29 May

1pm Arrival and Packed Lunch
We have been told to expect very little from this lunch, just sandwiches and a bit of fruit)

2pm Laptop available for transferring presentations and practice.

5:30pm **Welcome and Guest Lecture**
Roger Watt
Visual Perception and the Paddington Rail Crash of 5/10/1999: Personal Views.

7pm Dinner

30 May

9am Breakfast

10am **Talks Session A**
Peter Andras, Stefano Panzeri, Malcolm P. Young.
Finding the Prior Knowledge of Neurons about the Visual World
Erich Graf, James Maxwell & Clifton
Oculomotor plasticity to serve visual processing
Julie Calvert, Velitchko Manahilov & William A. Simpson
Temporal Characteristics Of Luminance And Contrast Modulated Visual Noise
Kellyanne Findlay, William Simpson & David R, Simmons
Distributed attention and categorical perception of letters of the alphabet.

11am Refreshments

11:30 am **Talks Session B**
David R. Simmons and Isabella K Munro
The Binocular Combination of Chromatic Contrast.
Rebecca A. Champion and David R. Simmons
Luminance artifacts in red-green isoluminant stereoscopic stimuli.
Valerie Bonnardel
Study of colour discrimination with comb-filtered spectra
Julie Harris
What visual information is used to walking down a corridor?

1pm Lunch

3:30pm **Talks Session C**
Katie J. German & Julie M. Harris
Induced Motion in the 3rd Dimension.
Val Tuck & Julie M. Harris
Direction discrimination during motion in depth: an investigation using real world stimuli.
Julian Wallace, G.S. Masson, D.R. Mestre & P. Mamassian
The efficiency of smooth pursuit for surface motion.
Paul Hibbard
Binocular cues do not provide accurate depth information for the control of prehension.
Liza Paul, Frederic Gosselin & Philippe G. Schyns
Binding luminance and chrominance to categorize and perceive scenes.

5pm Refreshments

5:30pm **Talks Session D**

Pascal Mamassian
Light and Shape.

Benoit Bacon & Pascal Mamassian
Binocular Correspondence is not Necessary for the Perception of Stereoscopic Depth.

Wendy Adams & Pascal Mamassian
Bayesian Slant Estimation

Nick Wade
Fooling the eyes and convergence.

7pm Dinner

31 May

9am Breakfast

10am **Talks Session E**

Martin Lages
The Pulfrich effect revisited: phase-sensitivity of the stereo-motion system.

Philippe Schyns & Frederic Gosselin
Bubbles: A new technique to reveal the use of information in recognition tasks

Lizann Bonnar, Philippe G. Schyns & Frédéric Gosselin
The Spatial Scale Information that Mediates Face Identification, Gender and Expression

Frederic Gosselin & Phlippe Schyns
"Superstitious" perceptions can reveal properties of mental representations

11am Refreshments

11:30am **Talks Session F**

Frank Pollick
Recognising Human Movement

Helena Paterson & Frank Pollick
The Role of Velocity in Affect Discrimination

Maxine McCotter
Computational and psycho-physical investigation of visual perception of mouth movements.

Patrick Green
The visual control of ballistic jumps.

1pm Departure Lunch & Meeting Ends

Abstracts by Session

29 May
5:30pm - 6:30pm
Guest Lecture

Visual Perception and the Paddington Rail Crash of 5/10/1999: Personal Views.
Roger Watt, Department of Psychology, University of Stirling.

I was appointed as an expert witness to explore the question of why a train driver went through a red signal, causing the crash in which 31 people died (including the driver in question). My talk will have three parts. 1). I will describe the evidence and the conclusions that I believe can be safely reached from the evidence. What might have caused the driver to behave as if he had seen that the signal was clear? Why did the driver not notice his mis-perception? 2). I will address the non-trivial question of how to use knowledge of visual perception for forensic purposes. What knowledge do we hold with sufficient certainty that we are content to apply it in safety-critical applications? How do we evaluate the quality of our knowledge? How does our knowledge of visual perception actually work in real-life? 3). I will consider what I consider to be the abuse of knowledge about visual perception. Five other human factors experts provided evidence to the Inquiry involving visual perception, and in every case made substantial errors in understanding visual perception. I will seek what lessons might be learnt by vision scientists about how their theories and results can be taken by those not directly involved in generating the research.

