

vision

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Applied Vision Association

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Editorial

Welcome to the first bulletin of 2003. This issue comes in a re-styled format that we hope that you will enjoy. If you have any suggestions for new content, or would like to contribute material then we would be pleased to hear from you.

The next AVA meeting is the Annual General Meeting, being held on Wednesday 19th March at the college of Optometrists in London. This meeting has two important functions.

First, there will be excellent scientific content on the theme of *Vision in a 3-D World*. The highlight of the meeting will be the 2003 Geoffrey Burton memorial lecture being given by Professor Brian Rogers (University of Oxford) on the topic *Seeing in depth*.

Second, it is a chance for ordinary members to hear reports and ask questions about the activities of the association and the challenges it faces. This year there are a number of important issues to discuss, as well as the elections to the AVA management committee. This AGM will help shape the future of the association: we hope as many of you will attend as possible (please contact Theresa Murtagh at the College of Optometrists by March 12th if you plan to attend – see ad later in the bulletin for details).

The AGM also marks the occasion when the Geoffrey J. Burton Travel Award is given to a promising young scientist. Any PhD students or first-year post-docs wishing to apply have until the 28th February. It is only possible to make these awards through the generosity of members; any donations to the Vision Scientists memorial fund that you would like to make will be gratefully received.

Finally, there is a vacancy in the AVA committee! We are looking for an enthusiastic post-graduate student to fill the role of post-graduate representative. If you are such a person, or know someone suitable, please contact the Chairman (mscase@dmu.ac.uk).

We hope you enjoy the bulletin, and that we'll see you at the AGM.

Paul & Andrew

Geoffrey J Burton Travel Award

The Geoffrey J Burton fund was established in 1986 with the aim of providing financial assistance to students (postgraduates studying for a higher degree or first-year postdoctoral junior scientists) based in the UK travelling to any conferences or meetings at which they will be presenting a paper or poster. The fund has been renamed to the Vision Scientists Memorial Fund but the AVA will continue to award an annual Geoffrey J. Burton Travel Award from this fund. Donations to the fund can be directed to the AVA secretariat and cheques etc. should be made payable to "The Vision Scientists Memorial Fund".

The maximum award to any one individual is £400.

The closing date for awards will be the last day in February each year and will be for conferences held from 1st March to the end of the following February (i.e. there will not be retrospective awards). Applicants do not have to be presenting at an AVA conference.

The next closing date for applications is 28th February 2003, for conferences held between 1st March 2003 and 28th February 2004.

Applicants must

- be AVA members
- have attended at least one AVA meeting in the last 18 months

To apply for an award you need to complete an application form which is available from:

The AVA Secretariat,
College of Optometrists,
42 Craven Street,
London,
WC2N 5NG.

A PDF format version of the application form is available on the AVA web site at:

<http://www.dmu.ac.uk/ava/>

Aim of the AVA: to promote and advance the application of
research work in all areas related to vision

Meeting Report

Toto, I've a feeling we're not in Kansas anymore...

Ian Thornton gets geographically confused, but finds Psychometrics 2002 rewarding.

Not a lot of people know this, but there are actually two places in the USA called Kansas City. The larger and more well known, home to great BBQ, better Jazz, the wonderful Union Station (once the 2nd busiest railway station in the USA, now a beautiful, converted museum and shopping area with one of the prettiest bars I've ever seen!) and the venue for the 43rd annual meeting of the Psychonomics Society, is not actually in Kansas at all, but is across the river in the state of Missouri. No one could explain this apparent geographical error, and I soon became too busy to keep asking.

Psychonomics is an interesting meeting, one that I have been going to pretty religiously over the last 8 years. It is small by American standards (less than 1000 participants), quite intense in the scheduling (lots of parallel sessions) and has maintained much of the formality I associate more with European meetings. This latter point is reflected in the fact that talks can only be presented by members of the society, who are nominated and elected, and must be established faculty. Students and associate members (anyone with a PhD) can only present posters. On the plus side, the meeting is free, visits a different location in North America each year, and has spawned a number of interesting satellite meetings, such as OPAM (Object Perception and Memory), APCAM (Auditory Perception, Cognition and Action Meeting) and the Tactile Research Group. As Psychonomics always opens with a Thursday evening poster session, these satellite meetings are typically held during that day. At least the first of these, OPAM, is intentionally biased towards presenting work from graduate students.

As Psychonomics is a general experimental psychology meeting, much of the program is not directly relevant for the vision researcher - focusing instead on issues relating to psycholinguistics, memory, motor control and decision making. Nevertheless, there has always been a hard core of mid- and higher level vision work, particularly relating to object recognition, attention, visual search, spatial cognition, biological motion, and more recently perception and action. Given that the

schedule is all packed in to two and a half days, there is typically plenty of vision to go round and in fact it is often difficult to find time to get out of the hotel (a nice thing about the size of the meeting is that everything fits under one roof, conference rooms and bedrooms) and sample the local culture.

This year's keynote address was given by Roger Shepard, a talk that presented a very personal tour through a scientific career famous for trying to link the physical and the mental environments through the concept of "mental laws". In the general program, a number of presentations are worthy of mention, with the caveat, of course, that they reflect my particular areas of interest: Maggie Shiffrar and Alissa Jacobs gave a very interesting talk on biological motion, trying to tease apart the contributions of visual familiarity from those relating to owning and moving one's own body, concluding that visual experience has an independent influence on performance at least in some tasks. In another very clever biological motion study, Simone Bosbach, Dirk Kerzel & Wolfgang Prinz showed that the left-right orientation of a walking figure can influence the speed and accuracy of unrelated left-right hand responses using a dynamic version of the classic response-compatibility Simon effect.

As mentioned above, there is always a fine turn out from those researchers interested in visual search, and this year was no exception. In addition to a special symposium entitled "New Perspectives in Visual Search", there were a great many papers and posters dealing with such tasks. Dan Smilek, Mike Dixon and Phil Merikle demonstrated how efficiency of search for identical physical displays (find the vertical line among right oblique distractors) could be modulated by experimentally established, arbitrary semantic associations. For example, in one condition both target and distractor items were associated with the same semantic label (e.g. elephant). In another condition, the target was give one label (e.g. elephant) and the distractor another (e.g. mouse). Even though the visual arrays were the same, search for observers in the latter condition was much more efficient, suggesting that the meaning of objects can influence search. Another presentation that grabbed my attention (!) was that by Shawn Christ & Rich Abrams. They re-examined the well-established finding that a moving item among stationary distractors captures attention, concluding that it is the onset of motion, not the motion per se that is responsible for such effects.

