWM was relatively preserved. Deficits of visuospatial attention and emotion recognition appear to offer a promising cognitive marker for differential diagnosis of PSP and PD

Keywords: Attention, face perception, memory, neuropsychology
External Funding: Dunhill Medical Trust

Talk 18: Do we perceive the physical structure of the world? A case study of a falling object.

Domini, F & Deeb, Abdul-Rahim

Brown University

Bayesian theories of visual perception postulate that the brain infers from retinal images the accurate spatiotemporal properties of physical events by combining noisy sensory information with prior knowledge of environmental properties, such as Newtonian laws of motion. We tested this general assumption with a study where participants observed the trajectory of a ball rolling off a surface. We simulated this dynamic event in virtual reality: participants viewed a marble-sized ball fall towards them from a tabletop. The ball disappeared upon hitting the floor. Their task was to indicate the fall location of the ball by positioning a probe dot on the ground floor below the tabletop. There were two sources of visual information specifying the final location of the ball. First, the final location itself, which was perfectly visible to the participants, although for a very brief period. Second, the parabolic motion of the ball, which provided predictive information about the possible fall locations. Contrary to the Bayesian prediction we found the paradoxical result that adding sensory information led to systematic biases in the perceived trajectory of the ball. The results are compatible with the Intrinsic Constrained theory of cue integration that does not postulate accurate perception of physical events.

Keywords: sensory-integration, 3D motion, intuitive-physics
External Funding: NSF no.BCS 2120610

Talk 19: A neurological basis for visual stress

Arnold Wilkins

University of Essex

Images from nature, despite their heterogeneity, have in common certain statistical features that enable them to be encoded efficiently by the human visual system. Certain images that have an un-natural spatial and chromatic structure are uncomfortable to look at and give rise to a large cortical haemodynamic response, consistent with indications from computational neurology that they are processed inefficiently. Some images induce not only discomfort but migraine and seizures and these images have a spatial and chromatic structure that deviates maximally from those found in natural images. There are large differences in the susceptibility of individuals to discomfort from images, and the individual differences reflect differences in neurology. In susceptible individuals a strong un-natural excitation of the visual cortex leads to perceptual distortion, discomfort and ultimately pain. Tinted lenses of the individually selected hue and saturation reduce the discomfort, possibly because the resulting change in the cortical distribution of activation avoids locally excitable tissue.

Keywords: visual stress, cortical hyperexcitability,
External Funding:

Talk 20: Binocular asymmetries

Nicholas Wade

Psychology, University of Dundee

Asymmetries in binocular vision occur in terms of eye dominance and retinal projections. Visual experience of the world with two eyes reflects a balance between the symmetries and asymmetries of projections to them. Singleness of vision is served mainly by the stimulation of corresponding points on the two retinas whereas stereoscopic depth perception is based on non-correspondence or retinal disparities. Large disparities result in binocular rivalry. Much of the history concerning vision with two eyes has centred on single vision. A solution, proposed by Johannes Mueller in 1838, was based on geometrical optics: stimulation of corresponding points results in single vision and any points in space either outside or inside the binocular circle would be seen double. Binocular single vision is based on symmetry. In the same year Charles Wheatstone described his invention of the stereoscope and the experiments he conducted with it. Stimulation of slightly non-corresponding points resulted in not only single vision but also depth. Stereoscopic depth perception is based on binocular asymmetry. These distinctions are made pictorially by means of anaglyphs which need to be viewed with red/cyan filters in order to experience stereoscopic depth, binocular rivalry and their combination.

Keywords: Binocular single vision, stereopsis, anaglyphs
External Funding:

Talk 21: Bayesian Hierarchical Signal Detection Models: Opportunities and Pitfalls

Martin Lages

University of Glasgow

Secondary data analysis on individual estimates of signal detection parameters is problematic and has been replaced by hierarchical/multi-level signal detection models for visual detection and discrimination tasks. These hierarchical models are typically implemented in statistical software using generalised linear regression algorithms. However, exploiting the full potential of hierarchical models is often difficult or simply not possible. Here, signal detection models are implemented using the versatile R-package brms which supports a surprising wide range of (Bayesian) model variants with latent parameters that are often not considered in other packages. For example, (un)correlated mixed-effect models with (un)equal variance are relatively straightforward to implement. Using existing data sets, it is illustrated which options are available and how this can be implemented in brms code. It is hoped that adopting this approach will lead to more comprehensive model comparisons in vision research and beyond. Some pitfalls and problems are also outlined.