30 May
10am - 11am
Session A

Finding the Prior Knowledge of Neurons about the Visual World
Peter Andras, Stefano Panzeri, Malcolm P. Young; Neural Systems Group, Department of Psychology, University of Newcastle upon Tyne, {peter.andras, stefano.panzeri, m.p.young}@ncl.ac.uk

Classic theories suppose that visual information processing is a pure analysis of incoming information gathered by the retina. Recent work suggests that this might not be the case. Instead the role of visual information processing might be to construct visual percepts, using information gathered by the retina, and relying heavily on pre-existing knowledge about the visual world. A key issue of the inferential interpretation of visual perception is to find signs of such a priori knowledge buried in the structure and functioning of the visual brain. Here we present a methodology of finding such prior knowledge at the neural level. We analyzed electrophysiological data from cat primary visual cortex. We found that optimizing the information transmission capacity of the recorded neurons in terms of prior statistical assumptions about the presented stimuli leads to non-flat prior distributions over the stimuli space. This implies that these neurons reflect through their functioning expectations of the visual system, indicating the presence of prior knowledge about the visual world. We discuss, how the proposed methodology can be applied in other similar experimental contexts.

Oculomotor plasticity to serve visual processing
Erich Graf, University of Glasgow, erichwgraf@yahoo.com, James Maxwell & Clifton Schor University of California-Berkeley.

To facilitate visual processing the binocular alignment of foveal images is aided by the synkinetic cross-coupling of vergence eye movements with distance and direction of gaze. These couplings reduce horizontal, vertical and cyclodisparities at the fovea without using feedback from retinal image disparity. Horizontal vergence is coupled with accommodation. Vertical vergence, which aligns tertiary targets in asymmetric convergence, is thought to be coupled with convergence and horizontal gaze. Cyclovergence aligns the horizontal retinal meridians during gaze elevation in symmetrical convergence and is coupled with convergence and vertical gaze. The latter vergence-dependent changes of cyclovergence have been described in terms of the orientation of Listing's plane and have been referred to as the binocular extension of Listing's law. Can these couplings be modified? Plasticity has been demonstrated previously for two of the three dimensions of vergence (horizontal and vertical). The current study demonstrates that convergence-dependent changes of the orientation of Listing's plane can be adapted to either exaggerate or to reduce the cyclovergence that normally facilitates alignment of the horizontal meridians of the retinas with one another during gaze elevation in symmetrical convergence. The adaptability of cyclovergence demonstrates a neural mechanism that, in conjunction with the passive forces determined by biomechanical properties of the orbit, could

play an active role in implementing Listing's extended law and provide a means for calibrating binocular eye alignment in three dimensions.

Temporal Characteristics Of Luminance And Contrast Modulated Visual Noise

Julie Calvert, j.calvert@gcal.ac.uk, Velitchko Manahilov, William A. Simpson, Glasgow Caledonian University

Information about visual objects may be coded by (first-order) modulations of luminance and (second-order) modulations of carrier contrast. We know little about the temporal characteristics of the visual responses to these two types of spatial patterns. This study examined the temporal summation of luminance and contrast modulated binary noise. Three stimulus types were used: (i) sinusoidal luminance gratings (first-order, L); L added to visual noise (first-order, LM); and (iii) sinusoidal contrast modulations of noise carrier (second-order, CM). Dynamic and static 2D binary noise of 40% contrast was used. The spatial frequency of the modulating grating was 0.5 or 2 c/deg. Detection thresholds were measured as a function of stimulus duration using a 2IFC staircase method. Detection thresholds for luminance gratings of 0.5 c/deg decreased as the stimulus duration increased and were independent of duration above 100 ms (transient response). At longer durations luminance gratings of 2 c/deg showed probability summation (sustained response). When dynamic noise was used, CM and LM patterns exhibited sustained-like temporal summation. However, both CM and LM patterns, embedded in static noise, showed transient-like temporal summation. Results have shown that the temporal characteristics of visual responses to LM and CM patterns depend on the dynamic properties (static or dynamic) of the noise employed. They suggest that the dynamic internal noise might be responsible (at least in part) for the sustained responses to luminance gratings. Static binary noise could be used to reveal the transient behaviour of the responses to LM and CM noise patterns.

This research was funded by a BBSRC project grant (223/S13702) to VM and WAS.

Distributed attention and categorical perception of letters of the alphabet.