This years Psychonomics stood out for me because

of the number of nominally “perceptual” presentations that dealt with the interactions between perception and action. There has always been a strong presence at Psychonomics from European groups working in this area (e.g., Wolfgang Prinz and Guenther Knoblich from Munich; Bernhard Hommel from Leiden) but the trend seemed much more widespread this year. One talk that really stayed with me was from Danny Proffitt’s lab. Previously, this group has shown that perceived distance can be influenced by expected effort. That is, observers standing in a field wearing a heavy backpack overestimate distance compared to observers with no load. The current presentation of work by PhD student Jessica Witt, showed that such effects only occur if observers have an intention to act. That is, throwing a heavy ball relative to a light ball will lead to changes in perceived distance only if the observer anticipates that distance will be measured in the testing session by throwing. That is, no cross-adaptation occurs between, say, walking and throwing. The authors suggest that perceived space is a combination of the geometry of the world and the actions we perform in that world, modified by our intention to act.

In general, the standard of presentations and the scope of the program at Psychonomics continues to be very good, although there are definite mutterings that the overlap with the more specifically focused ARVO-breakaway, VSS, may well start to discourage some labs from attending, particularly labs from Asia and Europe for which two trips to the USA each year may prove too much. Nevertheless, I shall be attending the 44th meeting, which will take place in November 2003 in Vancouver. Last time I looked at a map there was only one city with that name and it was in British Columbia, Canada. Hope to see you there!!

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Meeting abstracts

Human Vision: when it works and when it fails

*The Seventh AVA Christmas Meeting
Aston University
Wednesday 18th Decemeber 2002*

A model for motion sharpening: contrast gain control precedes compressive non-linearity.

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Blurred edges appear sharper in motion than when they are stationary. We have previously shown how such distortions in perceived edge blur may be explained by a model which assumes that luminance contrast is encoded by a local contrast transducer whose response becomes progressively more compressive as speed increases. To test this model further, we measured the sharpening of drifting, periodic patterns over a large range of contrasts, blur widths and speeds (0-32 deg/s). The results indicate that while sharpening increased with speed it was practically invariant with contrast. This contrast invariance cannot be explained by a fixed compressive non-linearity since that predicts almost no sharpening at low contrasts. We show by computational modelling of spatio-temporal responses that if a dynamic contrast gain control precedes the static non-linear transducer then motion sharpening, its speed dependence, and its invariance with contrast, can be predicted with reasonable accuracy.

Perceiving edge blur: linear filtering and a rectifying non-linearity.

Keith A. May & Mark A. Georgeson (Neurosciences Research Institute, Aston University, Birmingham B4 7ET, UK; E-mail: mayka@aston.ac.uk, m.a.georgeson@aston.ac.uk)

We studied the visual mechanisms that encode edge blur in images. Our previous work suggested that the visual system spatially differentiates the luminance profile twice to create the ‘signature’ of

the edge, and then evaluates the spatial scale of this signature profile by applying Gaussian derivative templates of different sizes. The scale of the best-fitting template indicates the blur of the edge. In blur-matching experiments, a staircase procedure adjusted the blur of a comparison edge (40% contrast, 0.3 s duration) until it appeared to match the blur of test edges at different contrasts (5-40%) and blurs (6-32 min arc). Results showed that lower contrast edges looked progressively sharper. We also added a linear luminance gradient to blurred test edges. When the added gradient was of opposite polarity to the edge gradient, it made the edge look progressively sharper. Both effects can be explained quantitatively by the action of a half-wave rectifying nonlinearity that sits between the first and second (linear) differentiating stages. This rectifier was introduced to account for a range of other effects on perceived blur (Barbieri-Hesse & Georgeson, 2002, *Perception* 31, suppl., 54), but it readily predicts the influence of the negative ramp. The effect of contrast arises because the rectifier has a threshold: it not only suppresses negative values but also small positive values. At low contrasts, more of the gradient profile falls below threshold and its effective spatial scale shrinks in size, leading to perceived sharpening.

Orientation-masking: suppression and mechanism bandwidths.

Tim S. Meese & David J. Holmes (Neurosciences Research Institute, Aston University, Birmingham, B4 7ET UK; E-mail: t.s.meese@aston.ac.uk)

'Within-channel' models of masking suppose that mask and test excite a common detecting mechanism whose output is followed by a compressive nonlinearity at moderate contrasts and above. From this, Phillips & Wilson (1984; *JOSA A*, **1**, 226-) estimated that orientation half-bandwidths (h) for low spatial frequency (SF) mechanisms are about 30°. More recent 'cross-channel' models (e.g. Foley, 1994; *JOSA A*, **11**, 1710-) include suppressive contributions from an inhibitory pool. In these models, a mask component can elevate detection threshold without exciting the detecting mechanism. If it elevates the entire orientation-masking function then the estimate of its half-width increases and, if not accounted for, h is overestimated.

We performed masking experiments similar to Phillips and Wilson but extended the range of mask and test orientation differences from 0-45° to 0-90°. For transient presentation (one cycle of 15 Hz) and low SFs (1 - 3 c/deg), masking functions were orientation tuned from 0° to about 30° and then

declined gently to 90°, where thresholds were raised by up to factor of 4. We also measured contrast-masking functions and found facilitation at low mask contrasts for parallel but not orthogonal masks. We fitted a model of cross-orientation suppression to our data and those of Phillips and Wilson and found h to be narrower than many previous estimates (as low as 18° at 1.0 c/deg). We found little or no evidence for cross-orientation suppression at high spatial frequencies or for sustained presentation. These and other results suggest that (phase-insensitive) psychophysical mechanisms with properties similar to those ascribed to magnocellular channels have tight orientation tuning and receive substantial suppression from a much more broadly tuned source.

Border ownership and holes.

