A HCSNet Priority Area Workshop

INTERNATIONAL INTERSENSORY RESEARCH SYMPOSIUM:

PERCEPTION AND ACTION

Program, Information and Abstracts

Hotel InterContinental, Sydney, Australia
3 July, 2007

International Multisensory Research Forum

Southern Cross UNIVERSITY

Contents

Welcome

"*The affordances of the environment are what it offers the animal, what it provides or furnishes, either for good or ill.*"
Gibson (1979) The Ecological Approach to Visual Perception. p. 127.

While Gibson may have preferred the term "perception for action", the development of the research enterprise now referred to as Perception and Action affords an exciting paradigm from within which to investigate behaviour. Perhaps most exciting of all are the opportunities for collaborations: Investigating the relationships between perceiving and acting provides shared research ground for psychologists, cognitive neuroscientists, computer scientists, speech pathologists, philosophers of science, human-movement researchers, performance artists, and the list goes on. This International Intersensory Research Symposium was set up as a unique opportunity to facilitate the exchange of ideas and to foster relationships between researchers from across disciplines.

On behalf of the Australian Research Council's Human Communication Science Network (HCSNet), I welcome you to this meeting. It is my sincere hope that the day provides everyone an opportunity to develop new and productive research relationships.

I take this opportunity also to thank everyone who has travelled long and far to be here, both from interstate and from overseas. Special thanks go also to Kym Buckley and Dr Anna Brooks. Without Kym little of the day would have been possible and we are greatly indebted to her. Dr Brooks too has been wonderful in her enterprise and advice; many thanks Annie.

Dr Rick van der Zwan

About HCSNet

The ARC Research Network in Human Communication Science – HCSNet - was awarded five years' funding by the Australian Research Council in late 2004. The aim of HCSNet is to promote and facilitate interdisciplinary research in human communication science by connecting leading researchers in language, speech and sonics.

Priority Research Areas in HCSNet are:

- Human and Machine Speech
- Effective Interfaces
- Next-Generation Search Technology
- Human Communication Disorders
- Perception and Action

By generating an explosion of new approaches and knowledge, the network aims to build Australia's reputation as a leader in communication science and technology via advances in areas as diverse as automatic speech recognition, distress call monitoring, hearing prostheses, web interfaces, and data retrieval and data mining systems.

Getting involved in HCSNet is easy: visit www.hcsnet.edu.au to sign up as a member of the network. You'll be added to our online profile database, and automatically receive our weekly electronic newsletter, HCSNet Update, which will keep you informed of HCSNet activities, including the annual SummerFest, and events in the range of HCSNet disciplines. Australian-based HCSNet members can apply for funding under our various programs.

Registration and General Information

Conference Venue

The Symposium will be held at the Hotel InterContinental, Sydney, Australia.

Premiers Room
Hotel InterContinental
Corner Bridge and Phillip Streets
Sydney, Australia
Phone: (02) 9253 9000

The Hotel InterContinental is conveniently located in the CBD, within easy walking distance from trains, buses and ferries. The Symposium will take place in the *Premiers Room* and signs will direct you to the room once you arrive at the Hotel.

Registration Desk

The registration desk is the place for enquiries related to registration, accommodation, or any information that you require about the Symposium, the evening reception, or the local area.

The registration desk will be located in the Arcade on Level 2, and will open at 8.30am. Please proceed to the registration desk upon your arrival to collect your delegate pack and name tag (and organise payment of your registration fee if applicable).

Delegate Pack

Your delegate pack contains the following: Program, Information and Abstracts Book, name tag, pen and notepad.

Financial Matters

For any matters relating to finances please ask for Kym Buckley at the registration desk. The closest ATMs are located in the AMP Building Food Court (available between 7am- 7pm), and at the Circular Quay Train Station (available 24 hrs).

Refreshments and Meals

Morning tea, afternoon tea and lunch are provided for all registrants during the day. All refreshments will be served in the Arcade.