Kellyanne Findlay, k.findlay@gcal.ac.uk, Dr.William Simpson; Vision Sciences Dept., Glasgow Caledonian University, David S. Simmons, University of Glasgow

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In cases of categorical perception (e.g. speech sounds), discrimination of two stimuli is poor if they both fall in the same perceptual category, and is good if they fall in different categories. Alternatively, in cases of continuous perception, performance depends only on the size of the difference between the stimuli. We tested whether briefly presented lowercase letters are perceived categorically or continuously. A series of stimuli between the letters 'a' and 'd' was constructed from a circle and a line of varying length to produce a letter continuum. Subjects discriminated singly presented letters sampled from this continuum and results showed no evidence of a pattern consistent with categorical perception. Subjects then performed 2,4 (and in one case) 6-alternative forced choice tasks in order to assess the effect of distributed attention on categorical perception of letter-like stimuli. Distributed attention facilitates categorical perception of letter-like stimuli.

11:30am - 12:30pm
Session B

The Binocular Combination of Chromatic Contrast.

David R. Simmons and Isabella K Munro, Department of Psychology, University of Glasgow.

How is chromatic contrast combined binocularly? One index of binocularity is the binocular contrast summation ratio (BCSR), which is the improvement in contrast sensitivity with binocular rather than monocular presentation. Simmons & Kingdom (1998; Vis Res 38 1063-1071) noted that BCSRs with some red-green isoluminant stimuli were suggestive of full linear summation. This suggestion was investigated further in four subjects by measuring binocular and monocular contrast thresholds for the detection of 0.5 c/deg isoluminant (red/green) and isochromatic (yellow/black) Gabor patches. These Gabor patches had either vertically or horizontally oriented carriers and were either correlated (same coloured bars matching) or anti-correlated (opposite coloured bars matching) between the eyes. Full linear summation would be indicated by BSCRs of two for the correlated and zero for the anti-correlated conditions. Mean BCSRs at isoluminance were 1.77 and 0.88 respectively for the correlated and anti-correlated stimuli with horizontal carriers. BCSRs with isoluminant stimuli were not significantly higher than those obtained with the corresponding isochromatic stimuli in the correlated conditions but were significantly lower in the anti-correlated conditions.

These data fall short of demonstrating full linear summation of chromatic contrast between the

eyes, but they do indicate that there are strong binocular interactions at red-green isoluminance.

Luminance artifacts in red-green isoluminant stereoscopic stimuli.
Rebecca A. Champion and David R. Simmons, Department of Psychology, University of Glasgow.

Are demonstrations of maintained stereoscopic performance at red-green isoluminance due to the presence of luminance artifacts? We addressed this issue by adapting a technique of Lu, et al. (1999, PNAS 96 8289-8294) to stereopsis. The stimulus consisted of a "chromatic" (red/green) half-image in one eye and an "achromatic" (yellow/black) half-image in the other. The ratio of red to mean luminance (R/R+G ratio) in the 0.5 cpd Gabor stimulus was varied. A range of achromatic contrasts was employed to find the best match for each chromatic stimulus. The dichoptic combination at each R/R+G ratio giving the best performance in a stereoscopic task provided an estimate of the strength of the artifact. Isoluminance was taken to be the R/R+G ratio at which the contrast of this artifact was minimized. Using this new technique for isoluminance determination we found that: (a) stereoscopic performance with isoluminant chromatic stimuli in both eyes could not be explained in terms of the luminance artifact and (b) there still existed a "contrast gap" between contrast thresholds for stereopsis and simple detection at isoluminance (Simmons & Kingdom, 1994 Vis Res 34 2971-2982). These data provide further evidence for the existence of a chromatic-contrast sensitive stereopsis mechanism.

Study of colour discrimination with comb-filtered spectra.
Valerie Bonnardel, University of Sunderland, valerie.bonnardel@sunderland.ac.uk.

Techniques that involve the use of comb-filtered spectra to study human colour vision have been developed in previous work (Bonnardel et al., 1996 & Bonnardel et al., 1997). These techniques are applied in the present study to measure colour discrimination among deuteranomalous observers and normal trichromats, with the aim of determining the spectral position of the anomalous cone fundamentals. Results show that comb-filtered spectra are useful in determining the extent to which variability in colour discrimination among anomalous and normal trichromatic colour observers is accounted for by the spectral properties of photoreceptors.

What visual information is used when walking down a corridor?
Julie Harris, Department of Psychology, University of Newcastle upon Tyne.