Keywords: signal detection, Bayesian inference
External Funding:

Talk 22: Perceptual averaging on relevant and irrelevant featural dimensions

Philip T. Quinlan, Dale J. Cohen Keith Allen

Department of Psychology University of York UK

The issue of ensemble coding in visual perception is addressed in four experiments. On each trial, a brief (50 ms) display containing 64 randomly positioned bars was followed immediately by a single probe bar that remained until response. In all conditions, participants judged whether one feature of the bar was present in the display. In the orientation conditions, participants judged the presence/absence of the probe's orientation: in the color conditions, they similarly judged the probe?s color. In the irrelevant constant conditions, the irrelevant feature did not change within or across displays, whereas in the irrelevant varied conditions, there was irrelevant variation in both cases. For both kinds of orientation conditions, it was found that accuracy of reports of orientation were indicative of a process of perceptual averaging - participants tended to report the presence of the mean value even though this was not present. However, there was no corresponding evidence for perceptual averaging in the color conditions. Moreover, variation on the irrelevant dimension had different effects depending on whether orientation or color was being judged. The data are considered against differing accounts of featural processing that either posit processes of perceptual averaging or those that posit processes concerning perceptual similarity.

Keywords: ensemble coding, perceptual averaging
External Funding:

Talk 23: How to use asymptotic regression to learn more from your data

Alasdair D. F. Clarke & Amelia R. Hunt

University of Essex

All of our experiments have a temporal context, whether we are interested in it or not. Many perceptual phenomena, such as adaptation and aftereffects, grow or dissipate over time. Experiments also tend to involve multiple trials and performance generally improves throughout the course of the study. The effects of time often takes a similar form: monotonically decreasing or increasing towards an asymptote. Whether these behavioural dynamics are the object of study or a nuisance variable, their inclusion in models of data makes conclusions more complete, robust and well-specified. Furthermore, being able to account for how behaviour changes dynamically can contribute to theory development. We demonstrate that asymptotic regression is a relatively simple tool that can be applied to time series data to estimate three parameters: starting point, rate of change, and asymptote. Each parameter has a meaningful interpretation in terms of ecological validity, learning and performance limits, respectively. We demonstrate the utility of asymptotic regression over a range of paradigms including Stroop and visual search. In addition to providing a more accurate model of performance in these examples, we show how this approach provides principled answers to many common methodological questions e.g. how much practice is sufficient? How many trials should I run?

Keywords: modelling, visual search, learning
External Funding:

Talk 24: Dissociating the roles of category selective visual and medial parietal regions during recall of familiar visual stimuli: an EEG-fMRI fusion approach

Catriona L. Scrivener, Edward H. Silson

Department of Psychology, School of Philosophy, Psychology and Language Sciences, University of Edinburgh, Edinburgh, UK

We used an EEG-fMRI fusion approach to ask how the neural dynamics of category selectivity in EEG related to activity within both ventral visual and medial parietal regions during visual recall. Participants attended separate EEG and fMRI sessions where they were asked to recall personally familiar people and place stimuli. The contrast of people versus place stimuli in MRI data successfully replicated previous findings of category selectivity in the medial parietal cortex during mental recall (Silson, 2019). Using multivariate pattern analysis, the category of stimuli (person or place) was decodable in the EEG signal throughout the majority of the recall period. When decoding individual stimuli, place stimuli were decodable earlier in time than people. EEG-MRI fusion indicated that the timing of both MPC and ventral visual ROI involvement peaked early on during recall and did not clearly differ from each other. However, Place regions generally peaked earlier than People regions, suggesting that representations of place stimuli may have evolved more quickly for these participants. In contrast, fusion correlations with the early visual cortex (V1) occurred much later during the recall period, suggesting a top-down progression of mental imagery from category selective regions to early visual cortex.