Evening Reception

The evening reception will include drink and canapés and will be served in the Level 2 Arcade. The reception will commence at 5.00pm.

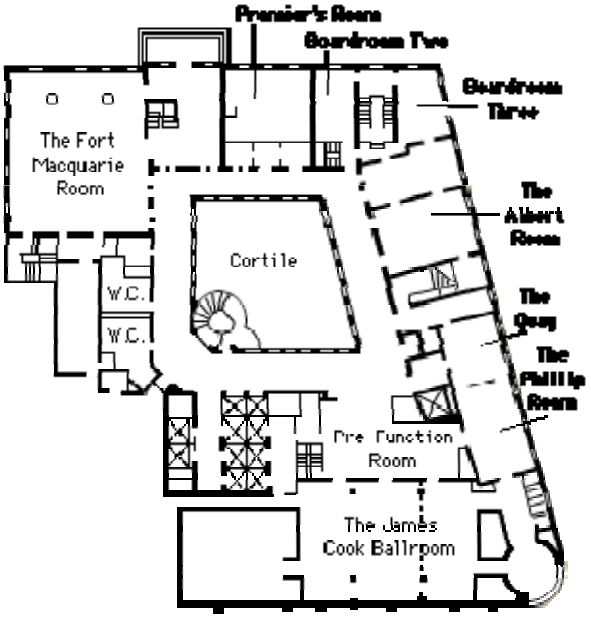
Internet Access

Internet access is available in the Hotel's Business Centre and charged at $15 per 30 minutes.

Smoking

Please note that the Hotel InterContinental has a no smoking policy.

Hotel InterContinental Floor Plan



Level 2

Please note that the Symposium will be held in the Premiers Room on Level 2. Morning and afternoon tea will be served just outside the Premiers Room whilst lunch will be served in the Arcade on Level 2.

Transport Information

Public Transport to the Hotel InterContinental

The Hotel Intercontinental is central to all public transport including buses, trains and ferries. The closest bus, train and ferry terminals are located at Circular Quay, less than 5mins walk north of the Hotel.

Parking

Valet Parking is available at the Hotel InterContinental for a rate of $30.00 per day.

Taxis

Taxis can be arranged by either the Symposium organisers or the Hotel concierge. Alternatively, you can book your own taxi by calling 133 300 or online at www.taxiscombined.com.au.

Transport To and From the Airport

The Hotel InterContinental is located 12km from the airport, with an approximate travelling time of 20 minutes by car. The most direct route from the airport is to travel via Southern Cross Drive and through the Eastern Distributor tunnel. Then take the Macquarie St/City exit & turn right down Macquarie St. The Hotel's heritage listed building is prominent on corner of Bridge St. A taxi fare from the airport is approximately $30.

Alternatively, you can take a train from either the International or Domestic airport terminals and alight at Circular Quay station. The train journey is approximately 15mins and costs $13 one-way. Circular Quay station is only a short walk north of the Hotel and train services depart the Domestic and International airport terminals approximately every 10 minutes to the city.

Program

8.30am	**Registration**
9.00am	**Welcome Address** Rick van der Zwan
9.10am	**Keynote Address** Prof Heinrich Bülthoff Max-Planck Institute, Germany *Multisensory Integration for Perception and Action*
10.10am	**Morning Tea**
11.10am	Prof Jason Mattingley University of Queensland *Monkey see, monkey do: interactions between action observation and execution in the human mirror system*
11.40am	Dr Nadia Bolognini University of Milano-Bicocca, Italy *Spatial remapping of visual-tactile interactions across postures in the intraparietal cortex*
12.10pm	**Lunch and Poster Session**
1.10pm	**Keynote Address** Prof Olaf Blanke Brain-Mind Institute, Switzerland *Brain correlates of the embodied self*
2.10pm	Prof Helen Chenery University of Queensland *Action verbs: Representation and processing, neural correlates, and consequences of brain damage*
2.40pm	Dr Geoff Stuart University of Melbourne Flying by night: Hyperstereopsis in night vision devices
3.10pm	**Afternoon Tea**
4.10pm	Future Directions for Perception and Action Research (all speakers)
5.00pm	**Reception (Drinks and Canapés)**