Despite more than 50 years of research on the importance of optic flow for guiding direction, there is now evidence that visual direction is the dominant cue for guiding human locomotion on foot. When wearing displacing prisms, people walk a curved path, consistent with the use of direction (Rushton et al, Current Biology, 1998) A key issue is why people veer less than predicted: are they influenced by flow, or could static cues reduce veering (Wood et al, Current Biology, 2000)? Here we measured walking trajectories for prism-wearing observers in a well lit corridor (high flow environment) and in the same corridor in the dark (no flow environment). Each walk was recorded by digital video, trajectories were plotted, and heading error (difference between heading direction and target direction) was calculated over the time course. For both dark and light conditions, we found less veering than predicted from the optical deflection of the prism. However, we found no significant difference between the heading errors for the high flow vs. no flow conditions. This suggests that although optic flow is available in a well lit corridor, it is not used to control the direction of locomotion. Further, reductions in veering do not appear to be caused by the presence of either optic flow or static visual information.

3:30pm - 5pm
Session C

Induced Motion in the 3rd Dimension.
K. J. German, k.j.german@ncl.ac.uk, J. M. Harris, Department of Psychology, University of Newcastle upon Tyne.

There is evidence that the human visual system may be less sensitive to motion in depth than to lateral motion. Here we explore this issue further by considering whether induced motion is perceived differently for lateral (X plane) motion and motion in depth (Z plane). Two experiments directly compared induced motion in depth with induced lateral motion: (i) at various speeds, and (ii) at various vertical separations. The hypothesis is that the magnitude of induced motion in depth will be less than that of induced lateral motion. Observers viewed 3 vertically aligned dots oscillating in one of 2 sets of directions: (a) continuously side to side (lateral motion), or (b) continuously forward and back (motion in depth). Observers fixated the central target dot and performed a nulling task to make the target dot

appear stationary. The amount of motion required to null any movement in the target was taken as a measure of the induced motion perceived. Perceived induced motion ranged from 10% to 80%. The magnitude of induced lateral motion was not found to differ significantly from the magnitude of induced motion in depth. However, the effects of speed and vertical separation were significant: the induction effect decreased with increasing speed and vertical separation of the inducers. For the parameters used, the results do not suggest that there is any difference in processing of lateral motion and motion in depth.

Direction discrimination during motion in depth: an investigation using real world stimuli.

V.L. Tuck, v.l.tuck@ncl.ac.uk, J.M. Harris, Department of Psychology, University of Newcastle upon Tyne.

When an object moves directly towards or away from us in depth the motion signals generated in each eye are equal but opposite. How useful is this disparity information for detecting motion in depth? So far the evidence is mixed; whether observers are more sensitive with one eye or two varies across labs. Further, most of the studies quoted in the literature have used computer presented stimuli and, whilst this type of presentation simulates motion in depth, it is not identical to object motion in the real world. The aim of our study was to use real life stimuli to study motion in depth. An LED was moved in depth directly towards and away from observers. Small movements were made at points in front of, around and behind a stationary fixation LED. Comparisons in performance between one eye and two were carried out for each observer. As expected, we found individual differences in thresholds for both binocular and monocular stimuli. However, results indicate that binocular viewing is superior for a range of positions in front of fixation whilst that advantage is lost for stimuli presented behind fixation. The distance at which this advantage is lost varies across observers. This novel method of real life stimulus presentation provides us with a way of investigating motion in depth judgements in the real world and will allow us to make comparisons between real life and computer presented 3D motion.

The efficiency of smooth pursuit for surface motion.

J. M. Wallace, G.S. Masson*, D.R. Mestre* & P. Mamassian, Psychology, University of Glasgow, Glasgow, Scotland and *Centre de Recherche en Neurosciences Cognitives, CNRS, Marseille, France.

Purpose: Statistical efficiency is a powerful measure of the level of information actually used when performing a given (visual) task. It is computed by comparing human performance with that of the 'ideal observer', a theoretical model using all of the available information for the task. Here we apply the ideal observer approach to smooth pursuit of similar motion stimuli to compute the efficiency of this oculomotor system. The advantage of this approach is that it permits a direct comparison of performance between perceptual and visuomotor discrimination tasks. We compute the efficiency of the oculomotor system over time to explore the temporal dynamics of motion processing.