Marco Bertamini (Psychology Dept, University of Liverpool, Liverpool L69 7ZA, UK; E-mail: m.bertamini@liverpool.ac.uk)

Unilateral border ownership implies that a hole is a background region and therefore shapeless, yet people recognise the shape of holes as well as the shape of objects. If what people perceive is the surrounding object then its shape has a reversed curvature polarity (i.e. a changed sign of curvature) compared to the hole region perceived as an object. We found before that observers are faster at judging the position of convex regions, therefore we predicted that a manipulation of figure/ground should produce a crossover interaction (i.e., a reversal of the relative speeds when the same regions were perceived as holes instead of objects). The interaction means that independently from the shape used, the response is always faster when the vertex is perceived as convex. Moreover, with stereoscopic information (random dot stereograms) depth stratification was made unambiguous and with these stimuli we found an even stronger interaction. We conclude that a change from figure to hole always reverses the encoding of curvature polarity. In turn polarity obligatorily affects the processing of position.

Distortions in the visual perception of size in Parkinson's disease.

John Harris (School of Psychology, University of Reading, Whiteknights, Reading RG6 6AL UK; E-mail: j.p.harris@reading.ac.uk; fax: +44 118 9316715)

Although Parkinson's disease (PD) is often regarded clinically as a motor disorder, much research over the past 25 years has demonstrated changes in

perception and attention in the illness, some of which may contribute to the well-known problems of motor control. Patients with worse left-sided motor symptoms misbisect horizontal lines too far towards the right, and vertical lines too far down. They also judge rectangles in left visual space to be narrower than rectangles in right space, and rectangles in upper space to be shorter than rectangles in lower space. Patients with worse right-sided motor symptoms do not differ from controls on these tasks. The pattern of data suggests a compression of at least the left and upper regions of visual space in PD (a compression which is greater in patients with worse left-sided motor symptoms, and so presumably worse right hemisphere damage). Some contrasts with the literature on perceptual distortions after stroke, and some speculations about the underlying neural mechanisms, will be put forward.

Time and the Observer Revisited

Dave Rose, Department of Psychology, University of Surrey, Guildford, Surrey GU2 7XH

The serial processing model of vision still guides some aspects of our research, but has been criticised from a number of directions. Neuroscientific and psychological evidence for the alternative models (parallel processing, recurrent processing) are well known. These have recently been joined by conceptual critiques, which aim particularly at the timing of visual processes, such as decision making and awareness (e.g. “Time and the Observer”, by Dennett and Kinsbourne, *Behavioral and Brain Sciences*, 1992). In this talk I compare and (attempt to) integrate the philosophical and empirical approaches. I conclude that Dennett and Kinsbourne’s “multiple drafts” model, while vague, is consistent with much current evidence as to how visual processing works.

Distorting time.

Derek H. Arnold¹, Colin W.G. Clifford² & Alan Johnston¹ (¹Dept. of Psychology, University College London; ² Dept. of Psychology, The University of Sydney).

It has been suggested that the time course of perceptual experience is not determined by the time course of neural activity, but by an interpretive process that corrects for the inherent temporal ambiguities of sensory processing (Eagleman & Sejnowski 2000 *Science* **287** 2036 – 2038). We examined the possibility that the time course of

perceptual experience could be distorted by manipulating a low-level stimulus attribute designed to influence sensory processing in a characteristic fashion. When successively presented opponent directions of motion were contrasted, the second interval of motion needed to be longer than the first to be perceived as being of the same duration. This asymmetry was reversed when the angular difference between the successive directions was reduced to 90°. This indicates that the inherent dynamics of sensory processing can perturb our sense of timing. Therefore, our results suggest that any interpretive analysis that is causally involved in the production of perceptual experience may be subject to the temporal limitations of the sensory processing on which it is based.

Detection of changes of objects, colours and shadows in natural scenes.

Michael J. Wright, Seema Shah & Louise Alston (Department of Human Sciences, Brunel University, Uxbridge, Middlesex, UB8 3PH, U.K.; E-mail: michael.wright@brunel.ac.uk)

The ability of observers to detect different types of changes in complex scenes was measured, using pairs of colour slides presented across an inter-stimulus interval (ISI). A localisation method was used. In keeping with “change blindness” findings, only 34.4% of changes were correctly located on a single presentation, but this showed wide variation with different pictures (0%-90.6%). Multiple regression was used to test different variables as predictors of change localisation. The only significant predictor was the rated salience of the pre-cued picture difference. Measures derived from the 2D Fourier amplitude spectrum of the difference image did not reach significance as predictors, despite evidence that such measures are effective in explaining the discrimination of natural images at threshold. Other non-significant predictors were rated complexity and presentation order. Analysis of the unstandardised residuals from the regression showed significant effects of the type of visual information. It was found that object additions and deletions were more detectable than predicted, whereas shadow additions and deletions were less detectable than predicted. Deletions were more detectable than additions for objects but not for shadows. It is argued that when we view a scene, we build an incomplete representation of that scene, in which objects are more strongly represented than shadows and surface colour changes.

Neural correlates of change detection and change blindness.

Louise Alston & Michael J Wright (Department of Human Sciences, Brunel University, Uxbridge, Middlesex, UB8 3PH, UK; email: Louise.Alston@brunel.ac.uk).

Event related potentials (ERPs) were recorded during a change detection task with two-frame stimulus presentation. The stimuli were pictures of faces and places presented centrally two at a time and concurrently with a peripherally presented letter search. Using a divided attention task ensured a failure to detect changes on a proportion of trials. Consistent with previous reports of attentional modulation in extrastriate cortex, when change detection was successful there was some evidence of increased amplitude of occipital P1 and N1 on presentation of the first stimulus frame. The clearest effect of hit versus miss trials was evident in terms of an amplification of P300 and N400 following the second stimulus. The largest evoked potentials were localised in right occipital-parietal areas, although differences between amplitudes were maximal in right parietal areas for the place stimuli and medial frontal areas for face stimuli. Place stimuli also produced differences in activation of the medial frontal areas but these effects were weaker than for face stimuli and may have reflected lower detection rates. Face stimuli would be predicted to produce activation in the fusiform gyrus - however this would not be readily recorded using EEG. The P300 can be evoked by presentation of old (recognised) objects, whereas the N400 is produced by novel stimuli. The medial frontal stimulation in addition to the more occipital-parietal / temporal activation is consistent with visual working memory processes. This was coupled with increased attention to the pictures during change detection evident in terms of greater P1 and N1 components of ERP.