Keynote Speakers and Abstracts

(By Order of Presentation)

Multisensory Integration for Perception and Action

Heinrich H. Bülthoff
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Abstract

Most experiments which study the mechanisms by which different senses interact in humans focus on perception. In most natural tasks, however, sensory signals are not ultimately used for perception, but rather for action. The effects of the action are sensed again by the sensory system, so that perception and action are complementary parts of a dynamic control system. In our cybernetics research group at the Max Planck Institute in Tübingen, we study how cues from different sensory modalities are integrated by the brain to perceive and act in the real world. In several psychophysical studies, we could show that humans can integrate multimodal sensory information in a statistically optimal way, such that cues are weighted according to their reliability.

In a recent study using a motion platform we investigated how cues from different sensory modalities are used when humans stabilize a simulated helicopter (hovering at a target spot) in a closed perception-action loop. Helicopters in flight are unstable, much like an inverse pendulum, and hovering at one spot requires the pilot to do a considerable amount of active control. To date, it is still under discussion which sensory cues helicopter pilots use for this stabilization task, and how these cues are combined. There are several sensory cues a pilot might use for hovering. The horizon provides visual information for the orientation of the helicopter in pitch and roll. Optic flow provided by movement of visual features in the observer's view during self-motion can tell the observer about translations and rotations. Apart from vision, pilots can also use force cues of self-motion. Rotations and accelerations of the head can be detected by the vestibular system in the inner ear, and body accelerations are measured by pressure sensors in the skin and by proprioceptive sensors. Our first results show that all three cues, horizon, optic flow, and motion platform rotations, can help the participants to stabilize a simulated helicopter. Platform rotations tended to help most. Adding physical rotation cues to visual stimulation in a simulator can thus significantly improve the ability of trained participants to stabilize the simulated helicopter at a target location

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Heinrich Bülthoff is scientific member of the Max Planck Society and director at the Max Planck Institute for Biological Cybernetics in Tübingen. He is head of the Psychophysics Department in which a group of about 70 biologists, computer scientists, mathematicians, physicists and psychologists work on psychophysical and computational aspects of higher level visual processes in the following areas: object and face recognition, sensory-motor integration, spatial cognition, computer graphics psychophysics, and perception and behavior in virtual environments. Prof. Bülthoff is involved in many international collaborations on these topics and member of the European research network ECVision, Enactive and Intuition. He holds a Ph.D. degree in the natural sciences from the Eberhard-Karls-Universität in Tübingen.

Monkey see, monkey do: interactions between action observation and execution in the human mirror system

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Abstract

Neurophysiological studies in the macaque have revealed neurons within frontal and temporal regions of the cerebral cortex that respond selectively when the monkey performs an action, and when it passively observes another monkey or person executing the same action. These so-called "mirror neurons" are thought to provide a neural mechanism through which a perceived action can be directly matched with its corresponding representation within the animal's own motor repertoire. Recent work has suggested that a similar mirror-neuron system exists in humans. This system is thought to underlie our ability to recognise the actions and gestures of others. We have used a combination of behavioural experiments and functional brain imaging (fMRI) studies to investigate interactions between action observation and action execution in humans. We have focused in particular on whether observed actions can be processed automatically, in the absence of selective attention and conscious perception; and whether observed actions can influence the observer's own motor behaviour, even when they are irrelevant to the task at hand. Our findings suggest that a network of frontal, temporal and parietal areas contribute to different aspects of action recognition in humans, and that watching irrelevant actions made by another person can influence the observer's own motor behaviour. I will discuss the implications of these findings for current models of the mirror system in humans.