Methods: We back-projected random-dot kinematograms (12x12deg.) of two simultaneous, correlated dot motions in opposite (horizontal) directions. These stimuli were perceived as two transparent surfaces. In a method of constant stimuli we varied the difference in speeds of the opposite motions (speed ratios : 1-4, standard speed : 4deg/s; stimulus duration : 450ms). Performance was limited by the addition of uncorrelated noise dots (10 values : 1-99%) to the stimuli. Observers (2 authors & 1 naïve) were instructed to track the faster surface. Responses were recorded with the scleral search coil technique.

We analysed the pursuit responses within early and late time windows, relative to the onset of the response. We established the direction of the response in each time-window by a velocity criterion. From this we obtain sensitivity functions for the oculomotor system. We compute the efficiency by comparing these sensitivities with that of the ideal observer.

Results: Efficiencies improved as the difference in speeds increased between the transparent motions, for both time-windows. However, efficiencies are higher within the early than the late time-window.

Conclusions: When presented with large transparent surface motions observers are able to selectively track one such motion. The improved efficiency with greater speed differences indicates that more information is available to observers at larger speed ratios. Our method unveils the temporal dynamics.of this mechanism, in which the availability of information changes over time. We discuss the implications of the efficiency measure for the

mechanisms underlying perceptual and oculomotor processing.

Binocular cues do not provide accurate depth information for the control of prehension.
Paul Hibbard, Department of Psychology, University of St. Andrews, pbh2@st-andrews.ac.uk.

Binocular cues provide information about the shape, size and location of objects in the environment that may be used in the control of prehension. However, the perception of three-dimensional space from this information is systematically distorted. We investigated whether these distortions affect how we reach for disparity defined objects. Prehensile movements to real and disparity defined virtual objects were analysed. For both real and virtual objects, peak wrist velocity scaled with object distance and peak grip aperture scaled with object size. For virtual objects, peak wrist velocity was consistent with an underestimation of object distance at the further distance. Grip apertures for virtual objects at the nearer distance were consistent with an overestimation of object size. These results suggest that the representation of three-dimensional space used to control prehension is subject to similar distortions to those affecting perceptual judgments.

Binding luminance and chrominance to categorize and perceive scenes.
Liza Paul, liza@psy.gla.ac.uk, Frederic Gosselin and Philippe G. Schyns, Department of Psychology, University of Glasgow.

People who recognize complex visual scenes must bind information from different sources. To study the interactions between categorization and perception, we introduce a method to examine the binding of information (here, luminance and chrominance) that determines the perception of scenes (left-red, right-red, left-green, and right-green). Phenomonologically it seems that chrominance and luminance will be perceived together and in real time. However, recent studies by Moutoussis and Zeki (1997a) (1997b) suggest that one object attribute (colour), presented at time t, is perceptually bound with another attribute of an object at time t-?t (motion). Where ?t is the perceptual time difference between these two attributes (here, a 118ms advantage for colour). The method used in this experiment builds on the perceptual time difference between luminance and chrominance. This method exploits the fact that a new perception emerges as a result of a temporal lag between these two attribute dimensions. This emergent scene is used as a tool to indicate which luminance and chromatic values are bound. After determining the base line temporal difference between processing luminance and chrominance we will examine how information from the two channels is bound as a function of selective attention. Selective attention will be manipulated using prior knowledge, a differential sensitization to luminance and chrominance. The advantage of the method presented here is simply that a new perception emerges when there is a change in the luminance and chromatic values that are bound.

5:30 pm - 6:15pm
Session D

Light and Shape.
Pascal Mamassian, Department of Psychology, University of Glasgow.

Light and surfaces interact in a variety of fascinating ways. This complex interaction gives rise to a number of light effects that the visual system can use to segregate, localize and identify objects in a visual scene. I will review past investigations and discuss the following outstanding issues: i) Shape from shading. What is the information available in the image to recover surface shape from shading? Why do humans appear to be worse at using this cue than at using other pictorial depth cues? ii) Shape and reflectance. How can surface shape and reflectance be simultaneously estimated from the same luminance measurement on a surface? iii) Prior assumptions on light. Why do humans seem to assume that light comes from above-left? How strong is the assumption that light is stationary? iv) Prior assumptions on shape. Why do objects appear flatter at low contrast levels? v) Shadows versus black paint. Are there any generic principles to distinguish shadows from dark surfaces? Are humans able to make this distinction? vi) Spatial layout from cast shadows. Can the location of an object be quantitatively inferred from its cast shadow? How are objects successfully matched with their cast shadows? vii) Impossible shadows. How sensitive is the visual system to detect when a cast shadow is incongruent with its casting object?