Keywords: EEG, fMRI, Mental imagery
External Funding: BBSRC and The School of Philosophy,

Psychology and Language Sciences, University of Edinburgh

Talk 25: Stepping over obstacles: Exploring the effects of surface properties and visual uncertainty

Zhong Jian Chee, Daniela Ruseva, Constanze Hesse, Martin Giesel

School of Psychology University of Aberdeen

This exploratory study (N=20) examined the effect of visual uncertainty (binocular vs monocular) and perceived unpleasantness and roughness of obstacles on stepping parameters during obstacle crossing. Roughness of the surfaces was manipulated by covering them with stones varying in size (small vs. large) and density (dense vs. sparse). Two additional conditions where the surfaces with large or small stones were reversed to present a smooth surface while maintaining a constant height were included. Participants? task was to step over the obstacles and to subsequently rate their perceived unpleasantness and roughness. Movements were recorded with a passive infrared motion tracker (Optitrack) with markers attached to the toes and heels of both feet. We explored spatial variables, e.g., clearance and step length (normalised to participants? leg length), as well as temporal variables, e.g., velocity. Participants rated surfaces with large or densely spaced stones as rougher and less pleasant than surfaces covered with small or sparsely spaced stones. Stepping parameters were affected by stone size and visual uncertainty, but not by stone density. Initially, leg clearance was higher in the monocular condition but decreased over trials to binocular level. Furthermore, step length increased over trials and was longer for obstacles perceived as unpleasant.

Keywords: obstacle-crossing, visual uncertainty, surface property
External Funding:

Talk 26: The effect of colour desaturation of food images on approach behaviour

Daniela Ruseva, Martin Giesel, Constanze Hesse

University of Aberdeen

The colour of food is a salient visual cue used to determine its freshness and quality. Interestingly, when the food colour is partially or completely desaturated (grey-scaled), self-reported cravings and palatability decrease; with larger effects for perishable than non-perishable foods. Furthermore, while food images reliably evoke attentional biases, they seem to be absent when food images are grey-scaled. However, it is unclear if this is also the case for human behavioural responses, i.e., approach biases. Our study investigated if and how colour desaturation (grey-scale vs. natural colour) affects approach responses towards perishable and non-perishable food images. Participants (N=29) completed a Stimulus Response Compatibility task with colour saturation being varied in blocks and counterbalanced across subjects. Results showed a general approach bias to all food images independent of colour saturation and food type. Post-hoc analysis, suggested that the order in which participants completed the tasks affected the presence or absence of approach biases in the grey-scale condition. Consequently, we are currently running a study in which colour saturation levels are varied between-subjects to determine if approach biases truly persist for grey-scaled images which would suggest that approach and avoidance biases are mediated by different processes.

Keywords: food perception,grey-scaling, approach bias
External Funding:

Talk 27: Effects of light level and material appearance on hand movements

Martin Giesel, Daniela Ruseva, Constanze Hesse

University of Aberdeen

We investigated if and how visual uncertainty and accuracy-requirements influence hand movements in a combined obstacle avoidance and grasping task. Specifically, we wanted to find out if their effects on movements are independent or interact with another. Visual uncertainty was varied by using different photopic and mesopic light levels ($6.3, 0.1, 0.01 cd/m^2$). Accuracy-requirements were manipulated by using obstacles differing in their perceived fragility. Participants (N=22) moved their hands around an obstacle to pick up an object under the three different light levels. The obstacles differed in material appearance: glass (high fragility) or metal (low fragility). For each combination of light level and material, participants performed 10 trials under full vision while the movements of their thumb and index finger were tracked. We found that light level influenced both the reaching and grasping component of the movement: the pathlength, the distance of the hand from the obstacle, and the maximum-grip aperture increased with decreasing light level. Obstacle appearance only influenced the reaching component: the pathlength and the distance of the hand from the obstacle increased for the fragile obstacle. Our findings suggest that to ensure safe movements, visual uncertainty and accuracy-requirements independently influence the programming and execution of motor behaviour.

Keywords: perception, action, grasping, obstacle avoidance
External Funding: Supported by ESRC grant ES/V005170/1 to CH.