Attentional capture by new objects and attentional loss by old objects.

A.R.H. Gellatly¹ & G. Cole² (Keele University; ¹Now at Department of Psychology, The Open University, Walton Hall, Milton Keynes, MK7 6AA, UK; Email: a.gellatly@open.ac.uk; ²Now at Department of Psychology, University of Durham, Science Laboratories, South Road, Durham DH1 3LE, UK)

It is well known that new objects onsetting in a visual display tend to capture attention at the expense of already present "old" objects. Observers are more efficient at detecting a target that is a new object than a target that is an old object. We report a series

of experiments investigating how this effect varies with the age of the old objects. Performance was studied for two tasks, one in which a target was defined by identity (E or P amongst other letters) and one in which a target was defined by a sensory feature (dark square amongst lighter squares). In circular mixed displays of new and old objects there was an advantage for new targets at even very short SOAs for both tasks. This difference increased with SOA when displays contained more than a single new object, though not otherwise. For the letter identity task, the increase largely reflected improving performance for new objects, with only a modest decrement in detection of old targets. For the feature target task, by contrast, detection of new targets increased only to a small degree with SOA whereas detection of old targets became extremely inefficient. These findings suggest a differential loss of access to information about objects as they age. Access to low level (featural) information about an object appears to diminish rapidly after onset whereas access to higher level (identity) information is much less affected. This was confirmed in two studies with displays containing objects all of the same age. Performance on the feature task fell dramatically within 500 ms of object onset whereas performance on the letter identification task was much less affected by object age.

Spatial interference in dynamic stimuli.

P.J. Bex, A. J. Simmers & S. C. Dakin (Institute of Ophthalmology, UCL, London, UK; E-mail: p.bex@ucl.ac.uk)

Contrast sensitivity, visual acuity, crowding, reading, and oculomotor stability are worse for peripherally-viewed stimuli, but sensitivity to dynamic stimuli remains relatively unchanged. To establish which, if any, of these visual factors underlies the improvement in reading rates afforded by rapid serial visual presentation (RSVP), we measured acuity and crowding effects with drifting gratings and letters. Observers either reported the identity of a Sloan letter or the orientation of a T target that moved along an annulus of constant eccentricity, flanked by up to four similar elements. Size thresholds and crowding increased with eccentricity, in line with previous studies. However, while size thresholds increased with speed, spatial interference zones (the area around the target within which crowding occurred), remained constant. Single elements that were more peripheral or moved ahead of the target crowded more than those that were more foveal or trailed behind it. Observers also identified the direction (up/down/left/right) of a drifting Gabor patch flanked

by four Gabors whose directions covaried to form meaningful (rotation, radiation, translation) or random global patterns of movement. Crowding was greatest when flanking elements all moved in different directions, regardless of the global form they created and when flanking and target elements were of the same spatial frequency at any temporal frequency tested.

Thus letter resolution and crowding are not improved by temporal modulation under conditions of steady fixation and do not account for the effectiveness of RSVP. Explanations of crowding that are based on compulsory texture integration vs segmentation cannot easily explain why crowder directions that average to zero are the most effective, whether in random or meaningful configurations. These findings are consistent with explanations in which local structure is encoded independently, but with positional uncertainty within the spatial interference zone.

Males are ‘noisy females’ when it comes to reporting the psychological structure of the basic colours.

Lewis D. Griffin (Imaging Science, School of Medicine, King’s College London; E-mail: L.D.Griffin@kcl.ac.uk)

The assumption that reported gender differences in colour language use are due to cultural effects has been called into question by two discoveries (i) ‘extra’ photopigment genes are more common in women than men [Neitz et al. 1998, *Vision Res*, 38, 3221-3225], and (ii) a performance difference in a colour task that correlated with the number of genes [Jameson et al. 2001, *Psychonomic B Review*, 8, 244-261].

With this context in mind, using data collected for another purpose [Griffin 2001, *Color Res Appl*, 26, 151-157], I investigated gender differences in the psychological structure of the basic colour terms. 82 subjects of each gender answered a total of 32497 similarity questions (e.g. “which are more similar brown & blue or white & orange?”). 24 subjects of each gender answered a total of 2612 lightness questions (e.g. “which is lighter yellow or pink?”). Analysis showed: (i) no gender difference for lightness questions; (ii) a significant ($p < 0.05$) gender difference for similarity questions; (iii) that the gender difference is noise-like i.e. devoid of significant structure; (iv) a model of females as ‘noisy males’ is rejected ($p < 0.05$); (v) a model of males as ‘noisy females’ is accepted. As corroborative evidence for the model, I note that both

individual and pooled male similarity judgements are less transitive than females (both tests $p < 0.05$). This argues against the gender difference being due to greater between-male than between-female variation, rather it suggests that males are individually noisy. I conclude that: the psychological structure of the basic colours is the same in males and females, but males are slightly more careless reporters of this structure.

Understanding cone distributions from saccadic dynamics. Is information rate maximised?

Alex Lewis, Raquel Garcia & Li Zhaoping (Department of Psychology, University College London, Gower Street, London, WC1E 6BTU.K.; E-mail: alex.lewis@ucl.ac.uk)

Although the retinal cone distribution is known for all retinal locations, there is not yet a satisfactory explanation as to why cones are so distributed. Intuitively, the cone density is highest at the fovea since eye movements bring objects of interest there. However, there has been little progress beyond this qualitative suggestion. Another proposal is that a decreasing sampling density with eccentricity facilitates scale invariant recognition of objects centred at the fovea. However, this cannot account for the radial asymmetry of cone distributions.