Professor Jason Mattingley is Foundation Chair of Cognitive Neuroscience at the University of Queensland, where he holds a joint appointment between the Queensland Brain Institute and School of Psychology. He received his PhD in neuropsychology from Monash University in 1994, and subsequently spent several years as a research fellow in Cambridge, England, where he was also elected a Fellow of King's College. His research spans the broad field of cognitive neuroscience, with particular emphasis on the behavioural effects of brain injury caused by stroke. His research team also employs brain imaging and brain stimulation techniques to investigate various aspects of cognition in healthy individuals. Professor Mattingley's work has helped to elucidate the cognitive and neural mechanisms underlying selective attention and motor control. He has published more than 100 articles in scholarly journals, including numerous papers in Nature, Science and Nature Neuroscience. He has also co-authored a major textbook on clinical neuropsychology. Professor Mattingley currently sits on the editorial boards of several major international journals, including Brain & Cognition, Cortex, Neurocase, and Neuropsychologia. His research is funded by grants from the Australian Research Council, the National Health and Medical Research Council, the British Stroke Association, and through collaborations with industry. Professor Mattingley has received Early Career Awards from the Academy of Social Sciences in Australia and the Australian Psychological Society. He currently sits of the Australian Academy of Science's National Committee for Psychology.

Spatial remapping of visual-tactile interactions across postures in the intraparietal cortex.

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Abstract

A touch on one hand can enhance the response to a visual stimulus delivered at a nearby location, improving our interactions with the external world. In order to keep such visual-tactile spatial interactions effective, the brain updates the continuous postural changes, like those typically accompanying hands actions, through proprioception, thus maintaining the somatosensory and visual maps in spatial register. The intraparietal cortex might be critical for such a spatial re-mapping, nevertheless a direct causal demonstration of its involvement is still lacking. Here we found that unattended touches enhanced the visual sensitivity for phosphenes induced by occipital Trancranial Magnetic Stimulation (TMS) when the touched hand was spatially coincident to the reported location of the phosphenes in external space. Notably, this spatially-specific crossmodal facilitation was maintained after hands crossing, suggesting an efficient visuo-tactile re-mapping. Critically, following 1-Hz rTMS interference over the intraparietal region, but not over the primary somatosensory cortex, phosphenes detection was still enhanced by spatially coincident touches with uncrossed hands, but by spatially non-coincident touches after hands crossing. This is the first causal evidence in humans that intraparietal cortex constantly updates the representation of the body in space in order to facilitate crossmodal interactions.

Dr Nadia Bolognini is an Assistant Professor in Psychology at the University of Milano-Bicocca (Italy). Nadia obtained her PhD in Neuropsychology in 2005 from the University of Bologna before going on to obtain a travel fellowship awarded by the Marco Polo Program, University of Bologna. This fellowship allowed Nadia to work on a Collaborative Research Project on multisensory integration at the Department of Neurobiology and Anatomy, NC-USA, for four months under the supervision of Prof. B.E. Stein. Nadia is a member of S.I.N.P., Italian Society of Neuro-Psychology; I.M.R.F., International Multisensory Research Forum; and the C.N.S, Cognitive Neuroscience Society.

Brain correlates of the embodied self

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Abstract

Although most humans have never had any trouble localizing themselves within their own bodily borders, this sense of self location or embodiment is a fundamental aspect of self consciousness and requires specific brain mechanisms. Recent clinical and neuroimaging evidence suggests that multisensory integration of bodily and two posterior brain regions, the temporo-parietal junction (TPJ) and cortex at/near the extrastriate body area (EBA) are crucial in coding embodiment.

In this seminar I will review three lines of research investigating brain correlates of embodiment. (1) Pathological states of embodiment (such as out-of-body experience, autoscopy, and feeling of a presence) due to focal brain damage to temporo-parietal cortex and extrastriate cortex in neurological patients. (2) Recent findings on activations of the temporo-pariatal cortex and extrastriate cortex in embodiment-related tasks using mental imagery in healthy subjects. (3) The experimental induction of disembodiment in healthy subjects using multisensory conflict and virtual reality.

I argue that these experimental and clinical findings on embodiment might turn out to be of relevance in defining functions and brain structures mediating fundamental aspects of self consciousness.