Binocular Correspondence Is Not Necessary For The Perception Of Stereoscopic Depth.

Benoit A. Bacon & Pascal Mamassian,
Psychology Department, University of Glasgow,
benoit@psy.gla.ac.uk

A number of recent studies have demonstrated that the traditional "binocular matching" view of stereopsis might be too narrow and have argued that stereopsis should be studied as a more general "surface recovery" problem. The present study shows that stereoscopic depth can be perceived without binocular correspondence in an ecologically valid occlusion situation and therefore supports this view. The left and right eye were simultaneously presented with a surface flashed behind a specifically designed occluder . The surface was half white and half black, and the resulting vertical black/white edge was visible only partially and in a mutually exclusive manner in the two eyes. The black and white areas were manipulated to create a convex or concave surface and the subject, looking through a modified Wheatsone stereoscope, had to respond accordingly. Subjects (n=3) performed this task very well when the visible segments of the edge were shown to the two eyes in a manner respecting the geometry of occluding surfaces. Plots centered on zero (flat surface) and ranging from very concave to very convex show a smooth cumulative gaussian curve of moderate to strong slope. Subjects performed at chance level when the geometry of occluding surfaces was not respected; since the overall available information was identical, this provides a very strong control against monocular cues. When the geometry of occlusion is valid, the visual system can extract the three dimensional configuration of surfaces in the absence of binocular matching. In this particular case, mutually exclusive but complementary information seems to be used. This supports the idea that matching might not be the primary event in stereopsis.

Bayesian Slant Estimation

Wendy Adams & Pascal Mamassian.
Department of Psychology, University of Glasgow.

Purpose: An observer estimating the slant of a surface from noisy information must have a strategy to make his decision. We provide a simple model of slant perception which predicts both the mean and the standard deviation of observers' responses.
Methods: Surfaces were depicted by a perspective-projected random-dot texture, consistent with a particular slant. Observers matched the perceived slant of the stimulus with the angle between two lines.
A Bayesian observer calculates a posterior distribution of world slants from the information in the image and his prior knowledge. Each response has an expected loss, computed from the loss function and the posterior distribution. We used the mean and spread of observers' responses to estimate the shape of the prior distribution, and the loss function.
Results: As predicted by the model, observers are better at estimating slant from texture when the displayed slant is large.
Supported by the Human Frontier Science Program RG 0109/1999-B

Fooling the eyes and convergence.

Nick J. Wade, Department of Psychology,
University of Dundee, Dundee DD1 4HN

Trompe l'oeil (fooling the eye) art attempts to make flat pictures look three-dimensional. Patrick Hughes has produced three-dimensional paintings that induce powerful reverse perspective (see web page). The parts that are physically close to the observer are pictorially distant. They are examples of "trompe yeux" (fooling the eyes). The works appear initially as conventional flat pictures but fluctuate in apparent depth, particularly when the observer moves. Then they undergo a plastic and fluid motion never experienced in physically flat pictures. An example of a large work will be displayed. One possible interpretation of the fluctuations is that convergence of the eyes changes, modifying the apparent distance of the picture plane; the false value for apparent distance can then influence apparent depth and motion. The variation in apparent distance can also affect the perception of depth with a stationary head. Convergence was measured continuously with the VidEyeO system and changes in apparent depth (in an enlarged version of the work available from the website above) were monitored. VidEyeO consists of two head-mounted infrared sources and two cameras which capture and track the location of each pupil, providing samples of convergence at 17 Hz. Six subjects were tested and fluctuations in depth were not correlated with changes in convergence.

31 May
10 am - 11 am
Session E

The Pulfrich effect revisited: phase-sensitivity of the stereo-motion system.
Martin Lages, Department of Psychology, Universiity of Glasgow.