We use information theory to establish a quantitative relationship between the retinal cone distribution and the dynamics of eye movements. The rate of information transfer is maximised if the receptor density at any location is proportional to the average rate at which information is received on that part of the retina, or the probability that the image of an object should be at that location. We build a model to compute this probability from experimental data on saccade dynamics. The resulting probability increases as $(1/\text{eccentricity})$ for small eccentricities, and is approximately constant in the periphery, in agreement with the general form of the retinal cone distribution. Using this approach we can also address the radial asymmetry of the receptor distribution. Our model provides a valuable link between two so far unrelated bodies of experimental data, and makes experimentally testable predictions, e.g., on how receptor distributions in some animals could be affected by eye movement dysfunction.

Ambiguity and biological motion.

Ian M. Thornton (Max Planck Institute for Biological Cybernetics, Tuebingen, Germany; E-mail: ian.thornton@tuebingen.mpg.de).

Ambiguity - and the “errors” it creates — have long been used as probes into visual processing. Here I describe a new form of dynamic ambiguous stimuli - the chimeric point-light walker - which is created by superimposing the profile views of a left and right facing figure. When viewed in isolation, this figure - which is ambiguous as it simultaneously suggests motion in both directions - does not appear to walk, but rather to be performing some complex novel action. However, when the figure is presented in a mask of additional moving dots, observers consistently fail to notice anything odd about the walker, reporting instead that they are watching an unambiguous figure moving either to the left or right. Some observers report that the initial percept fluctuates, moving first to the left, then to the right, or vice versa others always perceive a constant direction. All observers, when briefly shown the unmasked ambiguous figure, have no difficulty in perceiving the novel motion pattern once the mask is returned. These two findings, the initial report of unambiguous motion and the subsequent “primed” perception of the ambiguity are both consistent with an important role for top-down processing in biological motion. I will discuss several domains within the realm of biological motion processing where this simple stimuli may have an application.

Analysing optic flow generated by locomotion through a natural environment.

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Some 50 years have passed since Gibson drew attention to the characteristic field of velocity vectors generated on the retina when an observer is moving through the three-dimensional world. Although many theoretical, psychophysical, and physiological studies have demonstrated the use of such optic flow for a number of navigational tasks under laboratory conditions, we still know little about the actual flowfield structure under natural operating conditions. To study what motion information is available to the visual system in the real world, we moved a panoramic imaging device on accurately defined paths in outdoors environments and captured image sequences under a variety of conditions. These image sequences were used as input to a biologically inspired motion detector network which allows us to analyse the distribution of motion signals generated by such locomotion.

We found that motion signals are sparsely distributed in space and that local directions can be ambiguous and noisy, thus giving rise to motion signal maps in which local direction and strength can vary considerably. Spatial or temporal integration would be required to retrieve reliable information on local motion vectors. On the other hand, the overall structure of the flowfield, with distinct centres of expansion and contraction, is obvious even in sparse and noisy motion signal maps, and a surprisingly simple algorithm can be used to retrieve rather accurately the direction of heading, demonstrating the richness of information gathered with a panoramic field of view. Our approach is a first step to assess the role of specific behavioural, environmental and computational constraints on natural optic flow processing.

The visual control of braking.

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Lee (1976, *Percep.*, **5**, 437-459) proposed that drivers control their braking towards a static target by maintaining the rate of change of time-to-contact ($\tau\dot{\tau}$) at a margin value between 0 and -0.5. The work reported here tests this proposal using an interactive, computer-based task in which participants use a foot-brake to control their simulated approach towards a visual target. Results are broadly consistent with an implementation of Lee’s hypothesis (Yilmaz & Warren, 1995, *JEP: HPP*, **21**, 996-1014) in which both the direction and magnitude of brake adjustments are determined by the discrepancy between the instantaneous value of $\tau\dot{\tau}$ and the margin value. We also report a new analysis demonstrating that different starting conditions converge upon similar $\tau\dot{\tau}$ values, as would be expected if participants adopt a consistent strategy based upon $\tau\dot{\tau}$.

Currently, we are investigating whether or not physical constraints imposed upon the values of $\tau\dot{\tau}$ that are achievable during braking could produce results that are suggestive of a $\tau\dot{\tau}$ based strategy from random behaviour alone. Alternative strategies for the control of braking were reviewed by Yilmaz & Warren. These include the use of 3D environmental structure to compute required deceleration from spatial variables – a strategy which cannot as yet be discounted.

AVA 2003

Vision in a 3-D world

19 March 2003
The College of Optometrists,
42 Craven St
London WC2N 5NG(Off Trafalgar Square)

CALL FOR PAPERS

Applied Vision Association (AVA) annual London meeting, 19 March 2003. Oral and poster presentations are invited on (but not restricted to) the theme of Vision in a 3-D world and will include the

GEOFFREY J. BURTON MEMORIAL LECTURE

Professor Brian Rogers
Oxford University

“Seeing in Depth”

This 1-day meeting will begin at 10.30 a.m., with coffee and registration from 10.00 a.m., and will include the Annual General Meeting of the AVA.

Registration is £26 for non-AVA members and £16 for members (£16 and £10 respectively for students) including refreshments and lunch. Places are limited and prior registration is advised. To register, please send a cheque payable to “Applied Vision Association” to:

Theresa Murtagh at the above address, by March 12 at the latest.

Abstract deadline: February 5th 2003

Submit abstracts by email to: Mark Georgeson (m.a.georgeson@aston.ac.uk), indicating preference for talk or poster. Txt, pdf, rtf and Word formats are acceptable.

Abstracts (max. 300 words) should be in the format of ECVP (including address and contact email address), examples of which can be seen at: <http://www.perceptionweb.com/perc0100/ava99xms.pdf>

Abstracts should include no more than two references, in the body of the abstract, without the title: e.g. (Rayner et al, 2001, Vis Res, 41, 943-954)

For queries or further information about the meeting contact: Prof. Mark Georgeson,
Neurosciences Research Institute Aston University, Birmingham B4 7ET, UK
email: m.a.georgeson@aston.ac.uk

Meetings Calendar

March

fMRI Experience V

10-11 March 2003

Gainsford Lecture Theatre, Kings College
London.