Olaf Blanke is an Assistant Professor & Director of the Laboratory of Cognitive Neuroscience, Brain Mind Institute, Swiss Federal Institute of Technology, Lausanne, Switzerland. Olaf is also a Consultant Neurologist at the Department of Neurology, University of Geneva, Switzerland (Prof. T. Landis). Prof Blanke obtained his Ph.D. in 1999 in Neurophysiology from the Free University, Berlin, Germany ("Guidance of saccadic eye movements by tactile and proprioceptive stimuli"). Recently, Prof Blanke has been the recipient of the Pfizer Prize (2004) and the Bing Prize (2006).

Action verbs: Representation and processing, neural correlates, and consequences of brain damage.

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Abstract

Action verbs are that class of words that denotes physical actions. For example, the verb punch refers to a situation in which a person engages in a certain kind of bodily movement. This paper will review the current theories relating to action verb representation, particularly the differences between conceptual knowledge for actions and verb generation. An interesting literature is emerging relating to the neuroanatomical substrates of action verbs which proposes that the linguistic representation of action is grounded in the mirror neuron system (Kemmerer, 2006). These neuroimaging studies will be reviewed and behavioural data from a group of participants with Parkinson's disease who were asked to generate nouns and verbs in response to particular cues will be presented. The results are not easily interpreted within a motor theory of action verbs. Future directions for collaborative research integrating the theories and methodologies from both linguistic and motor paradigms will be explored.

Kemmerer, D. (2006). Action verbs, argument structure constructions, and the mirror neuron system. In M. Arbib (Ed.), Action to language via the mirror neuron system. Cambridge, UK: Cambridge University Press.

Professor Helen Chenery is Director of Studies in the Faculty of Health Sciences and Executive Director of the Centre for Research in Language Processing and Linguistics. Her major areas of research examine the nature of language processing in both healthy and neurologically-involved populations based on the integration of detailed models of language processing within a neurobiological framework. The research is underpinned by a detailed understanding of the processes involved in the moment-by-moment integration of information during on-going language comprehension and by the investigation of the component processes involved in language production. The work involves the use of a number of 'on-line' or 'real-time' measures of processing (including reaction-time and ERP) to examine both the behavioural details and the brain-areas involved in language processing. The behavioural and neurobiological bases of language disorders are investigated in both non neurologically impaired people and people with acquired neurological disorders including people with subcortical aphasia, bilingual people with aphasia subsequent to stroke, people with Parkinson's disease, adults and children with language impairment following traumatic brain injury, people with schizophrenia and healthy people scoring highly on ratings of dimensions of schizotypy. Helen's research involves collaborations with psychiatrists, neurologists, electrical engineers, psychologists, linguists, and computer scientists.

Flying by night: Hyperstereopsis in night vision devices

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Abstract

Modern helmet-mounted night vision devices, such as the Thales TopOwl helmet, project imagery from intensifiers mounted on the sides of the helmet onto the helmet faceplate. This produces a situation of hyperstereopsis in which binocular disparities are magnified. This has the potential to distort the perception of slope in depth (an important cue to landing), because the slope cue provided by binocular disparity conflicts with veridical cues to slope, such as texture gradients and motion parallax. In the experiments, eight observers viewed sparse and dense textured surfaces tilted in depth under three viewing conditions: normal stereo hyper-stereo (4 times magnification), and hypostereo (1/4 magnification). The surfaces were either stationary, or rotated slowly around a central vertical axis. Stimuli were projected at 6 metres to minimise conflict between accommodation and convergence, and stereo viewing was provided by a Z-screen and passive polarised glasses. Observers matched perceived visual slope using a small tilt table set by hand. We found that slope estimates were distorted by hyperstereopsis, but to a much lesser degree than predicted by disparity magnification. The distortion was almost completely eliminated when motion parallax was present.