The Pulfrich effect is an intriguing illusion that can be exploited to investigate stereo-motion perception. We reproduced this phenomenon with band-pass Gabor patches rather than broad-band random-dot patterns to control for spatial as well as temporal frequency. Thus phase-sensitivity of the binocular motion system can be measured by systematically varying the interocular phase-lag. Stimuli were presented to the left and right eye on a calibrated CRT flatscreen monitor with a refresh rate of 120 Hz, mean luminance of 34 cd/m2 and 10% Michelson contrast in a split-screen Wheatstone configuration. On each trial Ss verged on a fixation cross flanked by nonius lines before two sine-wave gratings of 1.0 cpd were presented. The gratings were displayed in a gaussian spatial envelope for 1.0 sec with the luminance modulation of the carrier changing sinusoidally in space and time. After each presentation Ss were asked to indicate whether direction of motion was clockwise or counterclockwise in depth from a bird's eye view. Temporal frequencies varied between 0.5 and 4.0 Hz. Binocular phase thresholds for perceiving motion-in-depth varied considerably betwen observers. In contrast to previous findings thresholds seem to depend on temporal frequency. The Pulfrich effect is severly impaired or absent if interocular temporal phase-lag (vertical disparity) is the onlycue. Results favour a stereo-motion system that is mainly tuned to binocular disparity.

Bubbles: A new technique to reveal the use of information in recognition tasks
Philippe G. Schyns & Frederic Gosselin, Department of Psychology, University of Glasgow, gosselinf@psy.gla.ac.uk

Everyday, people flexibly perform different categorizations of common faces, objects and scenes. Intuition and scattered evidence suggest that these categorizations require the use of different visual information from the input. However, there is no unifying method, based on human categorization performance, which isolates the information used. To this end, we developed Bubbles, a general technique that can assign the credit of a human categorization performance to specific visual information. Bubbles starts with specifying an 'image generation space' (e.g., the 2D image plane, or the 3D space of 2D image locations x n spatial scales). Stimuli are designed to randomly and sparsely sample this space with "bubbles" of information of Gaussian shape. Subjects are instructed to recognize these sparse stimuli. The number of bubbles is adjusted to maintain performance at a set criteria. Subjects succeed when the bubbles reveal enough information; the locations of these bubbles are recorded in a CorrectSpace and a TotalSpace. When subjects cannot identify the sparse stimuli, the bubbles are not sufficiently informative, and we only add their locations to the TotalSpace. We then divide CorrectSpace by TotalSpace to derive a ProportionSpace that weighs the significance of each region of the image generation space for the task at hand. We applied Bubbles to human and ideal observers resolving different tasks of face recognition (identity, gender, expression) and object recognition (basic vs. subordinate categorizations) to isolate the specificity of human feature extraction.

The Spatial Scale Information That Mediates Face Identification, Gender And Expression
Lizann Bonnar, lizann@psy.gla.ac.uk, Philippe G. Schyns, Frédéric Gosselin, Department Of Psychology, University Of Glasgow.

It is now well established that face information is represented at multiple spatial scales. However, research on face recognition has so far lacked a technique that identifies the specific information that humans locally represent at different scales, for different face categorization tasks. To address this issue, we used the Bubbles technique of Gosselin and Schyns (in press) in three different categorization tasks (identity, gender, and expressive or not) of 20 face stimuli. To compute the experimental stimuli, we decomposed the original faces into 6 bands of spatial frequencies of one octave each—at 2.81, 5.62, 11.25, 22.5, 45 and 90 cycles per face, from coarse to fine, respectively. Information at each spatial frequency bandwidth was partially revealed by a number of randomly located Gaussian bubbles forming a mask (standard deviations of bubbles were 2.15, 1.08, .54, .27, and .13 deg of visual angle, from coarse to fine scales, to normalize to 3 the number of cycles per bubble revealed). To generate an experimental stimulus, we simply added the information revealed at each scale (the number of bubbles per image was automatically adjusted to reveal just enough face information to maintain a 75% correct categorization criterion).

Three independent groups of 15 subjects resolved a different categorization of the same faces (identification, gender, and expressive or not). For each spatial scale, Bubbles isolated the different information human observers used to resolve these categorizations. Using this information, we synthesized the effective stimuli of each task.

"Superstitious" perceptions can reveal properties of mental representations
Frederic Gosselin, Philippe G. Schyns. Department of Psychology, University of Glasgow, gosselinf@psy.gla.ac.uk

We have all seen a human face in a cloud, a pebble or in blots on a wall. Evidence of superstitious perceptions have been documented since classical antiquity but have received little scientific attention. Here, we used superstitious perceptions in a new principled method to reveal the properties of unobservable object representations in memory. We stimulated the visual system with unstructured white noise. Observers firmly believed that they perceived an 'S' letter in Experiment 1 and a smile on a face in Experiment 2. Using reverse correlation, we visualized the memory representations subtending these superstitious perceptions. Importantly, these representations had spectral properties compatible with those reported in recognition studies. This is in line with recent findings demonstrating that some neurons in the human medial temporal lobe respond both to bottom-up visual inputs and to their top-down mental visualizations.