Contact: Tamara Russell (t.russell@iop.kcl.ac.uk)

<http://intramural.nimh.nih.gov/fmricnf/>

April

Ergonomics society annual conference 2003

15-17 April 2003

Edinburgh Conference Centre, Heriot-Watt
University, Edinburgh

Contact: s.hull@ergonomics.org.uk

www.ergonomics.org.uk/events/AC2003.htm

May

7th Vision Research conference: *The retinoid cycle and retina disease*

2-3 May 2003

Fort Lauderdale, USA

Contact: visionresearch@ntlworld.com

www.visres-interactivemeeting.com

Association for research in vision and ophthalmology meeting

4-9 May 2003

Fort Lauderdale, Florida, USA

www.arvo.org

VisionScienceS society annual meeting

9-14 May 2003

Sarasota, Florida, USA

www.vision-sciences.org

Association for the scientific study of consciousness

30 May - 2 June 2003

University of Memphis, Tennessee, USA.

Contact: assc7@memphis.edu

www.cs.memphis.edu/~assc7/

June

Visual processing of spatial form

Conference to celebrate the career of David M Regan

18-21 June 2003

Centre for Vision Research, York University, Canada

www.cvr.yorku.ca/conferences/index.html

July

BPS Perception and action workshop

4 July 2003 (provisional date)

University of Plymouth.

Contact: R.Ellis@plymouth.ac.uk

August

The 12th European conference on eye movements

20-24 August 2003

University of Dundee

Contact: m.h.fischer@dundee.ac.uk

www.dundee.ac.uk/psychology/ecem12/

European conference on visual perception

1-5 September 2003

Université René Descartes, Paris, France

www.ecvp.org

September

Vision in vehicles 10

6-10 September 2003

Granada, Spain

Contact: ibs@derby.ac.uk

<http://ibs.derby.ac.uk/viv/viv10.html>

Limits of vision - space, time and colour

8-9 September 2003.

Manchester

Contact: info@limits.org.uk

www.limits.org.uk

DAGM'03: 25th pattern recognition symposium

10-12 September 2003

Otto-von-Güricke University, Magdeburg,
Germany

Contact: dagm03@iesk.et.uni-magdeburg.de

<http://dagm03.uni-magdeburg.de>

The pupil colloquium

10/11-14 September 2003

Orthodox Academy of Crete, Kolimpari, Greece.

www.jiscmail.ac.uk/files/pupil/index.html

November

Society for Neuroscience annual meeting

8-12 November 2003

New Orleans, Louisiana, USA

www.sfn.org

Recent Findings

Action

Brouwer, AM, Brenner, E & Smeets, JBJ (2002). Perception of acceleration with short presentation times: Can acceleration be used in interception? *Perception & Psychophysics* **64**(7): 1160-8.

Hibbard, PB & Bradshaw, MF (2003) Reaching for virtual objects: binocular disparity and the control of prehension, *Experimental Brain Research*, **148**, 196-201.

Maden, M (2002). Positional information: Knowing where you are in a limb. *Current Biology* **12**(22): R773-R5.

Milner, D & Dyde, R (2003). Why do some perceptual illusions affect visually guided action, when others don't? *Trends in Cognitive Sciences* **7**(1): 10-1.

Wilkie, RM & Wann, JP (2002) Driving as Night Falls: The Contribution of Retinal Flow and Visual Direction to the Control of Steering. *Current Biology* **12**(23): 2014-2017

Attention and Awareness

ffytche, D (2002). Neural codes for conscious vision. *Trends in Cognitive Sciences* **6**(12): 493-5.

Hafed, ZM & Clark, JJ (2002). Microsaccades as an overt measure of covert attention shifts. *Vision Research* **42**(22): 2533-45.

Lamme, VAF (2003). Why visual attention and awareness are different. *Trends in Cognitive Sciences* **7**(1): 12-8.

Law, MB & Abrams, RA (2002). Object-based selection within and beyond the focus of spatial attention. *Perception & Psychophysics* **64**(7): 1017-27.

Pei, F, Pettet, MW & Norcia, AM (2002). Neural correlates of object-based attention. *Journal of Vision*, **2**(9): 588-596, <http://journalofvision.org/2/9/1/>, DOI 10.1167/2.9.1.

Reynolds, JH, Alborzian, S & Stoner, GR (2003). Exogenously cued attention triggers competitive selection of surfaces. *Vision Research* **43**(1): 59-66.

Xu, YD & Singh, M (2002). Early computation of part structure: Evidence from visual search. *Perception & Psychophysics* **64**(7): 1039-54.

Clinical

Chung, K, Mohidin, N & O'Leary, DJ (2002). Undercorrection of myopia enhances rather than inhibits myopia progression. *Vision Research* **42**(22): 2555-9.

Elleberg, D, Hess, RF & Arsenault, AS (2002). Lateral interactions in amblyopia. *Vision Research* **42**(21): 2471-8.

Turano, KA, Geruschat, DR & Baker, FH (2002). Fixation behavior while walking: persons with central visual field loss. *Vision Research* **42**(23): 2635-44.

Colour

Albrecht, J Jäggle, H Hood, DC & Sharpe, LT (2002). The multifocal electroretinogram (mfERG) and cone isolating stimuli: Variation in L- and M-cone driven signals across the retina. *Journal of Vision* **2**(8): 543-558, <http://journalofvision.org/2/8/2/>, DOI 10.1167/2.8.2.

Anstis, S (2002). The Purkinje rod-cone shift as a function of luminance and retinal eccentricity. *Vision Research* **42**(22): 2485-91.

Chen, C-C & Tyler, CW (2002). Lateral modulation of contrast discrimination: Flanker orientation effects. *Journal of Vision* **2**(6): 520-530, <http://journalofvision.org/2/6/8/>, DOI 10.1167/2.6.8.

Hemmi, JM, James, A, & Taylor, WR (2002). Color opponent retinal ganglion cells in the tamar wallaby retina. *Journal of Vision* **2**(9): 608-617, <http://journalofvision.org/2/9/3/>, DOI 10.1167/2.9.3.

Maloney, LT (2002). Illuminant estimation as cue combination. *Journal of Vision* **2**(6): 493-504, <http://journalofvision.org/2/6/6/>, DOI 10.1167/2.6.6.

Schluppeck, D, & Engel, SA (2002). Color Opponent Neurons in V1: A Review and Model Reconciling Results from Imaging and Single-Unit

Recording. *Journal of Vision* **2**(6): 480-492, <http://journalofvision.org/2/6/5/>, DOI 10.1167/2.6.5.