Associate Professor Geoff Stuart received his PhD in experimental psychology from Monash University in 1986. From 1989-1991 he was a Research Fellow at the Centre for Visual Sciences at the Australian National University. He is currently a Senior Research Scientist at the Defence Science and Technology Organisation, Melbourne, Australia. His research interests encompass the broad area of visual perception, including form perception, stereopsis, and colour vision. He is especially interested in the relationship between perception and the underlying physiological mechanisms in the visual system. More recently, he has carried out research in the area of visual attention. His applied interests include reading and developmental dyslexia, and aviation human factors.

Poster Abstracts

(In Alphabetical Order)

Interactive haptic-audio narratives

Stephen Barrass
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Abstract
The Cocktail Party Effect tells the story of the imminent extinction of Great Apes using touch and sound in the absence of visual elements. The narrative is driven by haptic-audio exploration of a virtual cocktail glass that contains cut-up conversations that make up the story within. The interface was developed through a series of prototypes that explored the perception and mental imagery of a haptic-audio simulation of the invisible glass. These experiments also developed narrative functions of the haptic-audio interface beyond conventional metonyms to include grammatical and dramatic special effects. Observations during the exhibition show promising narrative engagement with the piece but identify problems with the clarity of the sounds, and a conflict between the narrator and the story content.

Assessing multisensory integration in reaching space

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Abstract
Neurophysiological and neuropsychological studies showed that peripersonal space representation is based on visuo-tactile (VT) integration. We hypothesized that a grasping action may affect the visuo-tactile coding of peripersonal space. We studied the effects of different reach-to-grasp phases (planning, start, execution) on the performance in a visuo-tactile interference (VTI) task. Participants grasped an object presented in four different orientations with the right hand and performed an elevation discrimination of a tactile stimulus delivered on either the right hand's index or thumb, while ignoring a visual distractor concurrently presented on the object. As a control, the grasping was performed with the unstimulated left hand. Participants showed larger VTI when the object's main axis was spatially compatible with the axis formed by index and thumb before movement initiation. Crucially, grasping with the right hand modulated the VTI that increased during grasping execution, as compared to the planning phase. This on-line modulation was highly selective for object's orientations that were incompatible with the initial right hand posture. No difference as a function of the reach-to-grasp phases was observed for compatible orientations. In the control condition (left hand grasping) the interference was not modulated by any of the three action phases, nor object's orientations. The results support the hypothesis that performing an action can affect the multisensory coding of the peripersonal space. These findings also constitute the first experimental evidence that action-dependent modulations are selective for the body-part involved in the action. Finally, they suggest that multisensory integrations involving an object in action space can vary according to the different phases of an ongoing action towards it.

Task-irrelevant spatial sounds affect haptic scene recognition

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Abstract
Previous research has found that performance in either haptic matching tasks (Newport et al., 2002) and haptic scene perception (Pasqualotto et al., 2007) improved when non-informative visual information was available, suggesting that vision provides the reference frame for spatial information in other modalities. Here we explored whether non-informative spatial sounds can affect haptic scene perception. Participants were blindfolded to minimize any external visual cues and their task was to first learn the spatial arrangement of an array of objects through touch and to subsequently indicate which two objects in the array had switched positions. When broadband noise was presented from the four corners of the room consecutively (Exp. 1) or from one loudspeaker placed directly in front of the participant (Exp. 2), these sounds did not affect performance relative to the 'no sound' condition. However, when we presented spatially distinct pure tones in each corner of the room in succession (Exp 3) we found an interference effect. Our findings suggest that although sound information does not carry the same spatial precision as vision to facilitate cross-modal spatial perception, sound can be sufficient to disrupt spatial processing in touch.