11:30 am - 12:30 pm
Session F

Recognising Human Movement
Frank E. Pollick, Department of Psychlogy, University of Glasgow, frank@psy.gla.ac.uk

Studies of biological motion clearly demonstrate that even impoverished displays can be spontaneously organised into the percept of a moving figure. Although it appears that these displays provide sufficient information to appreciate detailed properties of the actor and action being performed, little is known about which properties of human motion are essential for its categorisation. I will present research from a variety of approaches including prototypes, movement primitives and statistical pattern matching that has examined the ability of humans to recognise identity, affect, and style from displays of human movement. Results of these studies indicate that recognition of style can be achieved via representations based on either the spatiotemporal signature of the movement or specific movement properties such as velocity. Finally, I will discuss extensions of this research into the field of designing interactions with humanoid robots.

The Role of Velocity in Affect Discrimination
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Although human observers appear able to discriminate between different styles of movement, the physical properties on which such discriminations are based are not well known. Two experiments are described that examine the role of speed in the categorisation of affective biological motion displays. A 3-dimensional position analysis system was used to record the arm movements of actors as they expressed different affects in their actions. For the first experiment movements were recorded for 10 affects and the point-light animations of them were shown to participants in a recognition task. The resultant confusion matrices were analysed using the ALSCAL multi-dimensional scaling procedure and produced a 2 dimensional psychological space. The psychological space for discrimination was similar to that from recent models of experienced affect in that the first dimension corresponded to the activation dimension from these models. A strong correlation between the movement speed and the activation dimension confirmed the finding. From these results it would appear that the mapping between stimulus properties and representation of activation in affect is a fairly direct one. For the second experiment more sad, angry and neutral movements were collected. New movements of different duration, but identical spatial displacement were made using an interpolation algorithm. This technique yielded re-sampled stimuli with movement duration ranging from the original angry duration to the original sad duration for each affect. Observers viewed the movements as point light displays. Their task was to rate the movements on a 100-point scale of intensity from sad to angry. Results from this experiment indicate that a major role of speed seems to be in modulating the intensity of activation in perceived affect.

Computational and psycho-physical investigation of visual perception of mouth movements.

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During speech, mouth movements produce marked contrasts between dark and light, and spatial deformations in the features. This information should reveal occluded features (e.g., teeth, tongue) and specify the spatial arrangement of features (e.g., shape of lips). If spatial cues are used, sensitivity to spatial discrimination of mouth movements should be affected by viewing distance of stimuli presented to the observer. If contrast cues are used, sensitivity should be unaffected by viewing distance until mouth movements cannot be resolved by the eye of the observer. This paper investigates these issues using computational and psycho-physical methods. Video recordings of mouth movements and syllables were presented computationally at viewing distances of up to 20m. Stimuli were discriminated using a psycho-physical 2AFC procedure. Experiment 1 presented male and female faces with the mouth open or closed. Experiment 2 presented the same faces articulating the syllables /ba/, /bi/, and /va/. Discrimination of mouth movements was uniform up to a cut-off distance of 20m. Discrimination of consonants and vowels was unaffected up to distances of 10m. These data suggest that contrast differences between the lips, teeth and tongue are important for human communication and can be perceived accurately at a range of viewing distances.

The visual control of ballistic jumps.

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Visuomotor integration requires a mapping between the spatial structure of an animal's environment and the forces exerted by its muscles. Ballistic jumps made from one surface to another provide a relatively simple paradigm of visuomotor integration, in which two motor parameters - the magnitude and direction of jumping force - are controlled by a small number of spatial parameters. At a minimum, these will be the horizontal and vertical distances of the target surface from the take-off position. Measurements of jumps made by week-old chicks across gaps indicate that they are able to modulate the direction and speed of their take-off in relation to gap dimensions, and that head posture is a component of the control system involved. Both the position and orientation of the head change systematically with the vertical distance of a target surface, and with a chick's take-off trajectory. This behaviour can be explained in terms of a control system that sets head posture to achieve the optimum combination of retinal elevation and distance of a patch of the target surface. The output of this system in turn controls the force exerted at take-off. Jumping can therefore be controlled visually without computing explicitly the location of the target surface.