Depth and Binocular Vision

Adams, WJ & Mamassian, P (2002). Common mechanisms for 2D tilt and 3D slant after-effects. *Vision Research* **42**(23): 2563-8.

Berends, EM van Ee, R Erkelens, CJ (2002) Vertical disparity can alter perceived direction. *Perception* **31**(11): 1323-1333

Duke, PA & Wilcox, LM (2003). Adaptation to vertical disparity induced-depth: implications for disparity processing. *Vision Research* **43**(2): 135-47.

Durand, J-B, Zhu, S, Celebrini, S & Trotter, Y (2002) Neurons in Parafoveal Areas V1 and V2 Encode Vertical and Horizontal Disparities *J Neurophysiol* **88**: 2874-2879

Harris, JM & Rushton, SK (2003). Poor visibility of motion in depth is due to early motion averaging. *Vision Research* **43**(4): 385-92.

Lee, S-H & Blake, R (2002). V1 activity is reduced during binocular rivalry. *Journal of Vision* **2**(9): 618-626, <http://journalofvision.org/2/9/4/>, DOI 10.1167/2.9.4.

Matthews, N, Meng, X, Xu, P & Qian, N (2003). A physiological theory of depth perception from vertical disparity. *Vision Research* **43**(1): 85-99.

Norman, JF & Raines, SR (2002). The perception and discrimination of local 3-D surface structure from deforming and disparate boundary contours. *Perception & Psychophysics* **64**(7): 1145-59.

Pianta, MJ & Gillam, BJ (2003). Paired and unpaired features can be equally effective in human depth perception. *Vision Research* **43**(1): 1-6.

Regan, D (2002). Binocular information about time to collision and time to passage. *Vision Research* **42**(22): 2479-84.

Ukwade, MT, Bedell, HE & Harwerth, RS (2003). Stereopsis is perturbed by vergence error. *Vision Research* **43**(2): 181-93.

van Ee, R, van Dam, LCJ & Erkelens, CJ (2002). Bi-stability in perceived slant when binocular

disparity and monocular perspective specify different slants. *Journal of Vision* **2**(9): 597-607, <http://journalofvision.org/2/9/2/>, DOI 10.1167/2.9.2.

van Ee, R & van Dam, LCJ (2003). The influence of cyclovergence on unconstrained stereoscopic matching. *Vision Research* **43**(3): 307-19.

Warren, PA, Maloney, LT & Landy, MS (2002). Interpolating sampled contours in 3-D: analyses of variability and bias. *Vision Research* **42**(21): 2431-46.

Development and Ageing

Furman, JM & Schor, RH (2003). Orientation of Listing's plane during static tilt in young and older human subjects. *Vision Research* **43**(1): 67-76.

Turner, JE, Horwood, AM, Houston, SM & Riddell, PM (2002). Development of the response AC/A ratio over the first year of life. *Vision Research* **42**(22): 2521-32.

Eye Movements

Adler, SA, Bala, J, & Krauzlis, RJ (2002). Primacy of spatial information in guiding target selection for pursuit and saccades. *Journal of Vision*, **2**(9): 627-644, <http://journalofvision.org/2/9/5/>, DOI 10.1167/2.9.5.

Bavelier, D, Schneider, KA & Monacelli, A (2002). Reflexive gaze orienting induces the line-motion illusion. *Vision Research* **42**(26): 2817-27.

Li, H-CO, Brenner, E, Cornelissen, FW & Kim, E-S (2002). Systematic distortion of perceived 2D shape during smooth pursuit eye movements. *Vision Research* **42**(23): 2569-75.

Masson, GS & Stone, LS (2002) From Following Edges to Pursuing Objects. *J Neurophysiol* **88**: 2869-2873

Masson, GS, Yang, D-S & Miles, FA (2002). Version and vergence eye movements in humans: open-loop dynamics determined by monocular rather than binocular image speed. *Vision Research* **42**(26): 2853-67.

Seidemann, A & Schaeffel, F (2003). An evaluation of the lag of accommodation using photorefractive. *Vision Research* **43**(4): 419-30.

Tajik-Parvinchi, DJ, Lillakas, L, Irving, E & Steinbach, MJ (2003). Children's pursuit eye movements: a

developmental study. *Vision Research* **43**(1): 77-84.

Tatler, BW & Troscianko, T (2002) Last but not least: A rare glimpse of the eye in motion *Perception* **31**(11):1403 – 06

Wardak C, Olivier E & Duhamel JR (2002) Saccadic target selection deficits after lateral intraparietal area inactivation in monkeys. *J Neurosci* **22**(22):9877-84

Yang, D-S, FitzGibbon, EJ & Miles, FA (2003). Short-latency disparity-vergence eye movements in humans: sensitivity to simulated orthogonal tropias. *Vision Research* **43**(4): 431-43.

Motion

Barraza, JF & Grzywacz, NM (2002). Measurement of angular velocity in the perception of rotation. *Vision Research* **42**(21): 2457-62.

Bex, PJ & Dakin, SC (2003). Motion detection and the coincidence of structure at high and low spatial frequencies. *Vision Research* **43**(4): 371-83.

Graf, EW, Adams, WJ & Lages, M (2002). Modulating motion-induced blindness with depth ordering and surface completion. *Vision Research* **42**(25): 2731-5.

Habak, C, Casanova, C & Faubert, J (2002). Central and peripheral interactions in the perception of optic flow. *Vision Research* **42**(26): 2843-52.

McGraw, PV, Whitaker, D, Skillen, J & Chung, TL (2002) Motion Adaptation Distorts Perceived Visual Position. *Current Biology* **12**(23): 2042-2047

Pollatsek, A & Rayner, K (2002). Simple rotary motion is integrated across fixations. *Perception & Psychophysics* **64**(7): 1120-9.

Pollick, FE, Lestou, V, Ryu, J & Cho, SB (2002). Estimating the efficiency of recognizing gender and affect from biological motion. *Vision Research* **42**(20): 2345-55.