Crossmodal effects on auditory and visual grouping mechanisms

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Abstract
Studies involving crossmodal effects on auditory and visual grouping mechanisms are rare, yet these processes lead to our perception of auditory and visual objects - a process crucial to our interactions with the environment. O'Leary and Rhodes (1984) found that when visual stimuli are perceived as two groups, simultaneously presented auditory stimuli are more likely to perceptually separate into two groups, and vice versa. Similarly, Vroomen and de Gelder (2000) found that a repeating tone, segregated from surrounding tones, made a coincident visual target easier to detect. Our first study tested whether the presentation of a singular flashing light, spatially separated from a group of three other lights, could have an impact on the formation of auditory objects in a simultaneous four-tone sequence. No effect was found. Our second study focussed on the temporal organization of the groups using a similar method. The 'temporal ventriloquism effect' (Bertelson & Aschersleben, 2003) suggests that a visual stimulus is often perceived as being temporally closer to an auditory stimulus if it occurs within certain proximity; our paradigm allowed us to examine whether groups of stimuli (rather than independent tones or lights) are susceptible to this same effect. Results confirmed that the singular flashing light was perceived as occurring temporally closer to, or coincident with, the tone that was perceptually segregated.

Perceived timing across modalities

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Abstract
Crossmodal stimuli can be perceived as being simultaneous even if they are not physically synchronous. This phenomenon has been attributed to different conduction delays. In this work we tested whether time in different modalities is processed independently or if crossmodal interaction influence the perception of synchrony. (1) If unimodal timing is processed independently, perceived simultaneity across modality pairs should be Transitive. For example, if modality A has to be presented 20ms before modality B to appear simultaneous and modality B 10ms before modality C, then A should be presented 30ms before C to appear simultaneous. Subjects made Temporal Order Judgments (TOJ) of asynchronous signals in three modality pairs (audio-visual, audio-tactile, visual-tactile). The Point of Subjective Simultaneity (PSS) calculated for each modality pair are not transitive, indicating that perceived time is not processed independently in each modality. (2) It has been shown that PSS of audio-visual signals can be recalibrated by the repeated presentation of asynchronous stimuli. It is not clear whether this effect is the result of an adaptation mechanism specific to the audio-visual modality pair or whether it is due to a common crossmodal mechanism. Using the same type of measurements, we show that PSS following presentation of an asynchronous audio-visual stimulus is not constant in the audio-tactile modality pair. Hence, crossmodal timing is also affected by a common adaptation mechanism. Since PSS for visual-tactile stimuli was not affected, audio-visual adaptation effects are likely the result of a phenomenal shift of the auditory events in time. Our results indicate that perceived timing in one modality depends on which other modality this is paired with and that perceived simultaneity changes also for non adapted modality pairs. These results are not consistent with independent-channels models of crossmodal timing, but they rather indicate that time perception is affected by crossmodal interactions.

Left to right: Representational biases for numbers and the effect of visuomotor adaptation

Andrea M. Loftus[1], Michael E.R. Nicholls[1], Jason B. Mattingley[2], John L. Bradshaw[3]
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Abstract
Visuomotor adaptation to right-shifting prisms improves left neglect for mental number line bisection. This study examined whether visuomotor adaptation affects the mental number line in normal participants. Thirty-six normal participants completed a mental number line task before and after adaptation to either: left-shifting prisms, right-shifting prisms or control spectacles that did not shift the visual scene. Participants were presented with visual number triplets (e.g. 16, 36, 55) and determined whether the numerical distance was greater on the left or right side of the inner number. Normal participants demonstrated a leftward bias (i.e. overestimated the length occupied by numbers located on the left side of the number line) that was corrected by a short period of visuomotor adaptation to left-shifting prisms. In contrast, this bias was unaffected by adaptation to right-shifting prisms and control spectacles. The findings demonstrate that a simple visuomotor task can alter the perception of space on the mental number line in normal participants, and lead us to suggest a functional anatomical link between the neural substrates involved in number and space representation and those involved in visuomotor adaptation.