Talk 28: Modeling the regularity of cone arrays in the chicken

John Troy, Arnold Chen, Stephen Eglen

Northwestern University, Cornell University, University of Cambridge

Birds are unusual in having retinas with five varieties of cone photoreceptor (violet, blue, green, red and double cones). Interesting hypotheses about the need for this many cone types have been proposed but the functions of bird cone types in vision remain unresolved. We were struck by the unusual regularity of chicken cone arrays that occurs in spite of the fact that the retinal densities of the different cone types vary greatly. We have subjected chicken cone arrays to modeling using methods that have been found productive previously for the study of other retinal cellular arrays. The model that seems to provide the best description of the statistics of the cone arrays is the pairwise interaction point process (PIPP) model in which neighboring cells in an array exert a field of inhibition limiting their ability to position themselves close to one another. How multiple cone varieties with varying density could employ a similar mechanism to achieve high regularity is an interesting question. The answer perhaps lies in the spacing of their bipolar cell targets and the complex nature of connectivity in the avian outer plexiform layer.

Keywords: Photoreceptor, Array, Regularity, Model
External Funding: Northwestern University, University of Cambridge

Talk 29: Task-dependent contribution to edge-based versus region-based texture perception

Elena Gheorghiu, Cassandra Diggiss & Frederick A.A. Kingdom

University of Stirling

Texture segregation studies indicate that some types of texture are processed by edge-based and others by region-based mechanisms. Here we investigate whether the nature of the task determines whether textures are processed by region- or edge-based mechanisms. Stimuli were textures containing five types of modulation: orientation modulation, orientation-variance modulation, luminance modulation, contrast modulation and contrast-variance modulation. Each modulation type was defined by three waveform types: sinewave (SN), square-wave (SQ) and cusped-wave (CS). Participants performed two tasks: detection (i.e., which of two stimuli contained the modulation) and discrimination (i.e., which of two textures contained leftward-oriented bars). Our results indicate that threshold amplitudes in the detection task followed the ordering SQ $<$ SN$<$ CS across all spatial frequencies, as would be expected if texture energy was used for detection and region-based. However, for the discrimination task at low texture spatial frequencies as well as for the contrast-variance modulated (CVM) textures at all spatial frequencies the order was CS $\leq$ SQ $<$ SN suggesting that texture edges were the basis. Therefore, a change in the task from detection to discrimination can under some circumstances cause texture processing to switch from being region-based to edge-based. We convolved the data with a single Difference of Gaussian filter and estimated the filter spatial frequency giving the largest amplitude response. We found that the peak amplitude was lower for detection than discrimination tasks and across all texture types, except for the CVM texture. We conclude that task

differences in part determine whether texture processing is region-or edge-based

Keywords: texture, edge, region, segmentation, contrast, orientation, luminance
External Funding:

Talk 30: Attention does not modulate colour-specific numerosity adaptation

Ramakrishna Chakravarthi, Alexander Donald, Soren K Andersen

University of Aberdeen

Humans can approximately estimate the number of visual items at a glance. One influential proposal that explains this ability posits that we possess a number sense that directly perceives numerosity. This proposal is based on the finding that participants can adapt to numerosity itself, irrespective of their feature content. Here, we tested whether colour-specific numerosity adaptation is modulated by feature-based attention. In two experiments, we asked participants, during the adaptation phase, to attend to items of one of two presented colours. We subsequently asked them to enumerate a set of items that were of the attended colour, the unattended colour, or a novel colour. In both experiments, we found numerosity adaptation not only for items matching the attended colour but also for those with the unattended colour, and no adaptation to items of a novel colour. Further, this effect was location specific. Together, these results indicate that numerosity adaptation is a local, early, feature-based phenomenon impervious to attentional modulation. This is in line with recent arguments that adaptation to numerosity is an artefact of adaptation to basic visual features or the visual system's propensity to discount previously processed items. Thus, our results argue against an independent and direct number sense.

Keywords: Numerosity estimation, adaptation, attention, colour
External Funding: School of Psychology

Notes

Notes

Sponsors

SVG 2024 is sponsored by MDPI Vision, who will be publishing a special issue to accompany this meeting. This is inspired by the roundtable discussion on the theme of Perceptual Experience and the Impact of AI on Vision Research. Papers on this and other subjects covered at the meeting are encouraged. Submissions on this theme from external contributors will also be welcomed. The deadline for submissions will be 30th September 2024.

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