Watanabe, K, Nijhawan, R & Shimojo, S (2002). Shifts in perceived position of flashed stimuli by illusory object motion. *Vision Research* **42**(24): 2645-50.

Natural Scenes

Braun, J (2003). Natural scenes upset the visual apperart. *Trends in Cognitive Sciences* **7**(1): 7-9.

Neural

Amedi A, Jacobson G, Hendler T, Malach R & Zohary E (2002) Convergence of visual and tactile shape

processing in the human lateral occipital complex. *Cereb Cortex* **12**(11):1202-12

Attwell, D & Iadecola, C (2002). The neural basis of functional brain imaging signals. *Trends in Neurosciences* **25**(12): 621-5.

Baker CI, Behrmann M & Olson CR (2002) Impact of learning on representation of parts and wholes in monkey inferotemporal cortex. *Nat Neurosci* **5**(11):1210-6

Bisley JW, Goldberg ME (2003) Neuronal activity in the lateral intraparietal area and spatial attention. *Science* **299**(5603): 81-6

Boynton, GM (2002) Color Vision: How the Cortex Represents Color." *Current Biology* **12**(24): R838-R840

Cavanaugh, JR, Bair, W & Movshon, JA (2002) Selectivity and Spatial Distribution of Signals From the Receptive Field Surround in Macaque V1 Neurons. *J Neurophysiol* **88**: 2547-2556

Cook EP, Maunsell JH (2002) Dynamics of neuronal responses in macaque MT and VIP during motion detection. *Nat Neurosci* **5**(10): 985-94

DeVries, SH, Qi, XF, Smith, R, Makous, W & Sterling, P (2002). Electrical coupling between mammalian cones. *Current Biology* **12**(22): 1900-7.

Heuer, HW & Britten, KH (2002) Contrast Dependence of Response Normalization in Area MT of the Rhesus Macaque. *J Neurophysiol* **88**: 3398-3408

Hochstein, S & Ahissar, M (2002). View from the top: Hierarchies and reverse hierarchies in the visual system. *Neuron* **36**(5): 791-804.

Lamme VA, Zipser K & Spekreijse H (2002) Masking interrupts figure-ground signals in V1. *J Cogn Neurosci* 2002 **14**(7): 1044-53

Land, MF (2003) The spatial resolution of the pinhole eyes of giant clams (*Tridacna maxima*) *Proceedings of the Royal Society of London: B* **270** (1511): 185-188

Laughlin, SB (2002) Retinal Function: Coupling Cones Clarifies Vision " *Current Biology* **12**(24): R833-R834

Liu, J & Newsome, WT (2003) Functional Organization of Speed Tuned Neurons in Visual Area MT. *J Neurophysiol* **89**: 246-256

Marcus, DS & Van Essen, DC (2002) Scene Segmentation and Attention in Primate Cortical Areas V1 and V2. *J Neurophysiol* **88**: 2648-2658

Shenoy, KV, Crowell, JA & Andersen, RA (2002) Pursuit Speed Compensation in Cortical Area MSTd. *J Neurophysiol* **88**: 2630-2647

Ugurbil, K, Toth, L & Kim, D-S (2003). How accurate is magnetic resonance imaging of brain function? *Trends in Neurosciences* **26**(2): 108-14.

Uka, T & DeAngelis, GC (2002). Binocular vision: An orientation to disparity coding. *Current Biology* **12**(22): R764-R6.

VanRullen, R & Thorpe, SJ (2002). Surfing a spike wave down the ventral stream. *Vision Research* **42**(23): 2593-615.

Van Wezel, RJA & Britten, KH (2002) Motion Adaptation in Area MT. *J Neurophysiol* **88**: 3469-3476

Zeki, S (2003) Improbable areas in the visual brain. *Trends in Neurosciences* **26**(1): 23-26

Object Recognition

Shams, L & von der Malsburg, C (2002). The role of complex cells in object recognition. *Vision Research* **42**(22): 2547-54.

Wexler, M (2002). More to 3-D vision than meets the eye. *Trends in Cognitive Sciences* **6**(12): 497-8.

Reading

Beckmann, PJ & Legge, GE (2002). Preneural limitations on letter identification in central and peripheral vision. *Journal of the Optical Society of America a-Optics Image Science and Vision* **19**(12): 2349-62.

Ducrot, S & Pynte, J (2002). What determines the eyes' landing position in words? *Perception & Psychophysics* **64**(7): 1130-44.

Space Perception

Lopez-Moliner, J & Bonnet, C (2002). Speed of response initiation in a time-to-contact discrimination task reflects the use of eta. *Vision Research* **42**(21): 2419-30.

Spatial Vision

Poom, L (2002). Visual binding of luminance, motion and disparity edges. *Vision Research* **42**(23): 2577-91.

Schofield, AJ & Georgeson, MA (2003). Sensitivity to contrast modulation: the spatial frequency dependence of second-order vision. *Vision Research* **43**(3): 243-59.

Skillen, J, Whitaker, D, Popple, AV & McGraw, PV (2002). The importance of spatial scale in determining illusions of orientation. *Vision Research* **42**(21): 2447-55.

Welchman, AE & Harris, JM (2003) Is neural filling-in necessary to explain the perceptual completion of motion and depth information? *Proceedings of the Royal Society of London: B* **270** (1510): 83-90

Westheimer, G & Gee, A (2002). Orthogonal adaptation and orientation discrimination. *Vision Research* **42**(20): 2339-43.

Westheimer, (2003). The distribution of preferred orientations in the peripheral visual field. *Vision Research* **43**(1): 53-7.

Zanker, JM & Harris, JP (2002). On temporal hyperacuity in the human visual system. *Vision Research* **42**(22): 2499-508.

Other Papers

Egelhaaf, M & Kern, R (2002) Vision in flying insects. *Current Opinion in Neurobiology* **12**(6): 699-706

Labhart, T & Meyer, EP (2002) Neural mechanisms in insect navigation: polarization compass and odometer. *Current Opinion in Neurobiology* **12**(6): 707-714

Mortensen, U (2002). Additive noise, Weibull functions and the approximation of psychometric functions. *Vision Research* **42**(20): 2371-93.

Smaglik, P (2002). Blurred vision. *Nature* **420**(6916): A19-+.