Hemispheric Differences in the Processing of Biological Motion

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Abstract
Behavioural correlates of hemispheric processing asymmetries have been demonstrated in an array of perceptual processing tasks. For example, asymmetries have been observed for spatial and motion-processing tasks, processing associated with survival and social skills, and global processing abilities. There is evidence that biological motion processing might be associated with mechanisms giving rise to effective social interactions. Indeed, critical mood and intention related information can be extracted on the basis of motion cues (Dittrich, Troscianko, Lea & Morgan, 1996; Montpare, Goldstein, & Clausen, 1987). For that reason hemispheric asymmetries associated with the processing of emotions and intentions might also be observed in processes giving rise to the perception of biological motion. The aim of the work described here was to test for asymmetrical processing of biological motion cues. The data reported provides evidence that processing of visually-defined biological movement is mediated by hemispheric specialisations that can manifest at the behavioural level. The specialisations are exhibited as differences in the ability of each hemisphere, when preferentially delivered cues to the presence of a point-light figure in motion, to discriminate features of the figure from noise. Thus, these data provide preliminary evidence for hemispheric asymmetries in biological motion perception.

Lost in Translation: A visual processing hierarchy for biological motion.

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Abstract
Considerable research effort has been devoted to understanding the visual perception of biological form-from-motion. That work has suggested some interesting relationships between cues giving rise to perceptions of form-from-biological motion and the nature of those perceptions. For example, inconsistencies between the apparent direction of articulation of a point-light figure and the orientation of the figure have been shown to affect the figure's perceived direction of facing (the apparent-facing effect, Pavlova et al. 2002). However, many of those studies have used only non-translating or treadmill actors. Recent models of biological motion processing predict the direction a figure translates is processed before other features of the figure (Giese & Poggio 2003). The aim of experiments reported here was to examine the contribution of direction of translation to perceptions of direction-of-facing. In particular, our experiments were designed to determine if incongruity between the direction of translation and the direction of facing influences performance on direction discrimination tasks. Results indicate that incongruities between direction of translation and direction of facing reduce performance on discriminations of the latter but not the former. These data suggest a serial processing model in which information about the direction of translation of a point-light figure contributes to perceptions of the direction the figure is facing.

Sound-Induced Flash Illusion: Interaction with Single Transient Visual Events

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Abstract
The sound-induced flash illusion, or 'Shams' effect (Shams, Kamitani, & Shimojo, 2000, 2002), purportedly demonstrates a qualitative and categorical cross modal perceptual-level interaction: the presentation of a single flash concurrently with two 'clicks' is erroneously perceived as two flashes. However, the fact that a single flash is comprised of two rapid transient events, an onset and offset step, may be predisposing subjects at a decisional level to report two events. If the effect of these steps is eliminated by ramping-up or ramping-down luminance, then these decisional level factors can be controlled. In ten observers, each of the onset and offset of the flash have been presented with each of none, one, two, or three brief tones (7ms, 75 dbA, 1000 Hz) at varying SOAs. When a high contrast, 2 deg disc was ramped on or off (300 ms) in the presence of multiple tones, observers report more visual events than were presented and the illusion is much stronger than the original Shams effect. However the strength of the illusion was strongly dependent on the SOAs: the tones had to be presented during the ramp. Furthermore, presentation of one tone with multiple visual events decreased the number of visual events reported.

The role of motion in haptic and cross-modal object recognition

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Abstract
Recent studies in visual object recognition have found that objects are represented as unique spatiotemporal descriptions in memory. In 1709, however, the Irish philosopher George Berkeley asserted "Motion perceivable by Sight is of a Sort distinct from Motion perceivable by Touch". Here we investigated whether or not motion is an informative cue for the recognition of objects through touch alone and if this cue allows for efficient cross-modal object recognition. In all our experiments, participants first learned to name a set of 6 novel target objects with movable parts through active touch. Each target consisted of unique shape and motion combinations. In Experiment 1, participants were tested on their recognition of these target objects from a set of objects with either congruent or incongruent shape-motion pairings using touch alone. We found that motion was reliably used as a cue for object recognition in touch. In our second experiment, participants were tested on their recognition of these objects either within or across modalities (i.e. vision). Our results indicate that objects are represented in memory as unique spatiotemporal codes with multisensory access. As such, our findings contradict Berkeley's original proposal that motion is not shared across the modalities.

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